Town of Pound Ridge, NY

Natural Resources Inventory

2018

Written by the Pound Ridge Conservation Board
www.townofpoundridge.com/conservationboard
Prepublication copy, December 2018
Cover photo by Sonia Biancalani Levethan

Town of Pound Ridge, NY

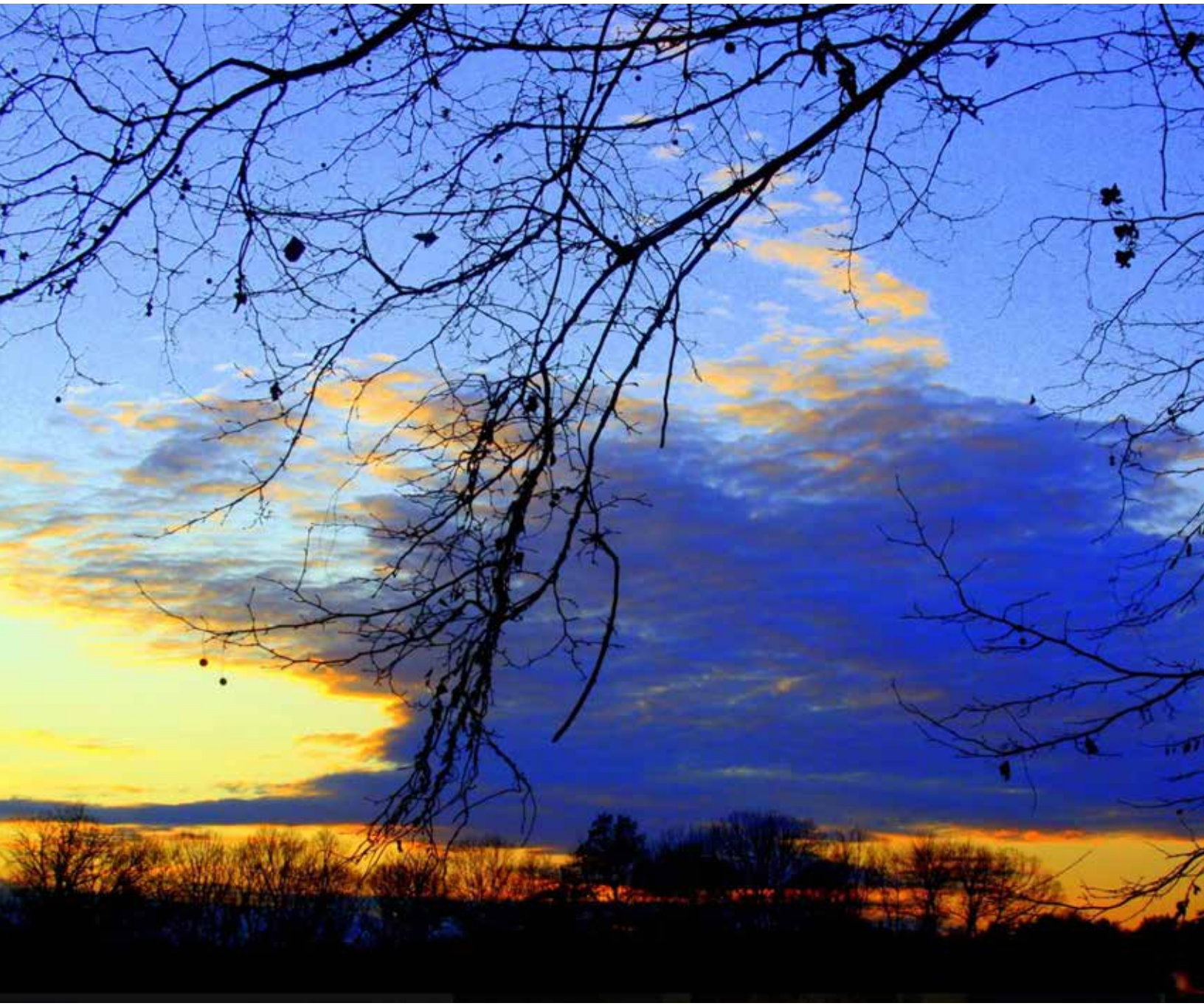
Natural Resources Inventory

2018

Dedicated to the people of Pound Ridge,
that they may take good care
of our natural resources

Pound Ridge Conservation Board
PROTECTING OUR ENVIRONMENTAL HEALTH AND NATURAL RESOURCES

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation | Hudson River Estuary Program



Breathtaking moments in Pound Ridge
Sally Semonite Green

Developing with a Natural Resources Inventory

Prepublication Copy

December 2018

TOWN BOARD

Kevin Hansan, Supervisor
Alison Boak, Deputy Supervisor
Daniel S. Paschkes
Jody Sullivan
David Dow
Diane Briggs

CONSERVATION BOARD

Carolynn R. Sears, Ph.D., Chair
Carla Brand
John Cosetti
Anthony Girardi
Ellen Grogan
Sonia Biancalani Levethan
Richard Mendes
Marilyn Shapiro
Robert Siegel

The Conservation Board was created in 1973 to advise in the management and protection of the natural resources of Pound Ridge.

Michigan Road
Gail Jankus

ACKNOWLEDGEMENTS

The Conservation Board and Town of Pound Ridge gratefully acknowledge the multiple agencies and individuals supporting this project.

The development of this narrative was partially funded with a grant from the New York State Environmental Protection Fund through the NYSDEC Hudson River Estuary Program. Additional funds were provided by the Beverly Bender Fund of Westchester Community Foundation, as well as the Westchester Community Foundation, Aquarion Water Company, Henry Morgenthau Preserve, Pound Ridge Land Conservancy, Wellspring Monastery, Rockrimmon Country Club, plus the Conservation and Town Boards.

In writing this narrative, the Conservation Board relied heavily upon *Creating a Natural Resources Inventory: A Guide for Communities in the Hudson River Watershed* (2014) by Ingrid Haeckel and Laura Heady. In addition, both authors were extremely helpful reading drafts and in connecting us to other DEC Region 3 supportive staff members, such as Andrew Meyer, Libby Zemaitis, and Nate Nardi-Cyrus. In addition, Brad Hanover, Manager of Water Quality at Aquarion, explained its water testing data. Toxic Targeting, Inc. was contracted with for a study on underground spills and Hudsonia Ltd. completed a report on significant habitats in Pound Ridge. Both studies were presented to the Town Board.

Throughout this project, the Conservation Board benefited from the technical skills, support, and patience of the staff at Westchester GIS, and CAI Technology. The Open Space inventory was accomplished with the support of Paul LaBella, an intern from SUNY Purchase.

The Conservation Board enjoyed the support of many others. Ellen Ivens was with us at the beginning of the process. Phil Sears, Bill Bedford, Tom Anderson, Jim Norgren, and others served as readers of different sections of the narrative. Elyse Arnow served as an advisor for the GIS intern, as open space shapefiles were created. Dick Lyman, Jim Perry, and Vinnie Duffield shared observations about local conditions. Nearly a dozen individuals provided photographs to capture the natural resources and character of Pound Ridge. Susan Roos located photos in the archives of the Pound Ridge Historical Society. Finally, Sonia Biancalani Levethan skillfully and patiently laid-out the document for the reader.

We apologize for not mentioning every individual by name who has helped this project come to fruition.

PREFACE

The Natural Resources Inventory was prepared by the Town's Conservation Board and drawn from various complementary, but not necessarily comprehensive, sources. The narrative should not be considered complete as new information is always being collected. All data need to be reviewed and verified by the user at the time of use. The narrative accompanies the Town Geospatial Information System (GIS) viewer and bridges two key Town documents:

- The Town GIS viewer is accessible on the Town website. The availability of GIS technology and how it greatly enhances our understanding of natural resources motivated the updating of the Town's Natural Resources Inventory. Many shapefiles and data layers, often referred to as maps, were uploaded onto the Town GIS as part of this effort. The Town GIS allows the viewer to measure distances and areas, superimpose layers, switch base maps, zoom in and out, see street views, bird's eye views, and more. The "quick reference maps" are screen shots of maps available on the Town GIS. They do not provide satisfactory detail, lack a scale and legend, and are not proper maps. Town boundaries are delineated and the map is oriented with north at the top of the page. These are not intended to substitute for the Town GIS maps.

It is important to remember the limitations of all base maps and data layers. All maps and data layers provide approximate locations and, to a limited extent, surface and underground features. They are inherently inaccurate and not a substitute for site visits, on-the-ground delineation, or surveys. While the data are updated periodically, it may not always be current and should be used for illustrative purposes only. The User's agreement for the Town GIS specifies: "Any use of the information contained herein should be accompanied by (1) a reference to its source, (2) a caveat that the Town of Pound Ridge makes no warranties, guarantees, or representations to the accuracy or completeness of this information, and (3) a statement that the information contained herein is NOT a legal description." Hudsonia Ltd. attaches a similar request to its shapefiles.

- *Land Use Through Ecology: A Case Study of Pound Ridge, New York* (1980). Based upon a study executed by Jerzy E. Glowczewski and commissioned by Pound Ridge United for Planning, the case study is also referred to as "the PRUP report."

- The Town's 2010 *Comprehensive Plan*. The reader will find it helpful to have a copy of the Comprehensive Plan at hand while using this document.

Contents

Appendices

List of Tables

ACRONYMS AND ABBREVIATIONS

ArcGIS	A geographic information system (GIS) for working with maps and geographic information
AWC	Aquarion Water Company (Previously Bridgeport Hydraulic Company (2000) or Stamford Water Company (1986)
BMP	Best management practice(s)
CB	Conservation Board (Town)
CCA	Community Choice Aggregation (County)
CEA	Critical Environmental Area
CEC	Clean Energy Community (State designation)
CSC	Climate Smart Community (State designation)
CSLAP	Citizens Statewide Lake Assessment Program
CUGIR	Cornell University Geospatial Information Repository
DEC	Department of Environmental Conservation (State)
DEEP	Connecticut Department of Energy & Environmental Protection
DEP	Department of Environmental Protection (New York City)
EAC	Energy Action Committee (Town)
EAF	Environmental Conservation Form
ECL	Environmental Conservation Law (State)
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency (Federal)
ESRI	Environmental Systems Research Institute
EWBC	Eastern Westchester Biotic Corridor (Regional)
FEMA	Federal Emergency Management Agency
GIS	Geospatial or geographic information system
HUD	US Department of Housing and Urban Development
LHPRISM	Lower Hudson PRISM (Partner in Regional Invasive Species Management)
MS4	Municipal Separate Storm Sewer Systems
NPS	Nonpoint source pollution
NRCS	National Resources Conservation Service
NRI	Natural Resources Inventory
NWI	National Wetlands Inventory (USGS)
NYCRR	New York Code, Rules, and Regulations (State)
NYSDEC	New York State Department of Environmental Conservation
NYSEG	New York State Electric and Gas
NYSERDA	New York State Energy Research and Development Authority
NYSGS	New York State Geological Survey
OEM	Office of Emergency Management (Town)
PRLC	Pound Ridge Land Conservancy (Local)
PWTL	Private Well Water Test Law (County)
SEQR	State Environmental Quality Review Act (Also SEQRA)
SPDES	State Pollution Discharge Elimination System
SSURGO	A database containing information about soil collected by the National Cooperative Soil Survey
SWM	Stormwater Management Program
TEP	Traffic Enhancement Program (Town)
TIP	The Invasives Project (Local)
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UST	Underground storage tank
WLT	Westchester Land Trust
WPRR	Ward Pound Ridge Reservation

Coyote Rocks
Gail Jankus

A BEGINNER'S GUIDE TO USING THE TOWN GIS

MISSING CAPTION

The Town GIS is a viewer, which means data are coming from multiple sources and cannot be manipulated. As a user, you can turn data layers on and off without changing the Town GIS or hurting it.

To get started, go to the Town of Pound Ridge website, and on the lower banner, click GIS Mapping. Allow or don't allow the use of your location and agree that you understand the limitations of CAI's AxisGIS. Notice three tabs on the left: **Search, Abutters, Layers.** Click on the **LAYERS** tab to activate the **slide-out menu** on the left.

Notice the major headings: **Westchester County** (county-provided data as requested), **Infrastructure Features**, and **Pound Ridge** (uploaded by CAI Technology for the Town). Check (√) a major heading and any subheading. Notice the drop menu with additional data layers.

To find a specific address, click on **SEARCH** (the top tab on the left) and enter parcel number, owner, or address. Notice the useful **Abutters** tab to identify abutting or surrounding properties.

Return to **LAYERS**. To superimpose data layers, you may need to adjust the **Zoom** (+/- on the right, top two tabs). The **Property Map** and **Westchester County GIS Contours** are examples of this requirement. Check (√) and uncheck different layers such as Flood Map (FEMA), and layers found under headings such as Habitat and Wildlife Maps; Geology and Soils Maps, etc. As you explore, remember to uncheck extraneous data.

OTHER TOOLS

Across the top bar, explore (left to right) tools for: **Drawing, Measuring, Switch Base map, Areas of Interest, Share, Identify**, and **Reset** the map to clear all graphics. Reminder: return your tools!

On the right-side bar, explore (top to bottom) multiple **Zoom** tools (to decrease or increase the area viewed, zoom to selected area, zoom to full extent, next extent, or previous extent, and zoom by drawing a box on the map), **Pan** the map, see **Street View,** see **Bird's Eye View**, see **Pictometry (3-D image)** of that location, and **Print** current map.

For **HELP** refer to the footer at the bottom of the page.

Executive **Summary**

Yellow Trail
Gail Jankus

At a Glance

Executive Summary

A natural resources inventory (NRI) compiles information to describe important, naturally occurring resources within a given locality. The Pound Ridge NRI is comprised of four comprehensive inventories addressing Climate Impacts, Water Resources, Open Space, and Habitats, plus Geospatial Information System (GIS) resources. The Habitats Inventory includes a report by Hudsonia Ltd. Endnotes and Works Cited are to be found at the end of each inventory.

This NRI is written for the people of Pound Ridge by the Conservation Board and has four basic purposes:

• to stress the importance and care of the town's natural resources and direct the reader to additional sources of information to support comprehensive land-use planning, protection of open space, and conservation practices

• to provide natural resource information for local planning and zoning decisions; and

• to update recommendations on preserving, protecting, and enhancing critical, finite natural resources for the town and its residents.

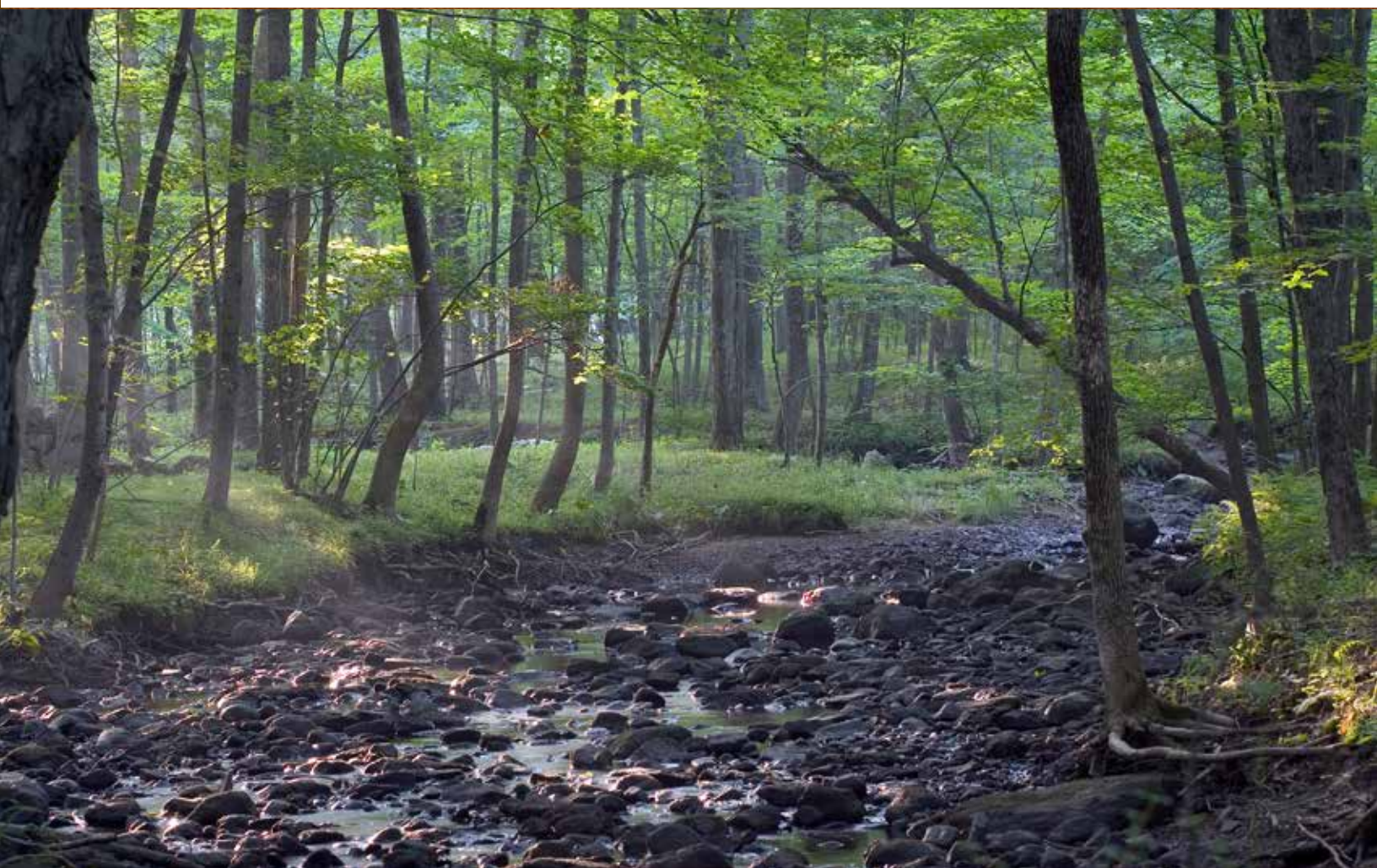
Major funds were provided by DEC Hudson River Estuary and Westchester Community Foundation and supplemented by Beverly Bender Fund, Pound Ridge Land Conservancy, Henry Morgenthau Preserve, Rockrimmon Country Club, Wellspring Monastery, and the Town.

This NRI builds on the Town's Open Space Inventory; *Land Use Through Ecology* (or the PRUP report, 1980); the *Comprehensive Plan: Town of Pound Ridge, NY* (2010), and multiple GIS resources. However, the NRI is not a substitute for any of these important documents or resources.

It is important to note that, while a NRI is useful for municipal-scale planning, it is generally not suitable for site-scale issues. NRI maps should not be substituted for on-site surveys. However, the NRI may be used as a screening tool during environmental reviews to see how projects fit in the larger context and to identify areas where more site-specific assessments may be required.

Spring Snow
Gail Jankus

Above: Meadow Walk; Below: Cross River *Gail Jankus*



CLIMATE IMPACTS INVENTORY

Changes to the global climate are already affecting weather patterns in our locality. Town planning needs to be based on climate models and long-term projections, not past experience. As global temperature rises, our area may experience more frequent and prolonged summer heat waves which increase ground-level ozone that can pose a threat to human health. High temperatures can also increase algal blooms on surface water and adversely affect water quality and supply. Regarding precipitation, our region will experience periods of short-term drought intermixed with more frequent severe rain or snow storms. Droughts threaten local drinking water supplies, streams and aquatic life; increase the risk of fire; and stress trees, plants and wildlife. Severe storms can cause flooding, runoff and soil erosion. Storms often result in prolonged power outages. The impact of a changing climate on local flora and fauna is less clear, but if left unchecked, familiar species of trees, plants and animals may disappear in our area to be replaced by species now associated with more southern latitudes.

According to recent studies, there are solutions to scale down greenhouse gases. By reaffirming its commitment to preserving and protecting natural resources and setting clear goals, the Town can make strides toward achieving climate resiliency. By making small, attainable changes in one's home, surroundings, and community, residents can also create positive environmental change. The steps we take locally, together and individually, can anticipate and mitigate the effects of global climate change.

RECOMMENDATIONS FOR CLIMATE IMPACTS

1. Address the lack of an identified goal related to climate change, for example, the Town should adopt forward-looking policies to prepare for climate impacts, reduce greenhouse gases, and protect the benefits freely gained from its natural environments.

2. Review best management practices, regulations and bylaws for consistency against the newly stated goal.

3. Appoint a Climate Smart Community (CSC) coordinator and task force comprised of key people (for example, a member of Energy Action Committee, Conservation Board, Town Board, and employees representing the Town House, Highway, Maintenance, Recreation).

4. Re-engage with the comprehensive planning process to revise community goals for development in light of (1) known and long-term climate impacts, (2) the pressing need to reduce greenhouse gases, and (3) new understandings of ecological services gained from the town's natural resources. The review should be broad and include all five documents previously listed. A new *Comprehensive Plan* might include goal-setting, cost- and risk-analysis, adaptation and mitigation strategies, coordination plans, identification of funding sources, and a schedule for the submission of documentation to become a *Climate Smart Community*.

WATER RESOURCES INVENTORY

Water is perhaps our most undervalued renewable resource. The Water Resources Inventory provides an overall assessment of the health of the water resources of Pound Ridge, sources of information, and recommendations.

GROUNDWATER AND OUR WELLS

Private wells provide the potable water used in Pound Ridge. A well test is the only assurance that the water is safe to drink. Concerns about our water supply fall under two broad categories: water quantity and quality. With regard to quantity, regional aquifer depletion is rare in New York and the low population density of our community is a safeguard against aquifer depletion. Water quality is a different matter. Groundwater pollution can be caused by multiple sources such as leaky underground storage tanks, road salt, and common household chemicals. These trends along with other recommendations for safeguarding our water are incorporated within the *Comprehensive Plan* and the Water Resources inventory. The recommendations include but are not limited to the protection of small wetlands and vernal ponds and the impacts of certain landscaping practices, impervious surfaces, and improperly spaced, poorly installed or maintained septic systems. In Pound Ridge, what homeowners do or do not do has the greatest impact on our drinking water supply.

BEDROCK AND SOILS

Different soil types vary in permeability and some are unsuitable for development. Soil data, while complex, have many practical applications to planning and provides valuable background information concerning underlying structure. Within this inventory, multiple resources are referenced and different maps identified regarding the soils of Pound Ridge.

STEEP SLOPES AND WATER

A slope is the inclination of the land's surface. The kinetic energy of water increases as it travels down a steep slope. Human activity speeds up the work of gravity and water on highly susceptible slopes. The steep slopes of Pound Ridge's varied terrain are among the most sensitive environmental features in our landscape. Through the Town GIS, maps of steep slopes within the Town boundaries are easily obtained and overlaid on property lines.

WATERSHEDS AND DRAINAGE BASINS

Mapped watershed and drainage basin boundaries provide a quick visual reference of how surface waters relate to each other and other features, such as adjacent steep slopes or floodplains. Pound Ridge is divided into two watersheds. The northern half of Pound Ridge (41%) lies within the Croton River Basin, draining into the Hudson River Estuary and the southern half of Town (59%) drains via two watersheds, the Mill River and the Mianus River, into the Long Island Sound Basin.

WATERSHEDS AND WOODLANDS

Our woodlands serve an incredible role in maintaining healthy watersheds, recharging our surface and groundwater supply, reducing stormwater, mitigating floods, and removing or filtering pollutants that would otherwise wind up in our water bodies, aquifers, and possibly us. These characteristics contribute to the health and safety of our community and minimize the need for public infrastructure to deal with storm water or water treatment.

Almost all of Pound Ridge is covered by either "locally important (2,000-5,999 acres)" or "regionally important (6,000-14,999 acres)" forest patches identified in the DEC map of Large Forest Patches. Maintaining forest cover benefits wildlife as well as water quality. Land utilization leading to forest fragmentation is primarily limited through building, wetlands, zoning, and subdivision regulations and by permanently protecting acreage as open space. Increasing pressure from the impacts of climate change and invasive pests suggests the need for forest management plans regarding large tracts of Town owned or trust lands.

STREAMS, RIVERS, PONDS, LAKES, AND RESERVOIRS

Our streams, rivers, ponds, lakes, reservoirs, and riparian (streamside) areas provide clean water, flood control, water storage, fishing, and wildlife habitats. Streams allow light to penetrate the canopy, keep surrounding soils moist, and distribute nutrients. These water bodies are nurseries for a variety of invertebrate and vertebrate animal life and provide resting places during migrations. The health of the Hudson River estuary and Long Island Sound is linked to the health of our tributaries and watersheds. An examination of the *Lakes, Rivers, Streams* map shows how many streams and water bodies are located in Pound Ridge.

WETLANDS

Wetlands are areas saturated by surface water or groundwater sufficient to support distinctive vegetation and soil types. In addition to providing critical habitat for many plants and animals, wetlands provide important benefits to human communities. They help to control

flooding and reduce damage from storm surge, act as filters to cleanse water of impurities, and provide recreation opportunities for many people, such as bird watching, fishing, and boating.

Ponds, lakes, reservoirs, natural drainage systems, and wetlands are to be protected from encroachment, alteration, pollution, or elimination. To accomplish this, the town adopted Water Control Commission Legislation in 1969. The existing FreshWater Wetlands Ordinance (adopted 1986) provides the tools to protect and preserve our water resources. The Ordinance defines all of our water resources as a "Controlled Area," setting a distance of 150 feet from the area as the "Minimum Activity Setback Area."

Small wetlands, those less than .25 acres, are poorly inventoried and sometimes undervalued by homeowners. During dry periods, small wetlands, including vernal pools, may be easily overlooked. Small wetlands and vernal pools provide critical habitat for certain rare animal species. The Hudsonia Ltd. Habitat report enhanced our inventory of small wetlands, but further study within our boundaries is needed.

WATER CLASSIFICATIONS AND QUALITY

New York State's Environmental Conservation Law outlines Water Quality Standards and Classifications designating the "best uses" that water bodies should support (e.g., sources of drinking water, swimming, boating, and fishing). The federal and state governments developed water quality standards as a basis for monitoring and protecting water bodies. The full narrative provides details on all classified water bodies in Pound Ridge.

A NEW PROBLEM: INVASIVE OR NUISANCE SPECIES

While many species create problems, presently invasive species are an issue. Invasive species are those that become established in ecosystems beyond their natural, historic range and outcompete native species. Locally, their presence may harm native ecosystems, limit recreational activities, or impact the water quality of local reservoirs providing drinking water for other communities.

STREAMS BARRIERS: CULVERTS AND DAMS

The New York State Inventory of Dams identifies ten dams within town boundaries. In addition, there are many unmapped smaller dams and culverts. Dams and culverts may affect hydrology, sediment transport, water quality, and cost towns money for replacement and maintenance. While they can play an important role in local infrastructure, dams and culverts can reduce available habitat, impede migrations, and isolate or severely limit the range of aquatic species, such as native brook trout. Restored passage at these dams and culverts can benefit aquatic organisms as well as terrestrial wildlife that travel along stream corridors. One culvert, near the Pound Ridge-Lewisboro boundary at Boutonville Road, has been identified as a barrier to trout.

FLOODING, FLOODPLAINS, AND STORMWATER MANAGEMENT

The Federal Emergency Management Agency (FEMA) and Department of Housing and Urban Development (HUD) traditionally delineated flood zones based on flood frequency according to the extent of land expected to have a one percent or greater chance of being inundated in any given year (often referred to as the "100-year flood"). Flood zones, whether at 100-year or 500-year statistical flooding intervals, are estimations based on the best data and technology available at the time of mapping and may change over time. The *FEMA Flood Map* is available on the Town GIS.

Floodplains are low-lying areas adjacent to streams and water bodies. By slowing and storing floodwaters, floodplains reduce downstream flood damage and serve as a safety zone between human settlement and the damaging impacts of floods. When left in their natural state, floodplains provide space for the fluctuations in flow that cause streams to expand, contract, and sometimes change course. These highly productive ecosystems are home to a unique suite of plants and animals that tolerate occasional flooding and serve as corridors for wildlife. When development occurs in a watershed, pavement and other impervious surfaces increase runoff volume and velocity, leading to more frequent and damaging floods and greater impacts on water quality. Preserving floodplains and minimizing impervious surfaces is increasingly important as the frequency and magnitude of flood events increase with climate change. Floodplain maps provide a starting point for proactive conservation planning.

LOCAL FLOODING PATTERNS

At this time, flooding in Pound Ridge is a temporary inconvenience. With increased storm events anticipated due to climate change, flood-prone areas should be monitored for effects on human activity and stream habitats. Stormwater retrofits, such as properly sized culverts, vegetative or riprap swales, check dams, and forebays, can be explored.

RECOMMENDATIONS FOR WATER RESOURCES

The following section reflects recommendations for water resources from the Town's Comprehensive Plan:

1. Consider the placement of a conservation easement, conservation overlay zone, Critical Environmental Area designation, or larger minimum lot size over all public water supply lands to protect critical watershed land from development. In addition, consider rezoning all lands that fall within the town's most environmentally sensitive areas, or in scientifically established biotic corridors to R-6A (6-acre minimum lot size. (C. P. B-11)

2. Consider amending the Zoning Law to establish a maximum percentage of impervious surface coverage for each lot. Consider requiring no net change in quality or quantity of stormwater between pre- and post-development conditions. (2a. P. C-8)

3. Consider amending land development regulations so as to incorporate best management practices for Low Impact Development, in accordance EPA, DEP, and DEC. (2b. P. C-8)

4. Consider prohibiting large-scale withdrawal of groundwater without significant recharge, other than for public water supply purposes. The same should apply to water withdrawal from surface waters. Significant water consumers should be required to prepare and implement a water supply and quality management plan. (2c. P. C-8)

5. Continue water quality monitoring program begun in the 1980s in the business district; institute similar monitoring programs in any other area showing similar stress. Pursue all reasonable means to minimize stress conditions. Coordinate with Westchester County's water quality testing program. (2f. P. C-9)

6. Consider creating Aquifer Protection Overlay Zones, with low impact development standards, and increase protective buffers to limit impervious surfaces, set forth prohibited uses, and require use of alternative construction materials and practices to allow water infiltration. (2g. P. C-9)

7. Implement public education initiative to promote the conservation of water. Consider limiting the use of groundwater for irrigation purposes. Require that roof water be directed to lawns and landscaped areas and away from impervious surfaces. Encourage the use of stormwater collected through roof gutters, rain barrels, and other devices for landscape watering. (2h. P. C-9)

8. Empower the Planning Board to improve overall site drainage through the use of depressional storage areas, bioretention areas, dry wells, and infiltration trenches, and other stormwater best management practices. (2i. P. C-9)

9. Use of road salt should be reduced to the minimum required for public safety. Continue to implement a salt reduction plan employing new equipment, application rates relative to road characteristics, environmentally sensitive areas, weather conditions, etc. Require Highway Department to develop a manual of its practices, maintenance and standard operating procedures, maintain records, and participate in training sessions. Engage with State and County agencies to balance their road maintenance practices with the Town's environmental concerns.

10. Implement best management practices to divert, retain, or detain stormwater flows from all sources of drinking water. Minimize use of road salt and prevent it from accumulating in the proximity of wells and surface waters. (3 a-b. P. C-10)

11. Review Phase 2 Stormwater MS4 Regulations and the Town's efforts to meet requirements. Review and address specific recommendations put forth in the Comprehensive Plan 2010. (4 a.-d. P.C-10-11).

12. Require periodic proof of integrity for existing underground fuel storage tanks. Require above-ground storage tanks for all new construction. Educate the public about the hazards of leaking underground fuel tanks. (5a.-d. P. C-11)

13. Encourage the repair and upgrade of existing septic systems. Implement a public education initiative regarding water conservation and wastewater management, proper disposal of hazardous waters, etc. (6a.-d. P. C-12)

14. Educate the public about the impacts of pesticides, herbicides, and fertilizers on water resources in Pound Ridge. Require Town departments to use environmentally safe alternatives. Investigate model ordinances designed to regulate use of pesticides and herbicides. (7a.-c. P. C-12)

15. Review open space recommendations as they relate to watershed protection and wetland loss. (8f.1-2 and g.1-6 P. C-14)

16. Review Tree Preservation ordinance to improve compliance and enforcement. Consider regulating removal of naturally-occuring, native vegetation, including shrubs, small trees, and understory vegetation. Promote the use of native plants and reduction of invasive plants. (11a.-b. and 12. P. C-18)

Additional Recommendations

The following recommendations are outcomes of this narrative:

• **Conduct a basic inventory** of the Town's fuel storage tanks (location, tank size, material, installation date, inspection schedule, etc) and establish an appropriate schedule for assessing storage tank integrity.

• **Seek funds** to replicate surface water and well quality testing previously conducted in Pound Ridge (Land Use Through Ecology. P.41 and a study referenced and summarized in Comprehensive Plan Appendix D, p. 23-28. See also Recommendations 2d P.C-8).

• **Evaluate the need for further inventory** of small water bodies and intermittent streams and ponds after the Hudsonia habitat mapping is complete and available to the Water Control Commission for use.

• **Evaluate the need for a more detailed inventory** of dams and culverts to assess the impact of stream barriers on habitats, local flooding, and water quality

• **Support the acquisition of land and methods to mitigate possible impacts from future development.**

• **Consider requiring extra precautions** regarding changes to the infrastructure in the business district in Scotts Corners because the area lies within the FEMA 100-year and 500-year floodplains, has concentrated impervious surfaces, and is vulnerable to climate change impacts.

• **Review Town ordinances** relevant to water and watershed protection every 10-15 years and align with best practices.

• **Consider revising the Wetlands Ordinance** to include wetlands smaller than .25 acres such as vernal or woodland pools. (11a.1-2. P. C-17).

• **Hire administrative personnel with GIS skills** and purchase a GIS license. Collect information as surveys filed with permit applications in order to produce more accurate wetland maps of the town.

• **Educate homeowners' associations and residents** living around lakes about invasive and nuisance aquatic species, such as water chestnut and Hydrilla.

• **Evaluate the need for Town property forest management plans.**

Season's peak
Phil Douglis

"My tree in Pound Ridge" (circa 1970)
Lisl Steiner © Lisl Baby

OPEN SPACE INVENTORY

Pound Ridge is one of the last remaining low density, predominantly residential towns in the tri-state region. Large areas of open space, left undeveloped and naturalized, are cherished and central to the town's identity. Pound Ridge has over 4,800 acres of open space.

Open space benefits the population by providing ecological services, recreational areas, and habitats for flora and fauna, including pollinators. Ecological services provided include reduction of stormwater runoff, prevention of flooding, filtration of water, and improvement in air quality. Woodlands provide lower ambient temperatures and carbon sequestration – the uptake and storage of carbon in trees and soil. Large open space areas offer greater local resilience to climate impacts with regard to ecoservices, biodiversity, and connectivity. Planning and preserving open space helps towns and municipalities to limit sprawl and unrestricted building in critical habitats.

Students visiting Halle Ravine in the 1970's with their teacher, Karen Sconce.
Lisl Steiner © Lisl Baby

RECOMMENDATIONS FOR OPEN SPACE PRESERVATION AND PROTECTION

PRESERVATION: The following section reflects recommendations for the preservation of open space from the Town's *Comprehensive Plan*. Language has been slightly modified to reflect new understandings regarding climate change impacts and land resiliency:

1. Continue to seek the permanent preservation of ecologically significant and aesthetically important properties by gift, purchase-in-fee, or conservation easements. Such acquisitions can be made by the Town and/or by local not-for-profit land organizations. An additional strategy to ensure these lands are properly preserved and managed is through the use of "cross easements" between the Town and community conservation organizations. (8a.P.C-13)

2. Consider offering property tax incentives for landowners who place conservation easements on their properties for the protection of water resources, scenic viewsheds and/or wildlife habitats. Conservation easements on land which is not subdividable, should be included, so long as the Conservation Board determines the land is important for biotic/aquifer protection or acts as an important buffer to critical land. Decisions on the purchase of land and development rights should be guided by using the selection criteria established by the Open Space Acquisitions Committee. The OSAC should periodically review and update the Committee's list of desired acquisitions reflecting new information gained from GIS mapping and other sources including working in partnership with nearby communities and regional partner organizations. (G4.P.C-15)

3. Seek to preserve as much of the Trinity Lake-Mill River Reservoir-Siscowit Reservoir corridor, in a manner consistent with Aquarion Water Company's management needs. This area generally encompasses the water company land bordering the Mill River near Trinity Pass and Winterbottom Lane, as well as individually-owned lands on Donbrook Road, Trinity Pass, Old Mill River Road, Old Church Lane, Eastwoods Road, Siscowit Road, Hack Green Road, Laurel Road and Barnegat Road, Halle Ravine, the Town's Indian Hill open space, and the Town Park. Similar goals and objectives should be mapped and inventoried as it pertains to other watersheds. (8b.P.C-13)

4. Maintain an inventory of all open space parcels that includes critical, threatened or endangered habitat, or resilient areas in Pound Ridge. Note: This recommendation is at least partially addressed by this narrative plus shapefiles recently uploaded to the Town GIS. (8d.P.C-13)

5. Implement a comprehensive open space mapping program to identify critical properties in need of preservation and a plan to acquire and support them. Emphasis should be given to incorporating composite environmental analysis maps such as were prepared for the 1981 *Town Master Plan* and for the *Land Use Through Ecology* (PRUP) study. The Town should utilize its GIS system for this purpose. As noted above, this is partially addressed by shapefiles recently uploaded to the Town GIS. In addition, a habitat inventory by Hudsonia Ltd. is due to be completed in 2018. (8c.P.C-13)

6. Promote and use a variety of techniques for open space preservation including, but not limited to, obtaining rights of first refusal, the purchase or leasing of development rights, conservation easements, overlay zones, and other mechanisms that may be developed in the future. (8e.P.C-13)

7. Seek to permanently protect existing open space, including natural areas within golf courses, reservoir and water supply lands, large parcels and estates, scenic roads and viewsheds, as well as large tracts of unfragmented woodlands and wildlife habitat. Toward this end the Town should:

- work with Aquarion and other watershed partners, including DEC and DEP Agricultural Watershed Council, to determine the current level of open space protection of watershed lands
- work to preserve water supply and aquifer recharge areas through conservation easements and/or appropriate rezoning
- encourage the preservation of additional lands within the Mill River Corridor and other watershed corridors essential to the protection of the public water supply, habitats, viewsheds, and local aquifer recharge.
- create Biotic Protection Overlay District(s) for all properties located within the Eastern Westchester Biotic Corridor (EWBC) as well as for those biotic protection corridors that have yet to be formally studied and defined (there may be some overlap between biotic corridor lands and aquifer protection overlay districts, thereby giving more reason to create conservation overlay districts in these areas)
- consider designating the EWBC as a Critical Environmental Area (CEA) in accordance with New York's State Environmental Quality Review Act (SEQRA or SEQR)

- with respect to property located within environmentally protected overlay districts:
  - ~ the Town should continue to pursue strategic partnerships with neighboring towns to maximize protection of aquifers and environmentally sensitive biotic corridors that traverse multiple jurisdictions
  - ~ whenever possible, work in conjunction with local open space organizations to facilitate Town and multi-town initiatives in the creation of biotic/aquifer protection districts. (8f.P.C-14)

8. Consider requiring a "heightened review" of proposed activities on environmentally sensitive lands and in designated biotic corridors for all new construction based upon specific standards. Such standards should include an analysis of areas in proximity to wetlands, streams, and water bodies. The Planning Board would use this information, at its discretion, to establish increased buffers, minimize impervious surfaces, regulate special lighting requirements, and other measures necessary to protect the integrity of the biotic/aquifer corridors. (G2.P.C-14)

9. Discourage driving through sensitive areas by adopting a policy, consistent with safety concerns, to avoid the creation of connector roads and to hinder shortcuts from one part of Town to another. (G3.P.C-15)

10. Include low impact development standards establishing narrower pavement widths and no curbs in road construction guidelines. (G3.P.C-15)

11. Educate citizens of the special care that is required when living in critical and sensitive environmental areas. (G5.P.C-15)

12. Create a "no net wetland loss" requirement for all new construction. (G6.P.C-15)

13. Decrease the minimum required size of locally controlled wetlands to include protection for vernal pools, seasonal and intermittent watercourses/wetlands.

The Town should also seek to implement these recommendations in all vulnerable environmental areas and, as much as possible, throughout the Town. (G6.P.C-15)

PROTECTION: Once open space has been preserved, it needs to be managed along with all the Town's natural resources. In the past, open space areas required minimal care. Over time, however, increased recreational use can result in good or bad environmental impacts, i.e., from preserving viewsheds and parklands to overuse of hiking trails, and destruction of habitat. Other stewardship challenges are increased deer herbivory, disturbances caused by off-leash dogs, the ongoing introduction and spread of invasive plant species, extended periods of drought, and the increasing occurrence of violent storms associated with climate change. These complexities and their resolutions present great challenges to the protection of open space lands.

The Town Board, through the Town Code and with recommendations of its Water Control Commission, Planning, Conservation, and Zoning Boards, works to maintain a reasonable balance between the environment, the needs of the community, and individual landowners. The *Comprehensive Plan,* adopted in 2010, includes extensive recommendations for protecting the environmental quality and ecological integrity of the Town's open space and natural resources. Major topics include:

- impervious surfaces and groundwater recharge
- use of road salt
- stormwater management plan
- underground fuel storage tanks
- septic systems
- use of pesticides, herbicides, fertilizers, and other chemicals
- open space preservation and protection of non-threatened flora and fauna
- public access and public education
- deer impacts
- changes to existing regulations
- native and non-native plants: invasive species
- energy conservation

(p.C-8 to C-18).

Additional Recommendations

Through this narrative, it is recommended that additional emphasis be placed on the following:

- **Need for handicap accessibility** to open space areas, connecting walking paths and hiking trails, and additional biking paths and/or bike lanes
- **Importance of protecting the eco-services** (the benefits of natural functions) provided by open space areas
- **Addressing the impact of climate change** on forest regeneration and woodland health to maintain biodiversity and connectivity

HABITAT INVENTORY

Many different habitats lie within our boundaries and on private property. Habitats are the places where plants, animals, and other organisms live. Buffers and corridors, or areas between habitats, can limit the spread of noise, chemical pollution, invasive species, etc. and are needed for the safe travel of wildlife. The two important messages of this narrative are (1) "Pound Ridge is home to an impressive diversity of high-quality, large habitat patches and unusual habitat types," according to the Hudsonia Report, and (2) we need to care for these habitats and the areas that surround and lie between habitats. Fortunately, we greatly benefit from the care that we extend to the environment in which we live.

The narrative is comprised of two parts:

Part I Habitats, prepared by the Conservation Board, is intended primarily for the property owner. It includes a brief history of the early forests of Pound Ridge and the pioneering efforts regarding the care of the land by Sara Stein, the volunteers of The Invasives Project-Pound Ridge, the preservation and protection of open space by individuals and national environmental leaders, including land preservation organizations, Rachel Carson, Lady Bird Johnson, and Doug Tallamy. These collective actions, plus a redefinition of gardening to embrace taking care of the land, add meaning to the underlying message of this narrative: our local habitats require our care. Part I includes *An Open Letter to Residents*, outlining what a property owner can do, *Citizen Science* programs, *Community Resources*, and useful *Plant Lists* of local flora. Many informative maps, including a map of the Eastern Westchester Biotic Corridor, are available on the Town GIS and are described in Part I.

Part II, *Significant Habitats in the Town of Pound Ridge, Westchester County, New York: Report to the Town of Pound Ridge, the Hudson River Estuary Program, and the Westchester Community Foundation,* is a technical report containing recommendations prepared by Hudsonia Ltd. (a not-for-profit institute for research, education, and technical assistance in the environmental sciences).

Biologists from Hudsonia Ltd. identified and mapped ecologically significant habitats in 24 selected tracts of land throughout the Town of Pound Ridge during the period of June 2017 through July 2018 through map analysis, aerial photograph interpretation, and field observations. The Hudsonia Ltd. report, as a stand-alone document, includes an *Executive Summary, Description of Methods, Results, Conservation Priorities, Conclusion, References, Appendices, Figures, and Tables.*

Our town has at least 23 different habitat types of ecological importance identified by Hudsonia Ltd. Some of the habitats are rare or declining in the region or support rare species of plants or animals, while others are high quality examples of common habitats or habitat complexes. A thought-provoking message, referenced in the report, is described as a "habitat approach," necessitating a deeper examination of the surroundings and nearby habitats to understand their constituent species, both permanent and transient, and the ecological processes that support the habitats and species (and vice versa). Even a superficial understanding of the demands of this approach generates a sense of awe.

The Hudsonia report starts with a simple definition of a habitat as a place where a plant or animal lives and, with Hudsonia's contributions, moves us to a deeper appreciation of what we have and a respect for the fullness of Hudsonia's closing charge "of incorporating this approach into planning and decision making... to minimize the adverse effects of human activities on the landscape, integrate the needs of the human community with those of natural communities, and protect the ecological patterns and processes that support us and the rest of the living world."

Turkey crossing
Romy Sgró Crone

RECOMMENDATIONS FOR HABITAT PROTECTION

The following consolidates many of the recommendations for the protection of habitats in Pound Ridge from the 2010 Comprehensive Plan.

Goal: The Town should protect the environmental quality and ecological integrity of the Town's natural resources. This Plan is based on a strict policy of environmental conservation, using as a basis the environmental data accumulated by the Town over many years.

1. Environmentally important land areas come in many different forms. Scenic vistas of open space, watercourses, natural forestland, historic properties, scenic roadways, natural habitats and the like, all contribute to the Town's character. The Town should request that the Conservation Board, in conjunction with the Pound Ridge Land Conservancy, another land preservation group in Town, compile an inventory of significant environmental areas and features. (2-c. P. A-3)

2. The current minimum front, side and rear setbacks and buffers should be increased in order to protect the Town's semi-rural character, animal habitat and woodland viewsheds, and to enhance privacy between neighbors. Further, the natural environment including geological occurrences, mature tree growth and vegetative under-story should be protected in these setbacks and buffer areas. (10-b. P B-15)

3. The requirement for a septic expansion area equal in size to the actual septic system creates unnecessary site disturbance due to the requirement to clear vegetation from the expansion area. Further, vegetative screening within the setback areas that once provided privacy and preservation of community character is reduced, and homes are therefore more visible. Given the size of currently constructed homes and their associated improvements, the need for adequate buffering can mean the need for larger lots. The Town should explore the feasibility of not requiring the full vegetative clearing of septic system expansion areas in order to preserve woodlands, wildlife habitat and viewsheds. (10-d. P. B-15)

4. The Town should continue to protect the environmental quality and ecological integrity of the Town's natural resources. (1-a. P. C-8)

5. The Town should continue its forward-looking policy of acquiring and preserving open space for purposes including protecting: the quality and quantity of the Town's surface and subsurface water supply, the quality and variety of wildlife habitats in the Town, and the scenic beauty, semi-rural character and aesthetic appeal of the Town. (1-b. P. C-8). This recommendation is reinforced in *Eastern Westchester Biotic Corridor*, Metropolitan Conservation Alliance, Technical Paper Series: No. 4 (Appendix B *Comprehensive Plan,* P. 14).

6. The Town should consider requiring a 'heightened review' of proposed activities on environmentally sensitive lands and in designated Biotic Corridors for all new construction, based upon specific standards. Specifically, such standard should include an analysis of areas in proximity to wetlands, streams and water bodies. The Planning Board would use this information, at its discretion, to establish increased buffers, minimization of impervious surfaces, special lighting requirements and other measures where necessary to protect the integrity of the biotic/aquifer corridors. (g-2. P. C-4)

7. Conservation subdivisions are used, among other things, to:
- preserve important scenic features, including mature forests, streams, gorges, rock outcroppings, scenic vistas, and other existing open spaces
- encourage the preservation of open space in highly visible areas such as along roadsides, ridgelines, entrances, etc. minimize the creation of impervious surfaces (g-3. P. C-15)

8. Pound Ridge should continue to plan for and encourage the preservation of a continuous linked open space network throughout the town. (8-j. P. C-16) To this end, the use of conservation area overlay ordinances are recommended in Eastern Westchester Biotic Corridor (Appendix B Comprehensive Plan) P. 15.

Additional Recommendations To the Town

- **Support a proposal** by Mianus River Gorge (2018) to inventory and rescue native reptiles, amphibians, and plants prior to construction on sites in Pound Ridge.
- **Continue to educate the public** about terrestrial invasive species, particularly those that are not well established (known as early detection/rapid response species) and encourage monitoring water bodies for aquatic invasive species, e.g., water chestnut and hydrilla.
- **Identify and prioritize high value habitats** for additional management efforts.
- **Engage volunteers** in reducing invasive plant species and restoring with native plants in preserves and on town properties.
- **Encourage the use of native plants** in public spaces and by homeowners.
- **Support decisions and actions** that maintain ecosystem function, biodiversity, and connectivity as a strategy for protecting wildlife and habitats in a time of climate change.

Review and incorporate the many recommendations in the Hudsonia report (Part II) into the municipal decision making practices and best management practices.

CLOSING SUGGESTIONS

Explore the Nationl Resources Inventory as a whole since the four inventories complement each other.

Check websites and resources with staff engaged in updating source materials, such as:

1. Westchester GIS

2. *New York Climate Change Science* with extensive resources about air emissions, climate data, ecosystems, public health, transportation, and water resources.

3. Resources on water:
   - Watershed boundary datasets managed by USGS and downloaded at https://www.usgs.gov/core-science-systems/ngp/national-hydrography/access-national-hydrography-products.

   - Check for proposed model of rivers and streams at NOAA Northeast River Forecast Center.

- Local-level catchments modeled by the New York Natural Heritage Program are available through the Statewide Riparian Opportunity Assessment at http://www.nynhp.org/treesfortribsny (in the geodatabase download).

- For the northern portion of Pound Ridge, refer to the Hudson Valley Natural Resource Mapper at http://www.dec.ny.gov/lands/112137.html, a tool for communities in the Hudson River Estuary Watershed, provided by DEC, which includes information about habitat and water resources as well as recreation sites.

- For the southern portion of Pound Ridge, information can be inferred from resources provided by Connecticut Department of Energy & Environmental Protection (DEEP) and the University of Connecticut Center for Land Use Education and Research (CLEAR). Accessible online maps and tools, including drainage basins, water quality classifications, and aquifer protection areas are available at Connecticut Environmental Conditions Online (CT ECO). Additional information may be available at the University of Connecticut Map and Geographic Information Center (MAGIC) website.

Quietude
Douglis Visual Workshop

Climate **Impacts**

At the Pound Ridge Nursery
C. Reppert 2017

At a Glance

Climate Impacts

Is there hope for our warming planet? Your view of the health of the planet, whatever it might be, is a call to action. The reality is that Pound Ridge has and will continue to experience climate impacts and, as a town, we must address them. At this time, we can expect longer and more severe heat waves, worsening air quality, frequent short-term droughts, plus extreme weather events accompanied by power outages and flooding, damage to infrastructure, and strained human and monetary resources. Town planning needs to be based on climate models and long-tem projections, not past experiences.

There is good news, however, according to Paul Hawken's 2017 bestseller, *Drawdown.* Based on the findings of 200 scientists, policymakers, and experts around the world, within 30 years humans can make significant strides toward achieving "drawdown," the point at which greenhouse gas levels in the atmosphere begin to decline.[1] These findings, both encouraging and sometimes surprising, inform us that 100 solutions, currently in place, are scaling greenhouse gases down. Our full out commitment to engage in solutions – large and small – can make a difference, but we have little time to waste.[2]

PURPOSE

Climate Impacts

The purpose of this narrative is to further our understanding of future climate impacts on our town, and to encourage town residents and officials to engage in adaptation and mitigation practices. Through adaptation, the town lowers the risks and consequences posed by climate events. Adaptation builds community resilience by increasing the ability of our town to use available resources before, during, and following adverse situations. Adaptation also supports the sustainability of our natural resources with water being of particular importance to all of our residents. Mitigation, by reducing or drawing down greenhouse gases, cleans the air of some forms of pollution and addresses the root causes of climate change, Mitigation is important for the future and what we do to mitigate greenhouse gases distinguishes us as a community.

Both adaptation and mitigation protect our natural resources and properties and, therefore, form part of the economic backbone of Pound Ridge. Together, these strategies lessen the cost and recovery time of electrical outages and flooding associated with damaging storms and prepare us for the impact of drought on our water resources. But most importantly, they increase the overall health and safety of our residents and the viability of our community.

HOW TO SUPPORT DRAWDOWN

At Home

Have a free home energy performance assessment to reduce your energy uses and emissions, save money, and increase the comfort and durability of your home. Make a request at www.nyserda.ny.gov/Contractors/Find-a-Contractor. Add insulation and weather stripping, and install energy efficient windows. Use LED bulbs, fully turn off electronics when not being used, and when you need to replace an appliance, shop for an energy efficient one. Install low flow showers and water fixtures, and double flush toilets. Install room sensors to adjust lighting and temperatures by sensing the presence of people. Use recycled paper. Ensure that chemicals, especially, refrigerants, are disposed of correctly. Install solar power* and if you cannot, offset your carbon footprint by supporting electricity from alternative sources such as *Community Choice Aggregation* programs (CCA) and *Solar for All.*

In the Kitchen

Work with the planet by choosing fresh, organic, seasonal, local, and unprocessed foods and remember to bring your reusable bags to shop. Eliminate fossil fuels needed for refrigeration and transport by supporting local farming and farm-to-table restaurants. To further reduce the carbon footprint, grow your own veggies, join the Meatless Monday movement, or adopt a plant-rich diet to eat less meat* When you do eat meat, choose cuts from grass-fed pastured animals. Minimize packaged foods. Cut down on food waste, buy only what you need and use the leftovers.* Compost food scraps during food preparation and at the end of meals.

*These three actions are among the top ten of 100 *Drawdown* Solutions[3]:
- Reduced Food Waste
- Adoption of a Plant-Rich Diet
- Rooftop Solar

WHAT YOU DO MAKES A DIFFERENCE

CURRENT CLIMATE CONDITIONS AND PROJECTIONS

PRIMARY IMPACTS

The temperate climate of the Hudson Valley region varies from warm summers with occasional heat waves and droughts to cold, snowy winters. Global climate changes have already affected our local weather patterns. The primary impacts we have witnessed are changes to temperatures and precipitation.

Increasing temperatures The greenhouse effect, or build-up of gaseous emissions in the atmosphere that trap the sun's energy, causes global temperatures to rise. Since 1970, New York's annual overall average temperature has risen nearly 2°F, with average winter temperatures up almost 5°F.[4] This trend is projected to continue and significantly alter local conditions (see Appendix B).

Changing precipitation patterns As temperatures increase globally, both the rate ocean water evaporates and the amount of water vapor the atmosphere can hold will increase. High levels of water vapor in the atmosphere create conditions more favorable for concentrated periods of heavier precipitation. Locally, between the periods of 1950-1979 and 1980-2009, the Northeast experienced a 74% increase in precipitation occurring as heavy snow storms or intense rain events.[5]

In the future, we can expect more frequent and longer dry periods intermixed with heavy rain events as well as decreased snow cover in winter.[6] At this time total rainfall has changed only marginally. Projections indicate that total annual precipitation could increase almost 15% by mid-century.

To review *Climate Projections in the Hudson River Estuary: A fact sheet for the public* see Appendix B. A summary of projections and the technical report, NYSERDA's *Responding to Climate Change in New York State* (ClimAID) (Rosenzweig et al. 2011; Horten et al. 2014), can be obtained at https://www.nyserda.ny.gov/climaid. For impacts of climate change where we live and a platform for visualizing climate and weather datasets, plus other resources, see Appendix D.

SECONDARY IMPACTS

Increasing temperatures and precipitation lead to other impacts.

Warmer Winters Warmer winters mean more freeze/thaw cycles which cause potholes, cracks, and frost heaves in pavement. Warmer winters could also reduce costs from snow removal and road salting.[7]

Summer Heat Waves As annual temperatures continue to increase, we will experience more frequent, intense, and long-lasting heat waves. It is projected that the number of days above 95°F in our area will triple by 2050.[8] The prolonged effects of extreme heat pose serious threats to human health in widely different ways:

- Air quality worsens during times of high temperatures because heat and sunlight activate airborne chemical compounds emitted from car exhaust, gas-powered equipment, smokestacks, etc. These compounds combine with naturally occurring nitrogen oxide and create "smog" while ground-level ozone is increased by the action of ultraviolet light. The results of these chemical reactions make breathing difficult for those with respiratory ailments or heart problems and can also make healthy people more susceptible to respiratory infections. The situation is worse in urban areas, due to emissions from vehicles, factories, and power plants, and in certain geographical areas, typically bounded by mountains. Air quality forecasts for our area can be found at http://airquality.weather.gov/probe_aq_data.php?latitude=41.2121&longitude=-73.5767

- Extreme heat combined with high humidity make it difficult for a person to maintain a normal safe internal body temperature and can lead to life-threatening illnesses such as heat exhaustion, heat cramps, and heat stroke. Infants, children under the age of four, the elderly, and those with pre-existing conditions are at greater risk during these periods.

- In surface waters, these conditions can lead to increased algal blooms. Algal blooms impact the color and clarity of the water and can lead to eutrophication,[9] a process that depletes the dissolved oxygen content of the water, and often causes die-offs of organisms such as fish kills,[10]

and foul odors. Smaller bodies of water are more vulnerable to algal blooms than larger ones. In reservoirs they can impact the supply and quality of drinking water for millions of people. This concern applies particularly to Aquarion Water Company and NYC DEP as managers of local reservoirs.

Public Health In addition to an increase in heat-related illnesses, climate change can potentially impact public health in other important ways:

- flooding and severe weather can prevent caregivers from reaching patients and providing medical attention
- power outages caused by extreme weather conditions including heat waves, flooding and other storms can impact individuals who rely on electricity to run medical devices
- exposure to vector borne diseases such as Lyme and West Nile can increase as warmer weather results in longer breeding seasons and ranges for pests such as ticks and mosquitoes.[11]

HOW TO SUPPORT DRAWDOWN

In Your Car

Observe the speed limit, since gas mileage decreases rapidly at high rates of speed. Use cruise control when you can. Give your car a tune-up. Keep tires properly inflated. Avoid speeding, rapidly accelerating, frequent braking, and idling. Avoid carrying extra weight in the trunk and hauling cargo on your roof since both practices decrease fuel economy. Make smarter transportation choices, including ride sharing and public transportation. When it's time, trade in the gas guzzler and replace it with a hybrid or electric vehicle (EV).

WHAT YOU DO MAKES A DIFFERENCE

Pound Ridge sunsets *are often more spectacular in the fall and winter, but are not caused by air pollution or climate change. This one occurred over Ward Pound Ridge Reservation and was enhanced by a deck of middle to high clouds.*[12]
C. Reppert 2017

Short-term Droughts A series of climate-related events, related to both precipitation and temperature, contribute to a drought. Soil moisture is likely to decrease with warmer, less snowy winters, fewer steady rainfall events,[13] and an increase in heavy rain events that are not conducive to the ground's absorption of water. Increased summer temperatures also lead to higher rates of soil moisture evaporation and transpiration whereby plants take in more water from the soil while giving off more water to the atmosphere. Overall human demands for water increase due to lawn irrigation and swimming pools. All of these factors contribute to short-term droughts which in turn can:

- threaten the local drinking water supplies
- reduce stream flow and threaten aquatic life
- increase risk of fire to forest and woodlands
- stress trees and other plants, affecting flower and fruit production
- affect insect populations in different ways (e.g., pollinator populations may plunge due to lack of forage, but populations of destructive sucking and boring insects, which favor stressed plants, may increase).

For the official U.S. Drought Monitor go to http://droughtmonitor.unl.edu. The U.S. Drought Monitor is produced through a partnership between the National Drought Mitigation Center at the University of Nebraska-Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration.

HOW TO SUPPORT DRAWDOWN ON YOUR PROPERTY

In the Garden

Keep soil covered with green plants or mulch. Compost vegetative debris and use it to add natural nutrients for plant health and vigor. Plant a rain garden and/or use rain barrels. Use permeable surfaces wherever possible.

On the Lawn

Reduce the size of your lawn. Raise the cutting height of your mower. Switch to an electric mulching mower. Various other lawn equipment, including power chainsaws and leaf blowers, now have electric alternatives. Try to follow best lawn care practices. Take your irrigation system off the timer, use a rain gauge (lawns need one inch/per week), and supplement only as needed. Buy green products which are safer for the environment.

In Your Woods, Waterways, and Wetlands

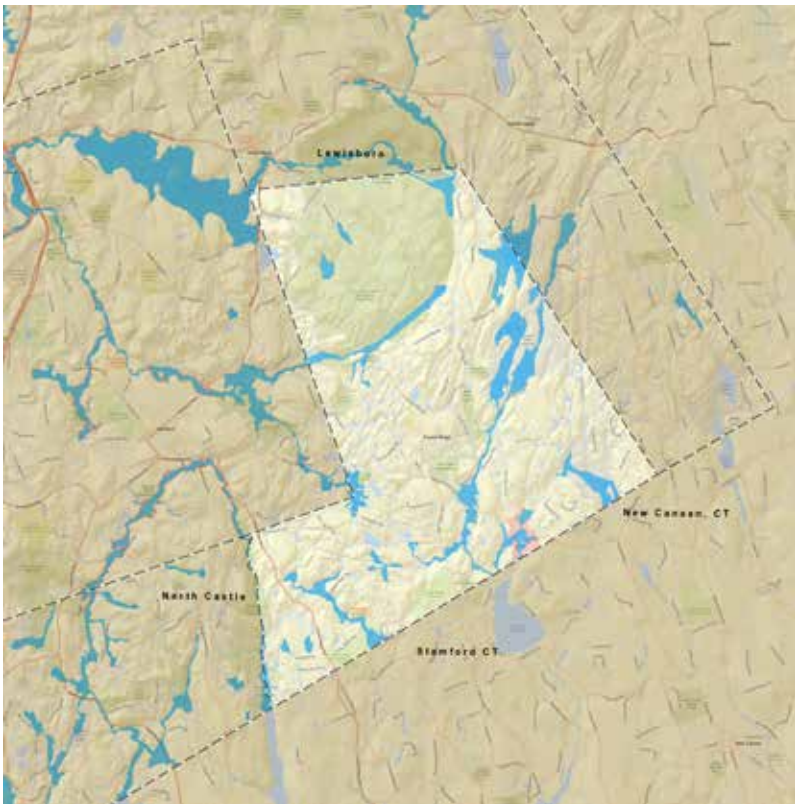
Mow less and support wildlife more by adding an herbaceous/shrub layer between the lawn and woods and a vegetative buffer between the lawn and streams, ponds, and lakes. Plant trees! Select native plants adapted for our environment and that support wildlife. Look into woodlot management practices, such as thinning for growth, creating a forest management plan, and monitoring for harmful insect pests.

WHAT YOU DO MAKES A DIFFERENCE

Extreme Rain Events and Flooding When intense rain events occur, there is more runoff and less recharge of the soil moisture and aquifers in upland areas. Increased upland runoff leads to flooding in the lowlands. At the present time, Pound Ridge experiences few episodes of flooding. However, with an anticipated increase in storm events due to climate change, areas presently prone to flooding should be monitored for:

- changes in drainage patterns and groundwater recharge
- increased erosion and sedimentation
- effects on upland flora and stream habitats
- impacts on infrastructure such as damage to bridges and road wash-out due to undersized culverts
- impacts on human activity such as road closures, leach field function, property damage, and basement flooding.

Areas vulnerable to flooding have been identified in the Water Resources Inventory and include the business district in Scotts Corners. Because this is an area of concentrated impervious surfaces and lies within the FEMA 100-year and 500-year floodplains, it is recommended that extra precautions be taken regarding changes to the infrastructure of this area of town.



Quick Reference: FEMA Flood Map

To determine if a home in Pound Ridge is vulnerable to flooding, homeowners are encouraged to view three map layers on the Town GIS: **Property Map**, combined with **Streams and Water bodies**, and the **100-year and 500-year Flood Map**. The GIS mapping tools can be found on the Town's website; the Data Warehouse can be found in Appendix A.

Clearly Pound Ridge is safe from sea level rise, but other areas of the county are not. To see the effect of sea level rise on Westchester County, go to a map model from Westchester GIS at http://wcgis.maps.arcgis.com/apps/MapJournal/index.html?appid=f1e6d9a3ed794b08abeaa1b9bd4861df

Prolonged Power Outages Power outages in our area are associated with extreme weather events and have lasted up to 12 days and longer. The Town, working with NYSEG, has created a model state-of-the-art system to identify and locate downed lines and equipment needs. This system enables NYSEG to expedite repairs by managing crews more efficiently, provisioning trucks with needed materials for repairs and determining the best routes to outage sites. In 2018, discussions regarding practices to prevent power outages and expedite recovery were renewed following the memorable month of March, when four Nor'easter storms occurred in quick succession, with three of the four events causing extensive property damage.

Office of Emergency Management

The Pound Ridge Office of Emergency Management (OEM) coordinates the Town's response and managed recovery from natural and man-made disasters. Established in October 2001, OEM is a coordinated effort by our police, volunteer fire department, volunteer ambulance corps, town employees, resident volunteers, NYSEG, area hospitals and emergency services from neighboring communities, in addition to local county and state officials.

OEM also attends to the most vulnerable members of the community, by operating warming/cooling centers as needed. OEM provides updates and notifications to the community by telephone, emails, text messages, and the Town website. Residents are encouraged to participate in OEM's Code Red Notification System, Pre-Emergency Plan Survey, and to support OEM as a volunteer. For more information, visit the Town's website. To learn about the prevention of power outages, preparation before a storm, and storm safety visit NYSEG's website: https://www.nyseg.com/UsageAndSafety/electricalsafety/default.html

Damage to Carolin's Grove by Hurricane Sandy
Elyse Arnow 2012

Pound Ridge lights up in the fall. *On many fall days the colors pop. With a brilliant blue sky above, tree branches with red, gold and russet colored leaves are set off against blue-gray stone walls and dark rock outcrops. Climate change may extend this beautiful season in the future, but color combinations and tree species will change*[14]. *C. Reppert 2017*

Impacts on Plants and Animals Predicting the full impact of climate change on local plant and animal populations is difficult for many reasons: plants spread by seed dispersal, some animals are nomadic, and species evolve. We have no idea which species will adapt to local conditions, which will migrate in or out of our area, or perhaps, fail to thrive and become extirpated. Changes of summer and winter ranges for birds in our area are documented in the 2015 *Audubon Climate Report* (see Appendix D).

According to Julius et al (p. 4),[15] the major effects of climate change on aspects of biodiversity in the United States are:

- patterns of life cycle events for some plants have been affected by shorter, milder winters and earlier spring thaws, with some plant species flowering around a day or two earlier per decade in the northern hemisphere
- species distributions have shifted over the last few decades, with plants and animals moving to higher elevations and latitudes at median rates of 36 feet of elevation per decade and 10.5 miles of range per decade respectively. Greater shifts are expected to occur in the future
- significant lengthening of the growing season and higher net primary productivity in higher latitudes, where temperature increases are relatively large, has been shown to correlate with higher biodiversity
- surface water quality is anticipated to degrade due to temperature increases, higher amounts of nutrient export (due to increased precipitation), and increased acidification, and will result in a variety of changes to aquatic ecosystems including potential species losses.

If left unchecked, climate change will make Pound Ridge appear and sound different. Trees, flowering plants, birds, bees, and butterflies that provide our sense of place will change. We can expect the loss of magnificent species such as Red Oaks and Sugar Maples, and anticipate an increase of species associated with more Southern latitudes such as Pignut Hickories. Invertebrate and vertebrate populations, which are dependent upon specific plant and tree species for habitat, nesting material, and food will join this exodus. Local bird populations will also change and presage shifts in the populations of other vertebrates, even fish. In place of native plants and animal species, we will be increasingly challenged by "opportunistic pioneers" or invasive species,[16] including pathogens.

Ecosystems and Ecological Services How climate impacts will disrupt, impair, or restructure ecosystems is simply not known due to the complexity of each system. An ecosystem is a community of plants and animals interacting with one another and their physical environment. Representative ecosystems in Pound Ridge include: deciduous woodlands, hemlock forests, meadows, vernal pools, wetlands, streams, lakes and reservoirs. Ecological services, or ecoservices, are those large and small benefits freely gained from natural environments. Examples are water filtration and improved air quality, flood abatement, storm water regulation, drought moderation, lowered ambient temperatures, soil regeneration and stabilization, nutrient recycling, carbon sequestration, pollination and seed dispersal complexes, control of pests, regulation of disease-carrying organisms (vectors), and more.

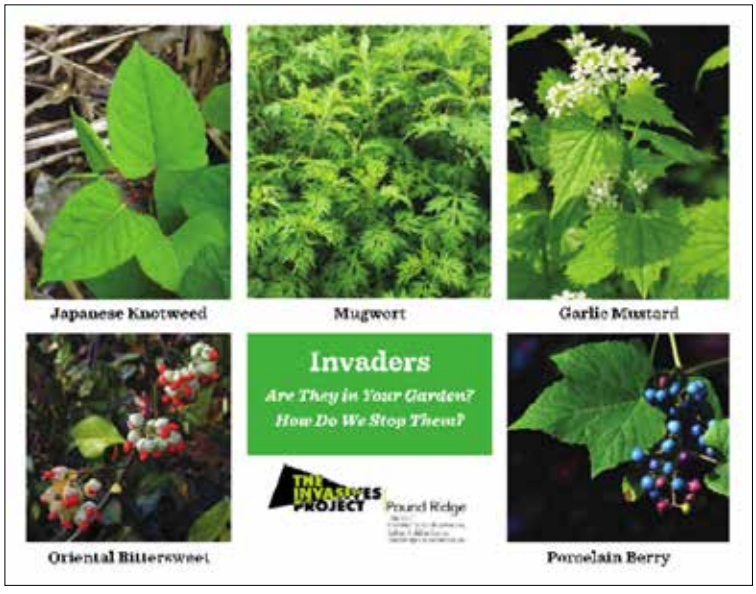
The role of the town's natural resources as ecoservice providers supports community resiliency. While the full value of these goods and services are impossible to assess, our natural resources are essential for a sustainable future and a silent source of strength. These critical, finite resources are key components of the community's adaptive and mitigating abilities, to both lower risks from climate impacts and drawdown greenhouse gases. These new understandings significantly underscore the need to preserve, protect, and enhance local natural resources.

HOW TO SUPPORT DRAWDOWN

With Citizen Science

Become a citizen scientist and engage in one of the many activities that monitor the health of the local environment. Participate in the annual Audubon Christmas Bird Count, help monitor streams with the Westchester County Citizen Volunteer Monitoring Program (CVMP), join Riverkeeper to protect the Hudson River, participate in Monarch Watch, or help Cornell University's Project Bud Break track the effects of climate change on native plants. Learn more about the effects of climate change and its impact on the community. We all need to work with nature to save both the diversity and health of our local ecosystems and our planet.

WHAT YOU DO MAKES A DIFFERENCE



Conservation Board Announcement
S. Levethan 2017

For more about invasive plants in our area and to report observations, go to http://www.imapinvasives.org. Regarding forest health, the 2011 Forest Health Aerial Survey Report includes Pound Ridge (See Appendix D), but will be more meaningful as data are collected over time.

Human and Monetary Resources Severe weather conditions place extra demands on municipal employees, volunteers, infrastructure, and the town budget. The operation of heating and cooling centers, providing water to residents in need, clearing roads of felled trees, snow removal, and repairing damage to road infrastructure is costly. The unpredictable nature of weather from year to year complicates the budgetary process and planning for emergency preparedness.

WHAT THE TOWN CAN DO

By reaffirming its protection of natural resources, including open space, and increasing outreach and education efforts, the Town can make strides toward climate resiliency, sustainability, and drawdown. But, by being more proactive, it will be more fiscally responsible and better able to prepare for impending challenges.

Five documents for the Town to review for strategies to actively prepare for climate change and, at the same time, help drawdown greenhouse gases are:

1. *Comprehensive Plan*[17] The Town's *Comprehensive Plan* stands as a key guiding document regarding the protection and preservation of the Town and its natural resources. Although the *Comprehensive Plan* does not discuss climate change directly, it references energy conservation (p. C-8), transportation (Section D), alternative "green"' sources of electricity (p. E-9) and the Town's recycling center (p. E-12). Many other recommendations (e.g., stormwater management, floodplain protection, erosion control, etc.) clearly support community resiliency. When the *Comprehensive Plan* is reviewed, long-term projections to 2050 need to be established as the basis for infrastructure decisions (e.g., size of culverts, bioswales, smart buildings).

2. *Natural Resources Inventory* Four updated narratives (Water Resources, Open Space, Habitats, and Climate Change) comprise the Natural Resources Inventory and include descriptions of the ecoservices associated with our natural resources and recommendations related to climate change.

3. *Mid-Hudson Regional Sustainability Plan* (Final May 2013)[18] This regional plan was written with the goals of promoting economic development, environmental sustainability, and enhancing the quality of life in the region and should be reviewed for what is applicable to our Town.

4. *Clean Energy Community (CEC)*[19] The Town's Energy Action Committee (EAC) and Conservation Board (CB) are working toward becoming a New York State Energy Research and Development Authority (NYSERDA) Clean Energy Community. The CEC and Climate Smart Community (CSC) program, described next, are complementary with many similar actions[20]. One example of a CEC High Impact Action Item already undertaken by the EAC and CB is the local solarize campaign (2017) to increase the use of solar panels on residential rooftops. Adopting CEC High Impact Action Items brings the Town closer to becoming a CSC.

5. *Climate Smart Community* (CSC)[21] In 2016, at the request of the CB and EAC, the Pound Ridge Town Board adopted the *Climate Smart Communities Pledge*. The Pledge is the first step toward becoming a New York State Department of Environmental Conservation (NYSDEC or DEC) recognized CSC. Taking this pledge furthers the Town's commitment to reducing greenhouse gas emissions and improving the efficiency and sustainability of our local infrastructure. Many documents about the CSC program can be found on the Internet, including: *A Guide to Local Action: Climate Smart Community Certification* https://www.dec.ny.gov/energy/50845.html. An action check list is provided in Appendix C.

Of the five documents, the guidelines to become a CSC are the most comprehensive with more than 130 actions

Pound Ridge Trail Maintenance
C. Reppert 2018

NEW YORK STATE OF OPPORTUNITY. Climate Smart Communities PLEDGE

WHEREAS, we believe that our response to climate change provides us with an unprecedented WHEREAS, the Town of Pound Ridge believes that climate change poses a real and increasing threat to our local and global environments; and opportunity to save money, build livable, energy-independent and secure communities, promote vibrant innovative economies, healthy and safe schools, resilient infrastructures, and safeguard natural habitats and wildlife; and

WHEREAS, we believe that even if emissions were dramatically reduced today, communities would still be required to adapt to the effects of climate change for decades to come,

IT IS HEREBY RESOLVED that the Town of Pound Ridge, in order to reduce greenhouse gas emissions and adapt to a changing climate, adopts the New York State Climate Smart Communities Pledge, which comprises the following ten elements:

1. Pledge to be a Climate Smart Community.
2. Set goals, inventory emissions, plan for climate action.
3. Decrease community energy use.
4. Increase community use of renewable energy.
5. Realize benefits of recycling and other climate-smart solid waste management practices.
6. Reduce greenhouse gas emissions through use of climate-smart land-use tools.
7. Enhance community resilience and prepare for the effects of climate change.
8. Support development of a green innovation economy.
9. Inform and inspire the public.
10. Commit to an evolving process of climate action.

Signed Richard B. Lyman, Town Supervisor
Dated this Eighth of December 2016.

BECOMING A CLIMATE SMART COMMUNITY

To gain certification as a CSC the Town must work towards the twin goals of climate change preparation and the drawdown of greenhouse gases.

The CSC identifies actions a town can adopt and awards a certain number of points for each accomplished activity. Of these, the Town has undertaken a (1) *Solarize Lewisboro – Pound Ridge Campaign* (2017) previously mentioned.

The Town also joined (2) *Energize New York Finance* (2017) to offer energy upgrade financing to local businesses and not-for-profits and is anticipating energy efficient changes through a (3) *Traffic Enhancement Program* (TEP) in the business district. Proposed TEP changes include the conversion of street lights to energy-efficient LED's and the installation of traffic calming measures. These innovations are anticipated to be completed in 2019.

In addition, the Town approved participation in the (4) Westchester *Power's Community Choice Aggregation* (CCA) Program in May 2018. Through the CCA, residents were enrolled in an alternative green power source with the ability to opt out.

Other CSC activities that have earned, or are in the process of earning points for the Town include:

- the Town's recycling program and the CB campaign to educate and encourage recycling, composting, and waste reduction through flyers mailed to residents as well as through continuing *Living Here ebulletins*

- the CB *Energy Saving Trees* (April 2018) program, coordinated with NYSEG and DEC Forestry to distribute over 200 free trees to residents and promote energy efficiency and stormwater management.

- this narrative, the water resources inventory, and watershed assessment, are all components of the *Natural Resources Inventory*

- the establishment of the Office of Emergency Management's heat emergency plan.

There are other areas for the Town to explore: providing a mix of housing options; sponsoring transportation options such as car sharing, carpooling networks, park & ride lots, a shuttle to the train lines, and building a fleet of fuel-efficient vehicles; reducing the water and energy demands of its own buildings; and aiming to be a zero-waste community.

RECOMMENDATIONS FOR CLIMATE IMPACTS

1. Address the lack of an identified goal related to climate change, for example, the Town should adopt forward-looking policies to prepare for climate impacts, reduce greenhouse gases, and protect the benefits freely gained from its natural environments.

2. Review best management practices, regulations and bylaws for consistency against the newly stated goal.

3. Appoint a Climate Smart Community (CSC) coordinator and task force comprised of key people (for example, a member of Energy Action Committee, Conservation Board, Town Board, and employees representing the Town House, Highway, Maintenance, Recreation).

4. Re-engage with the comprehensive planning process to revise community goals for development in light of (1) known and long-term climate impacts, (2) the pressing need to reduce greenhouse gases, and (3) new understandings of ecological services gained from the town's natural resources. The review should be broad and include all five documents previously listed. A new *Comprehensive Plan* might include goal-setting, cost- and risk-analysis, adaptation and mitigation strategies, coordination plans, identification of funding sources, and a schedule for the submission of documentation to become a *Climate Smart Community*.

IN CLOSING

No other issue in our lifetime demonstrates the critical interconnectivity of humans and nature and the artifice of political boundaries like climate change. The call for responsible stewardship is clear. Opportunities exist for all of us to make a difference today in Pound Ridge. As citizens of a great town, we are the ones who will decide what we want to do and we are the ones to do it. Our actions on this issue, will define us and our future.

HOW TO SUPPORT DRAWDOWN

In Town and Beyond

Join the stewardship activities of the Pound Ridge Land Conservancy, Westchester Land Trust, The Invasives Project – Pound Ridge, The Henry Morgenthau Preserve, and Mianus River Gorge to help protect open space, sensitive habitats, and other natural resources of Pound Ridge. Attend meetings or join the Town's Conservation Board, Energy Action Committee, or Water Control Commission. Support organizations that protect our local environment and land through funding, land donations and conservation easements that restrict development. Recognize the benefits of the Town's Deer Management Program and allow participation on your property. Work with your children, their teachers, local school boards, and youth groups to design curricula and activities that highlight environmental conservation and sustainability. Elect state and national representatives who want to decrease our carbon footprint and support clean energy, air and water.

WHAT YOU DO MAKES A DIFFERENCE

Shine on me!
Solarized Homes
Pound Ridge 2018

ENDNOTES

1. Hawken, P., Ed. *Drawdown: the Most Comprehensive Plan Ever Proposed to Reverse Global Warming.* Penguin Books. 2017.

2. Ibid.

3. Hawken, P., Ed. 2017.

4. *Responding to Climate Change in New York State ClimAID. NYSERDA*. www.nyserda.ny.gov/climaid.

5. Ibid.

6. Haeckel, Ingrid, and Laura Heady. *Creating a Natural Resources Inventory: A Guide for Communities in the Hudson River Estuary Watershed*. New Paltz, NY: New York State Department of Environmental Conservation. Hudson River Estuary Program. 2014.

7. *Mid-Hudson Regional Sustainability Plan.* May 2013.

http://hudsonvalleyregionalcouncil.org/mid-hudson-regional-sustainability-plan/.

8. *Responding to Climate Change in New York State (ClimAID) - NYSERDA,* www.nyserda.ny.gov/climaid.

9. There are multiple causes of eutrophication, such as the decay of aquatic plants following treatment with n herbicide, the turnover of oxygen-poor bottom waters following a thunderstorm, or the runoff of organic fertilizers after a heavy rain.

10. *Fish Kills: Their Causes and Prevention.* http://pubs.ext.vt.edu/420/420-252/420-252.html

11. *Mid-Hudson Regional Sustainability Plan.* (May 2013). http://hudsonvalleyregionalcouncil.org/mid-hudson-regional-sustainability-plan/.

12. "The Colors of Sunset and Twilight." *THE COLORS OF TWILIGHT AND SUNSET* - Stephen F. Corfidi, www.spc.noaa.gov/publications/corfidi/sunset/.

13. Since 1970, the steady rise in temperatures in New York State is greater for winter months at 1.1°F/ decade, than the annual average increase rate of 0.6 °F/decade. "NYSERDA." *Responding to Climate Change in New York State (ClimAID) - NYSERDA,* www.nyserda.ny.gov/climaid.

14. Smith, C. S. *How a Changing Climate Helps Add Color to a Leaf Peeper's Paradise*. The New York Times. P. A20. Nov. 3, 2016.

15. Julius, S. H. et al. *Climate Change and U.S. Natural Resources: Advancing the Nation's Capacity to Adapt.* Issues in Ecology. Number 18. Fall 2013. www.esa.org/esa/wp-content/uploads/2013/12/Issue18.pdf

16. "Invasive species" means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health. Feb 8, 1999. Executive Order 13112 https://www.gpo.gov/fdsys/pkg/FR-1999-02-08/pdf/99-3184.pdf

17. *Comprehensive Plan: Town of Pound Ridge, NY.* Adopted Nov. 4, 2010.

18. *Mid-Hudson Regional Sustainability Plan. Final-May 2013.* http://hudsonvalleyregionalcouncil.org/mid-hudson-regional-sustainability-plan/. Or https://app.luminpdf.com/viewer/eWZgeQhir66eSKRyh

19. *Clean Energy Communities Program* https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Communities

20. *Clean Energy Communities & Climate Smart Communities Certification Program.* http://southerntiersolarworks.org/wp-content/uploads/2016/08/CEC_CSC_Related_Actions.pdf

21. *A Guide to Local Action: Climate Smart Communities* https://www.dec.ny.gov/energy/50845.html

WORKS CITED

A Guide to Local Action: Climate Smart Communities https://www.decny.gov/energy/50845.html

Clean Energy Communities & Climate Smart Communities Certification Program. http://southerntiersolarworks.org/wp-content/uploads/2016/08/CEC_CSC_Related_Actions.pdf

Clean Energy Communities Program https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Communities

Comprehensive Plan: Town of Pound Ridge, NY. Adopted Nov. 4, 2010.

Corfidi, S. F. *The Colors of Sunset and Twilight*. Sept. 2014. www.spc.noaa.gov/publications/corfidi/sunset/.

Executive Order 13112. Definition of invasive species. https://www.gpo.gov/fdsys/pkg/FR-1999-02-08/pdf/99-3184.pdf

Fish Kills: Their Causes and Prevention. http://pubs.ext.vt.edu/420/420-252/420-252.html

Haeckel, Ingrid, and Laura Heady. *Creating a Natural Resources Inventory: A Guide for Communities in the Hudson River Estuary Watershed.* New Paltz, NY: New York State Department of Environmental Conservation. Hudson River Estuary Program. 2014.

Hawken, P., Ed. Drawdown: *the Most Comprehensive Plan Ever Proposed to Reverse Global Warming.* Penguin Books. 2017.

Julius, S. H. et al. *Climate Change and U.S. Natural Resources: Advancing the Nation's Capacity to Adapt.* Issues in Ecology. Number 18. Fall 2013. www.esa.org/esa/wp-content/uploads/2013/12/Issue18.pdf

Mid-Hudson Regional Sustainability Plan. May 2013. http://hudsonvalleyregionalcouncil.org/mid-hudson-regional-sustainability-plan/. Or https://app.luminpdf.com/viewer/eWZgeQhir66eSKRyh

Rosenzweig et al. (2011); Horten et al. 2014. *Responding Climate Change in New York State ClimAID. NYSERDA*. www.nyserda.ny.gov/climaid.

Rustad, Lindsey and John Campbell, Jeffrey S. Dukes, Thomas Huntington, Kathy Fallon Lambert, Jacqueline Mohan, and Nicholas Rodenhouse. Changing Climate, Changing Forests: The Impacts of Climate Change on Forests of the Northeastern United States and Eastern Canada. USDA Forest Service Report NRS-99. 2014. https://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs99.pdf

Smith, C. S. *How a Changing Climate Helps Add Color to a Leaf Peeper's Paradise.* The New York Times. P.A20. Nov. 3, 2016.

Water **Resources**

Spring Thaw on Blue Heron Lake
M. Shapiro 2017

At a Glance

Water Resources

Water, in the form of rain or snow, determines the beauty and diversity of the natural world that surrounds us. It fills ponds and streams, lakes and reservoirs; it supports our deciduous woodlands, hemlock forests, and meadows. At times stormwaters and floods challenge us. Water supports our physical and emotional well-being: our survival depends upon it. Despite our vital need for it, water is perhaps our most undervalued renewable resource. Perhaps because it is replaced through the water cycle, we take for granted how it travels underground, fills our wells, flows from our taps for drinking, cooking and bathing, and then carries waste out of our homes into septic systems. Up to now, water where we live has been abundant.

This narrative accompanies the Town Geospatial Information System (GIS) viewer and bridges two key Town documents:

TOWN GIS

The Town GIS viewer, accessible on the Town website, provides information about our water resources in several different ways. Various base maps allow the viewer to use information from Digital Elevation and Surface Models, Aerial and Google maps, and Environmental Systems Research Institute Imagery (ESRI). Presently data layers related to water resources are located under two major headings: Westchester County Environmental Features and Pound Ridge. Additional data layers and shapefiles (file format used by GIS) are added to the Town GIS viewer as they become available. Data layers may also be found in the DEC Natural Resources and Environmental Protection Maps. Because the sources of layers on the Town's website are poorly identified, a shortcoming of the service provider, the Conservation Board developed a Data Warehouse to accompany the Natural Resources Inventory (Appendix A).

PURPOSE

Water Resources

The purpose of this narrative is to provide (1) an inventory and general assessment of the health of our waters, (2) sources of information, and (3) recommendations for residents, Town officials, and planners. The development of this narrative was partially funded with a grant from the New York State Environmental Protection Fund through the NYSDEC Hudson River Estuary Program. It was prepared by the Town's Conservation Board and drawn from various complementary, but not necessarily comprehensive, sources. The narrative contains the most current information available and identifies data gaps. It should not be considered complete as water is always on the move, water quality can change quickly, and new information is always being collected. All data need to be reviewed and verified by the user at the time of use.

Water
Ross Lowell

It is important to remember the limitations of all base maps and data layers. All maps and data layers provide approximate locations and extent of surface and underground features. They are inherently inaccurate and not a substitute for site visits, on-the-ground delineation, or surveys. While the data are updated periodically, it may not always be current and should be used for illustrative purposes only. The User's Agreement for the Town GIS specifies: "Any use of the information contained herein should be accompanied by (1) a reference to its source, (2) a caveat that the Town of Pound Ridge makes no warranties, guarantees, or representations to the accuracy or completeness of this information, and (3) a statement that the information contained herein is NOT a legal description."

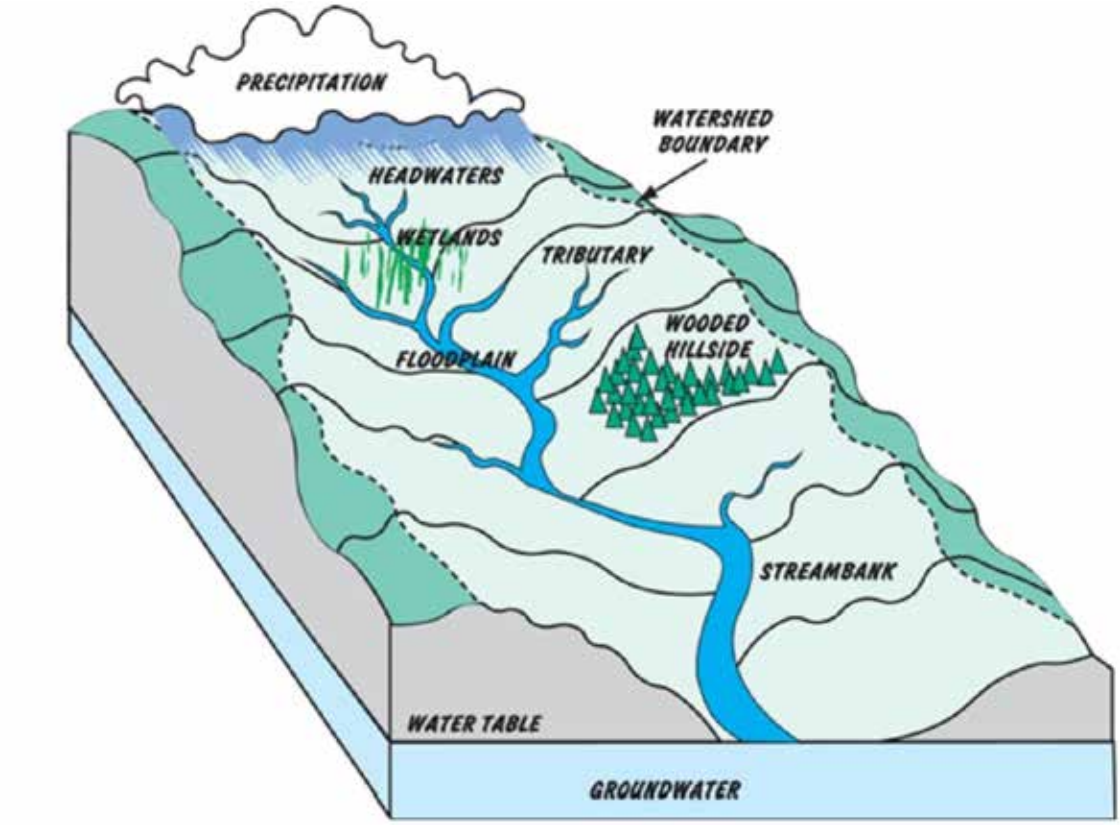
KEY TOWN DOCUMENTS

1. *Land Use Through Ecology: A Case Study of Pound Ridge, New York* (1980) is also referred to as the PRUP (Pound Ridge United for Planning) Report. The information it provides on 11 watersheds in our area continues to be relevant 39 years later. The project on which the study is based was executed by Jerzy E. Glowczewski, a noted innovator in the field of ecological land use planning, upon commission from Pound Ridge United for Planning.

The multiple ways to access the report are:
(1) purchase a copy through Pound Ridge Historical Society
(2) borrow a copy of the report from the Pound Ridge Library
(3) go online to the Town website http://www.townofpoundridge.com/sites/default/files/fileattachments/appendixe_land_use_through_ecology.pdf.
(4) refer to Appendix E in *Comprehensive Plan*, Town of Pound Ridge, New York (adopted November 4, 2010)

2. The Town's 2010 *Comprehensive Plan* represents a rewriting and updating of the goals found in the 1981 *Town Plan of Development* and addresses: residential and nonresidential land use, community services, facilities and recreation, natural resources, open space, transportation, community character, and historic preservation. The *Comprehensive Plan* is available on the Town website. A hard copy is available at the Town House. The reader will find it helpful to have a copy of the *Comprehensive Plan* at hand while using this document.

In writing this narrative, the Conservation Board relied heavily upon *Creating a Natural Resources Inventory: A Guide for Communities in the Hudson River Watershed* by Ingrid Haeckel and Laura Heady.



A schematic of a watershed
Source: Allegheny County Conservation District

ACRONYMS, ETC. ASSOCIATED WITH WATER TESTING

COND	CONDUCTIVITY
DO	DISSOLVED OXYGEN
HAA	HALOACETIC ACIDS
MTBE	METHYL TERTIARY BUTYL ETHER
NO3	NITRATES
P	PHOSPHATES
PCE	TETRACHLOROETHENE
PCB	POLYCHLORINATED BIPHENYL
PH	A SCALE FOR INDICATING LEVELS OF ACIDITY
THM	TRIHALOMETHANES
TOC	TOTAL ORGANIC CARBON
TURB	TURBIDITY

AQUIFER

An aquifer is an underground geological formation that can store and yield water. In Pound Ridge, the aquifers are mainly in bedrock where the water is found in cracks and joints or in the permeable rock. The top of the water level in an aquifer is called the water table.

Aquifers fill with water from rain or melted snow that has moved into the ground. In some areas, water passes through soil on top of the aquifer; in others, it enters through joints and cracks in rocks. The water then moves downward until it meets less permeable rock.

Aquifers act as reservoirs for groundwater. Wells drilled into aquifers provide water for drinking, agriculture and industrial uses. However, a well can dry up when people drain them faster than nature can refill them. This is a particular concern during extended periods of drought, one of the predicted impacts of climate change for our area. In addition, because aquifers fill with water that drains from the surface of the earth, a well can be contaminated by chemical or toxic substances found on the surface. Contaminants picked up on the surface are filtered and cleaned, to a certain degree, as groundwater travels through the aquifer.

AQUIFER RECHARGE AREA

The land surface principally contributing water to an aquifer is called the aquifer recharge area. Protecting the aquifer recharge area helps maintain water quality and quantity.

IMPERVIOUS OR IMPERMEABLE SURFACE

Any material that significantly reduces and prevents natural infiltration of water into the soil is impervious. Examples include, but are not limited to, roofs, patios, balconies, decks, streets, parking areas, driveways, sidewalks and any concrete, stone, brick, asphalt or compacted gravel surfaces. Impervious surfaces are a major threat to aquifer recharge areas as they impede the absorption of water.

POROUS SUBSTANCES AND PERMEABLE (PERVIOUS) SURFACES

Substances that permit water to enter by virtue of their porous nature or large spaces are porous. Those that allow water to pass through are pervious or permeable. Rocks, soils, and building materials differ in porosity and permeability. One of the main, permeable, water bearing rock formations in Pound Ridge is the Inwood Marble.

WELLHEAD PROTECTION AREA

A wellhead protection area, usually a subset of the larger aquifer recharge area, is the area surrounding and upgradient of a public water supply well or well field. Wellhead protection programs seek to limit contaminants within the area to limit risks to groundwater quality.

WATERSHED

A watershed is an area of land where all precipitation and surface or groundwater drains to a common outlet such as the mouth of a stream or the outflow of a reservoir or a bay. The ridges, hills, or higher elevations that separate two watersheds comprise the drainage divide. Larger watersheds contain many smaller watersheds. Watersheds are also referred to as drainage basins.

GROUNDWATER AND OUR WELLS

Private wells provide the potable water used in Pound Ridge. When a home is built, a well is drilled and groundwater seeps through the cracks and fractures of the bedrock to fill it with water. Bedrock, in contrast to unconsolidated sediments like sand and gravel, is more difficult to use as an aquifer and is a limiting factor in the development of Pound Ridge. The **Aquifer Map** is provided by Westchester GIS.

WELL TESTS

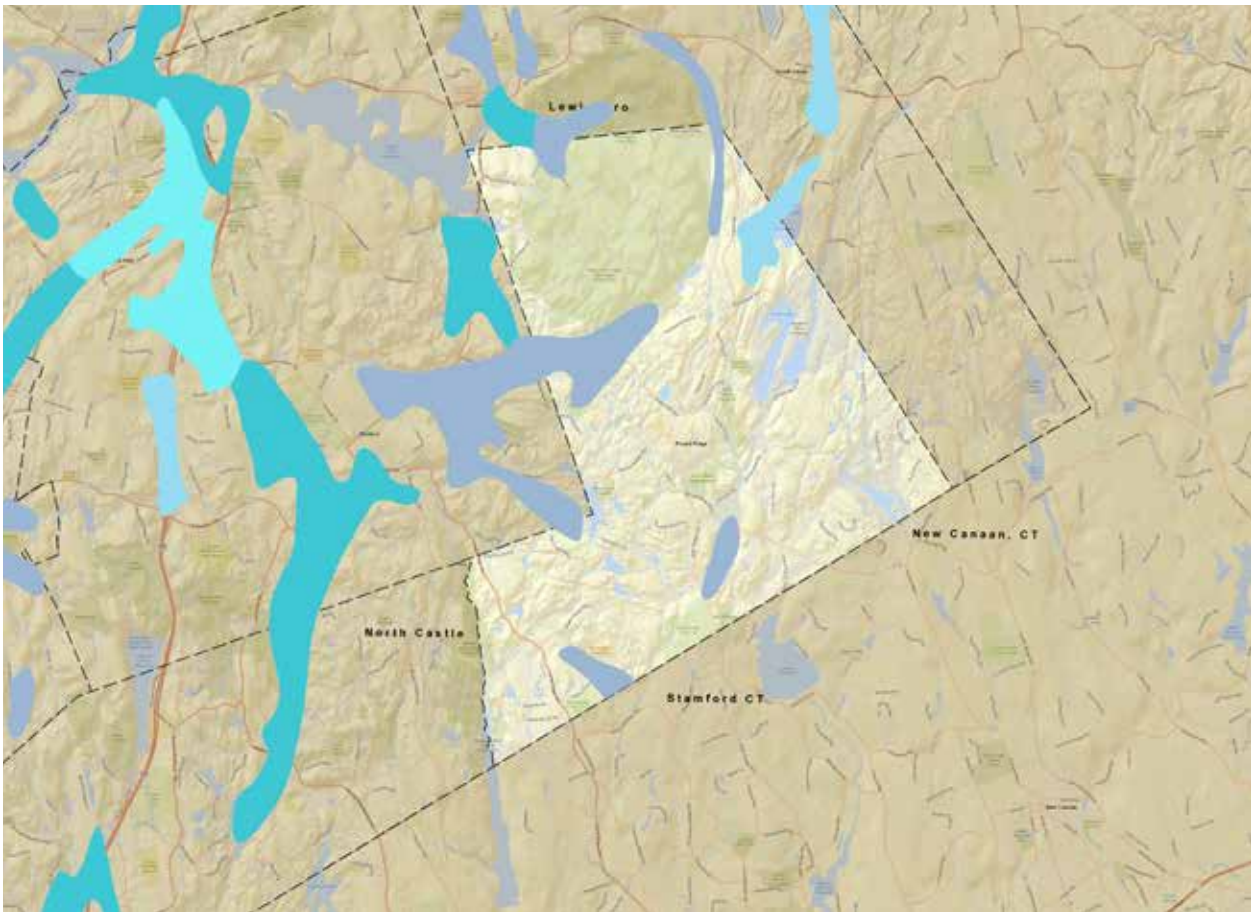
A water test is the only way to be assured water is safe to drink. The Private Well Water Test Law (PWTL) requires that a water test be conducted upon signing a contract of sale for any property served by a private well. The law also requires such testing on an ongoing basis for leased properties and prior to the use of water from new wells. The water test must be conducted by a certified laboratory. For more information on PWTL, visit the Westchester County Health Department website at: http://health.westchestergov.com/private-well-water.

Generally determining if private well water is safe to drink is the responsibility of the homeowner. As water is always on the move, it is recommended that wells be tested at least once a year. For more information about our water, the testing of drinking water, well maintenance, and water treatment systems, refer to *We Are All Connected* at: http://www.townofpoundridge.com/conservationboard/we-are-all-connected.

In *We Are All Connected*, three tables summarize information about common contaminants, water treatment systems, and troubleshooting. Frequently Asked Questions (FAQ) are included.

QUANTITY: AQUIFER DEPLETION

If a well runs dry, it may be a temporary situation and corrected by minimizing use of water for 24 hours. Regional aquifer depletion is rare in New York and the low population density of our community is a safeguard against aquifer depletion. In high density areas, impermeable surfaces such as buildings, parking lots, and roads can interfere with groundwater recharge. The *Comprehensive Plan* includes many recommendations regarding zoning laws, land development regulations, inventories, and studies associated with impervious surfaces and groundwater recharge (p. B-11; C 8-9).



Quick Reference: Aquifers

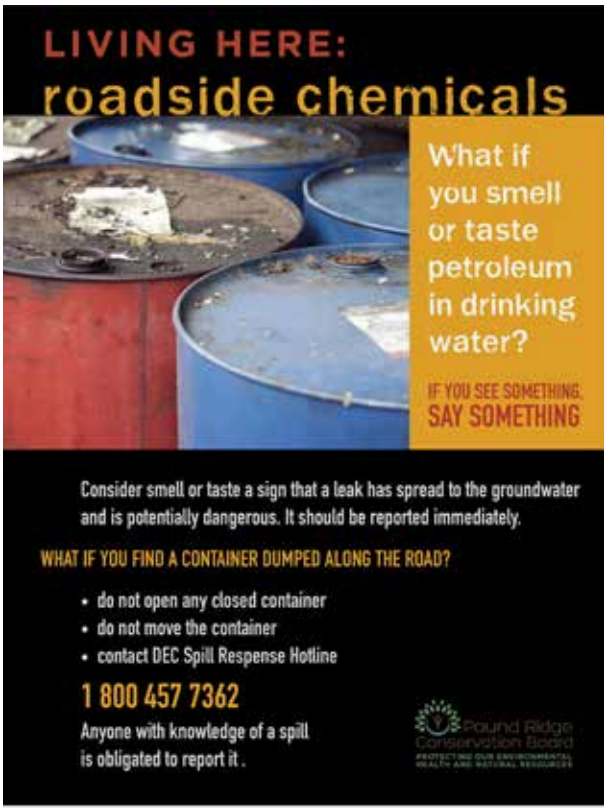
QUALITY: GROUNDWATER CONTAMINATION

Groundwater pollution can be caused by multiple sources including chemical spills, leaking underground storage tanks and septic systems, road salt, common household chemicals, pesticides, fertilizers, and other chemicals. Sources of water pollution are often described as nonpoint or point source pollution.

As defined in the Clean Water Act, Section 502, nonpoint source pollution (NPS) generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage, or hydrologic modification. NPS pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources such as rainfall or snow melt moving over and through the ground. As the runoff flows, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and groundwaters. The term "point source" means any discernible, confined and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.

In Pound Ridge, groundwater quality has been adversely impacted by a plume of MTBE (methyl tertiary butyl ether, an additive to gasoline) in Scotts Corners (1994), pesticide impact from the Pound Ridge Golf Course, and by the Town's use of road salt (circa 2002).

There are no permitted discharge points in Pound Ridge, but there have been spills and leaks from underground storage tanks and commercial activities. In 2016, with funds from the NYSDEC Hudson River Estuary grant for stewardship, the Conservation Board contracted with Toxics Targeting, Inc. to provide a comprehensive inventory of underground toxic sites, perhaps making Pound Ridge the first town in the state to have such an inventory. The report, based upon a review of two key databases, including Westchester County Petroleum Bulk Storage and NYS hazardous substance leaking tanks and spills, confirmed that harm to the environment in Pound Ridge has been minimal. A record of all reported spills (2017) is now available to serve as a baseline and reference. The *Toxic Targeting Report* can be reviewed by request at the Town House.



Conservation Board Announcement
S. Levethan 2017

Issues identified by a review of the *Toxic Targeting Report* include:

1. Residential tank failures or leaking underground storage tanks (UST) have contaminated more than 1,500 tons of soil in our community. When a spill occurs, the soil is removed to remediate the damage and the homeowner is responsible for the cost of the clean-up. For more information about residential underground oil tanks, visit the Town's website at http://www.townofpoundridge.com/conservationboard/underground-oil-tanks-removal-and-replacement. The importance of removing an older underground heating oil storage tank and replacing it with an above-ground tank cannot be overstressed.

2. Oil company spills due to over filling tanks are typically small. Generally, the oil company reports the spills and manages the clean up.

3. NYSEG electrical transformers on telephone poles can be damaged by storms or vehicular accidents. Clean-up of spilled PCB (polychlorinated biphenyl) is the responsibility of NYSEG. Pound Ridge Office of Emergency Management (OEM) has maps of the locations of all transformers.

4. Bulk Petroleum Storage Tanks and/or hazardous materials are under New York State regulation.

The petroleum bulk storage program applies to facilities that store more than 1,100 gallons of petroleum in above-ground and underground storage tanks. Facilities with one or more underground storage tanks larger than 110 gallons must also be registered. All tanks (with some exceptions) for the storage of petroleum at facilities must be registered with the DEC and managed in compliance with applicable regulations for the storage and handling of petroleum.

The chemical bulk storage program applies to facilities that store a "hazardous substance" listed in 6 NYCRR Part 597 in an above-ground storage tank larger than 185 gallons, any size underground storage tank, with some exceptions, or in a non-stationary tank used to store 1,000 kg or more for a period of 90 consecutive days or more. All regulated tanks at facilities must be registered with the DEC and managed in compliance with applicable regulations for the storage and handling of hazardous substances.

Bulk petroleum storage tanks are periodically inspected by Westchester County. The storage of hazardous materials (e.g., pool chemicals) is under the supervision of the Westchester County Department of Health and storage of pesticides is under the supervision of NYSDEC.

Conservation Board Announcement
S. Levethan 2017

In Pound Ridge, bulk storage is located in several areas:

- in the business district, there is currently a gas station, an auto repair shop, and a dry cleaner
- in the past, there were three gas stations and two dry cleaners. A history of spills has created a complicated spill site between 60-80 Westchester Avenue. The history of the area and nature of the contaminants (MTBE and PCE) suggest spills originated from a former Shell station (currently Sunoco at 66 Westchester Ave), a dry cleaner (72 Westchester), and Texaco station (77 Westchester, which no longer sells gasoline, but operates as a car repair business)
- in the Hamlet, bulk storage tanks can be found at the Pound Ridge Elementary School, Pound Ridge Nursery, Pound Ridge Auto, Highway Department, Town Park, and the Town House
- other bulk storage sites are found at Rockrimmon Country Club, Pound Ridge Golf Club, and Marshall Oil. Marshall Oil is currently studying the feasibility of converting to above-ground storage.

5. Other:

- inactive dump at Ward Pound Ridge Reservation (1950s-1986)
- abandoned drums along High Ridge Road, near the intersection of Upper Shad Road (removed 2015).

Local issues – leaking underground storage tanks and septics, plus the use of road salt, common household chemicals, and fertilizers – are acknowledged in the *Comprehensive Plan* (p. C-5) as well as the impacts of certain landscaping practices (increased lawn size and use of irrigation systems on timers), impervious surfaces, failure to protect small wetlands and vernal ponds, and improperly spaced or poorly installed systems. The *Comprehensive Plan* includes many recommendations (p. C-8 to C-12), to address these issues. In addition, it is recommended that the Town conduct a basic inventory of its own fuel storage tanks (location, tank size, material, installation date, inspection schedule, etc.) and establish an appropriate schedule for assessing storage tank integrity. Other recommendations are referenced in sections that follow.

In downtown Scotts Corners
C. Reppert 2016

WELL DATA

Unfortunately little information is available regarding the overall health and quality of the water in our wells.

Well Records: The Westchester County Department of Health maintains well records, but at this time the well records have not been digitized. The **Water Well Program Map** provides only a few data points and is available on the Town website (Pound Ridge, NY>Water Resources Map>Water Well Program Map https://goo.gl/YVjxt4).

Data regarding water wells have been collected since April 2000 as required by Environmental Conservation Law (ECL) 15-1525. This information is developed from well completion reports submitted to New York State's Department of Environmental Conservation (NYSDEC) and is not always verified. Information is subject to change at any time. The user assumes all risk and liability in using this information. Many wells do not have horizontal coordinates, but are included on the attribute table. These wells may or may not have partial address information available.

As well data accumulate, clusters of data could be analyzed and possible sources of contamination, such as septic failure or road salts, identified.

An ongoing inventory of well data have been recommended in the *Comprehensive Plan* (p. C-9).

Aquifer Studies: Some communities conduct an aquifer study and one was recommended in the *Comprehensive Plan* (p. C-8). An aquifer study generally identifies aquifer types, locations, and yields. From an aquifer study, a water budget comparing the yield of the aquifer with the need of the population served over 20, 30, or 40 years can be developed. The details of an aquifer study are used when a town provides water to determine how much development can be sustained. An aquifer study is not particularly applicable in most circumstances since the Town of Pound Ridge (Conservation Board Minutes 4.1.2015) does not supply water to residents, residential zoning is typically between two to four acres, and available land for large-scale development is limited. Possible situations calling for an aquifer study might be:

- in Scotts Corners, for a variety of reasons including, its location, concentration of buildings and impermeable surfaces, water supply demand, spill history
- if a large-scale development were proposed in Pound Ridge, an aquifer study would be required under the State Environmental Quality Review Act (SEQRA). The Town's approving agency would use the study to determine potential impacts on the aquifer. The Town and residents can use information gained from the SEQRA study for their own purposes
- if there were a significant spill.

Wellhead Protection Areas: A wellhead protection area, usually a subset of the larger aquifer recharge area, is the area surrounding and up gradient of a public water supply well or well field of interest. Wellhead protection programs seek to limit contaminants in such areas to limit water quality risks to wells serving the public. In theory, all of Pound Ridge should be viewed as a wellhead protection area.

Replicating a Town study: In 1974 and 1976 the Town conducted an extensive water quality study addressing both surface water and groundwater (referenced in the *Comprehensive Plan* 2010, Appendix D, p. 23). The detailed results of the study are on file at the Town House and described in the *Water and Land Resource Study.* The study includes a listing of severely stressed and moderately stressed areas (see summary in *Comprehensive Plan*, Appendix D, p. 26-27). Since water quality conditions can rapidly change, replicating this study is highly recommended. Comparing existing data and newly collected data at the same sites, following the same or improved protocols, would add to our understanding of trends and areas of concern. Since Pound Ridge is the headwaters for many streams, this would be of value to others. Costs estimates for replicating this study and funding sources should be pursued.

SAFEGUARDING OUR WATER

In a town largely comprised of individual homeowners, it is what residents do or do not do that has the greatest impact on water quality. Throughout this narrative are

recommendations and Best Management Practices (BMP) for the care of our water. For example, homeowners can prevent contaminants from getting into our water and support the natural processes that clean our water by the following means:

- minimize lawn size by planting trees, shrubs, and other perennials
- capture water from impervious surfaces (roofs) with rain barrels; and/or redirect runoff with gutters and downspouts
- reduce stormwater runoff or sheet runoff from sloped properties and/or impervious surfaces with a rain garden
- minimize the use of fertilizers and pesticides
- dispose of harmful materials properly
- understand the basic functioning of a septic tank and have it emptied regularly as required by Westchester County law
- value the purpose of the Town ordinances and abide by them
- participate at the Town level by attending meetings or serving on the boards and commissions that protect our Town resources and in volunteer efforts to monitor water quality, assess problems, and prioritize efforts.

Many helpful documents are on the Conservation Board's webpage (http://www.townofpoundridge.com/conservationboard):

- *Pound Ridge: The User's Guide*
- *Water and Septic Systems*
- *We Are All Connected*
- *Underground Oil Tanks*
- *Home and Garden*

In addition, many residents serve as elected, appointed, and volunteer members of Town boards, committees, and task forces. In these roles, they share the responsibility for protecting our water resources by issuing discretionary actions, such as building permits, zoning updates, and open space planning. A commitment to protecting our water and watersheds entails recognition of the value and limitations of the maps on the Town website. Maps do not substitute for detailed surveys and site visits. It is incumbent upon Town decision makers to use all available information throughout the decision-making process, including the many recommendations in this narrative and the *Comprehensive Plan* regarding groundwater recharge and watershed protections. To further safeguard our water, ordinances should be reviewed every 10-15 years and aligned with best practices.

CASE STUDY

WASTEWATER TASK FORCE

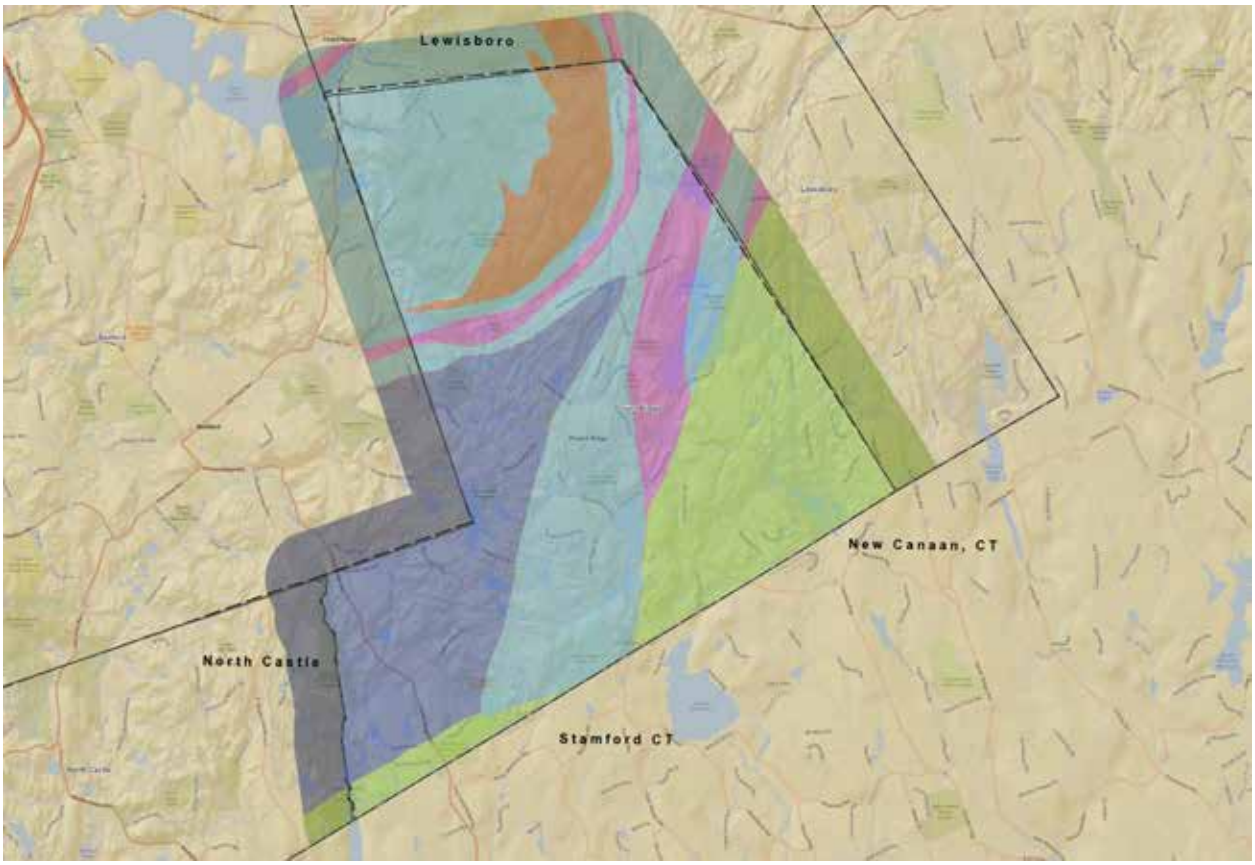
In 2015, The Pound Ridge Town Board authorized the formation of the Wastewater Task Force to develop potential solutions to the problems associated with septic systems in Scotts Corners, the Town's business district. A number of septic systems are aged, known to be overtaxed and in danger of failure. The Scotts Corners watershed discharges into Laurel Reservoir, which is part of the drinking water system serving the city of Stamford, CT.

The Task Force has used the Town GIS maps for both natural and constructed resources. The natural resources include watercourses, wetlands, floodplains, hydric soils, and wooded areas. The constructed features include roads, buildings, drinking water wells, septic systems, and regulatory setbacks for wetlands and well construction. The GIS data serve as the basis of an initial identification of possible locations for more advanced septic treatment and subsurface discharges. The Task Force has gathered more detailed well and septic data from Westchester County that can be added to the Town GIS. In the future, the Task Force will use the Town GIS to tell the technical story in non-technical terms to the Town Board and the public. (August 2016)

Wastewater Task Force
C. Reppert 2018

Back row, left to right: Max Mosolino, Phil Sears, Ellen Ivens. Front row, left to right: Ted Dowey, Diane Briggs, James Best, Pete Marchetti

BEDROCK AND SOILS



Quick Reference: Bedrock Geology

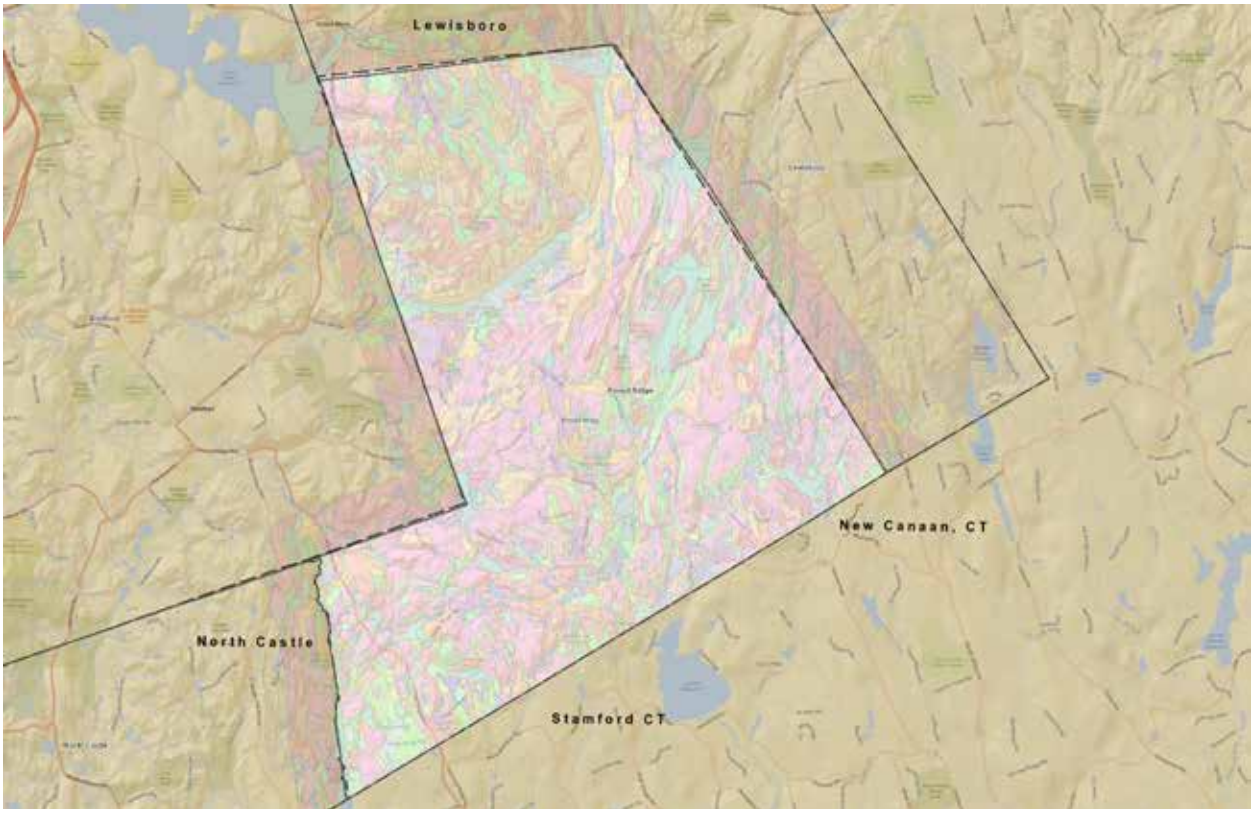
BEDROCK GEOLOGY

In addition to the **Bedrock Geology Map** above, several geology maps are available on the Town GIS, under Pound Ridge> Geology and Soils: **State Geology Map**, **Surficial Geology Map**, and **Geology Map**. The geology of a region directly or indirectly influences water features, hydrological activity, and water quality.

The geology of Pound Ridge is referenced in *Town of Pound Ridge: Environmental Synthesis Report* by F.P. Clark Associates as the "silent partner" in the Town's development and ongoing planning discussions. This report, available in the Town's *Comprehensive Plan* (Appendix D, p. 2-8), when read with the geology maps on the Town GIS clearly describes the Town's geology. Since the five maps in the report are too small to be deciphered, the topography, geology, soil, vegetation and hydrology maps on the Town GIS restore value to the entire 38-page report.

Stacked glacial erratics
C. Reppert 2018

SOILS



Quick Reference: Soil-Map Unit

A **Soil Map Unit** is a collection of areas defined and named the same in terms of their soil components. The map unit symbol is the key to finding more information in text and tables at Natural Resources Conservation Service (nrcs.usda.gov).

For major soil groups, go to https://www.axisgis.com/Pound_RidgeNY/ then Westchester County Environmental Features>Soil Survey (USDA).

Different soil types vary in permeability and some are unsuitable for development. Soil data, while complex, have many practical applications to planning and provide valuable background concerning underlying structure. According to F.P. Clark Associates, the Town's soils may be grouped in the following structural categories:

- formed in glacial till: Deep Upland Soils, Upland Hardpan Soils, moderately shallow or extremely stony
- Upland Soils
- shallow in depth to bedrock: Upland Soils
- Glacial Stream Terrace Soils
- Alluvial Soils
- Organic Soils
- Urban Land (cut and fill or gravel pits)

Detailed descriptions are available in *Soil Survey of Putnam and Westchester* (US Department of Agriculture. Soil Conservation Service). For a synthesis of this information specifically for Pound Ridge, refer to *Land Use Through Ecology,* or the PRUP Report (1980), p.15, 26-27.

Appendix D is an enlarged version of the soil map legend.

Four additional maps on the Town GIS are:

Drainage Class Map: Drainage classes provide a guide to the limitations and potentials of the soil for field crops, forestry, range, wildlife, and recreational uses. The class roughly indicates the degree, frequency, and duration of wetness, which are factors in rating soils for various uses.

Flooding Frequency Map: The susceptibility of soils to flooding is an important consideration for building sites, sanitary facilities, and other uses. For example, floods may be less costly per unit area of farmland as compared to that of urban land, but the loss of crops and livestock can be disastrous.

Ponding Frequency Map: The susceptibility of soils to ponding, or unwanted pooling of water, is important for homes, building sites, and sanitary facilities. Time and duration of the ponding are critical factors in determining

plant species. Ponding during the dormant season has few if any harmful effects on plant growth or mortality and may even improve growth.

Farmland Class Map: Farmland classification identifies the location and extent of the most suitable land for producing food, feed, fiber, forage, and oilseed crops. Note: Prime farmland is designated independently of current land use, but it cannot be areas of water or urban or built-up land. The same would apply to farmland of statewide importance.

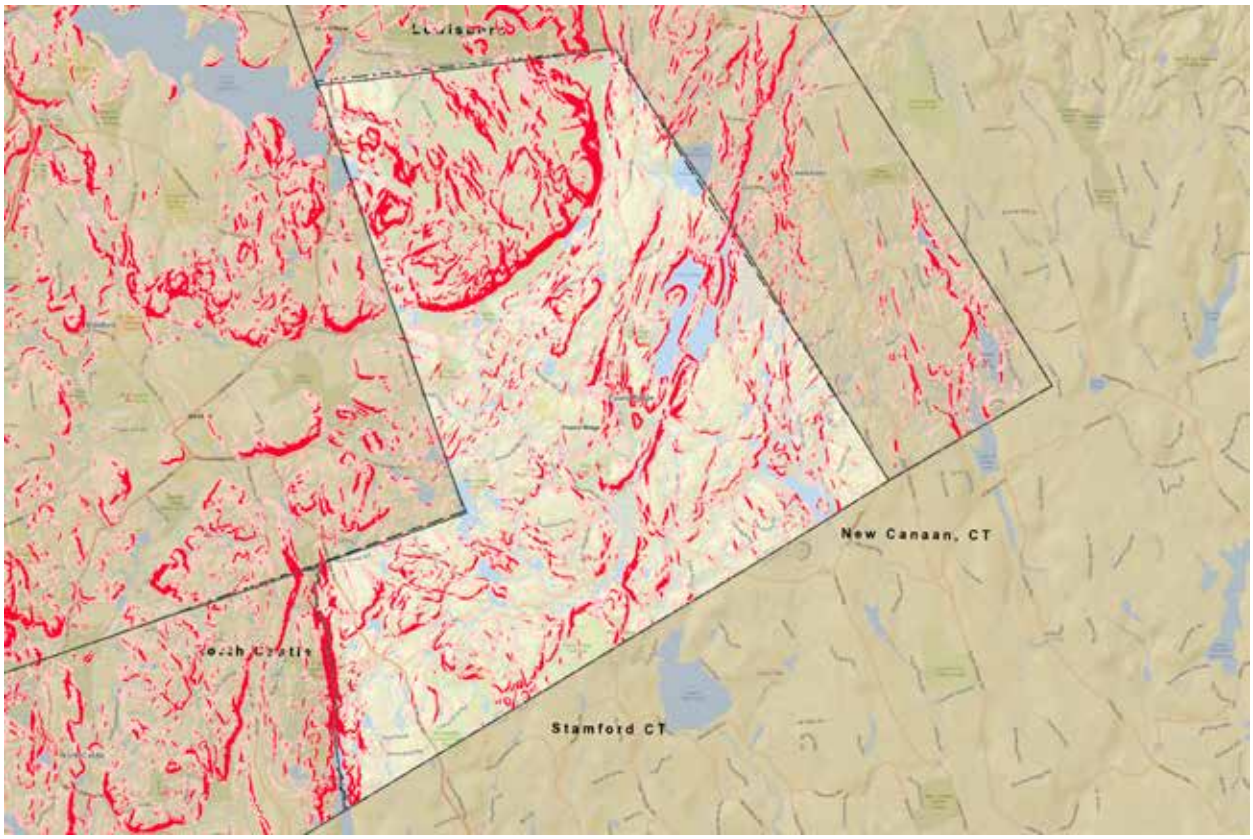
The following map is available on the Town GIS under Westchester Environmental Features:

Hydric Soils Wetlands Map: County soil survey data provide information about poorly drained and very poorly drained soils, which are commonly used indicators of probable wetlands. In general, the hydric soils maps tend to somewhat overestimate the acreage of wetland soils, due in part to the scale of the soils mapping (the smallest mapping unit is two acres).

For more information about soils and soil maps refer to the NRCS *National Soil Survey Handbook*. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054240#618

The Soil Survey Geographic Database (SSURGO) contains digital soil data from Natural Resources Conservation Services (NRCS) and is available on the NRCS Geospatial Data Gateway and the NYS GIS Clearinghouse. SSURGO contains digital soil maps in shapefile format, along with a separate tabular folder containing soil attribute data in .txt table format, and a template database in Microsoft Access .mdb format. The template database is designed to import the tabular files. Once the tabular database is set up, the spatial data shapefiles can be joined or related to the soil data tables.

TOPOGRAPHY



Quick Reference: Steep Slopes

STEEP SLOPES AND WATER

A slope is the inclination of the land's surface. Defining what constitutes "steep" for the purpose of slope regulation is at the discretion of each municipality, provided the definition is reasonable.

Pound Ridge Town Code (§ 113-22) states: *For the purpose of preventing erosion, minimizing stormwater runoff and flooding, preserving the Town's character and property values and protecting areas of prominent views,*

it is the intent of this chapter to prevent the inappropriate development of hilltops, ridgelines and steep slopes. For purposes of this section, steep slopes shall be considered to be those areas with a slope of or greater than 25% measured over any horizontal distance of 50 feet. Individual areas of steep slopes within 25 feet of each other shall be regulated as a single steep slope area.

New York State Department of Health prohibits septic systems on slopes greater than 15%.

Steep Slope Maps or inventories are easy to obtain and overlay over property lines but are not a substitute for on-site surveys or Town Code. The Town GIS links to Westchester County GIS, which provides two shapefiles, one indicating in color, slopes of 15-25% and 25% and the other showing two-foot contours. The steep slopes of the town's varied terrain are among the most sensitive environmental features in our landscape. Human activity speeds up the work of gravity and water on highly susceptible slopes.

In *Preserving Natural Resources Through Local Environmental Laws: A Guidebook for Local Governments,* steep slopes are defined as:

... areas that exceed a certain percent slope. Steep slopes are often associated with other environmental features such as rock outcrops, shallow soils, bedrock fractures, and groundwater seeps. Steep slopes are valuable resources and sensitive landforms that create microclimates where a diversity of organisms can thrive. The natural modification of slopes is extremely slow. Many factors and processes including climate, geology, hydrology, vegetation, weathering, and transport influence this process. Human activities can modify the natural slope system in a variety of ways. Excavations or building construction can promote instability by overloading the slope, removing vital support, and increasing pore-water pressures. Grading, cutting, and filling also modify the natural angle of repose or the maximum slope at which loose sediments will stand without sliding.

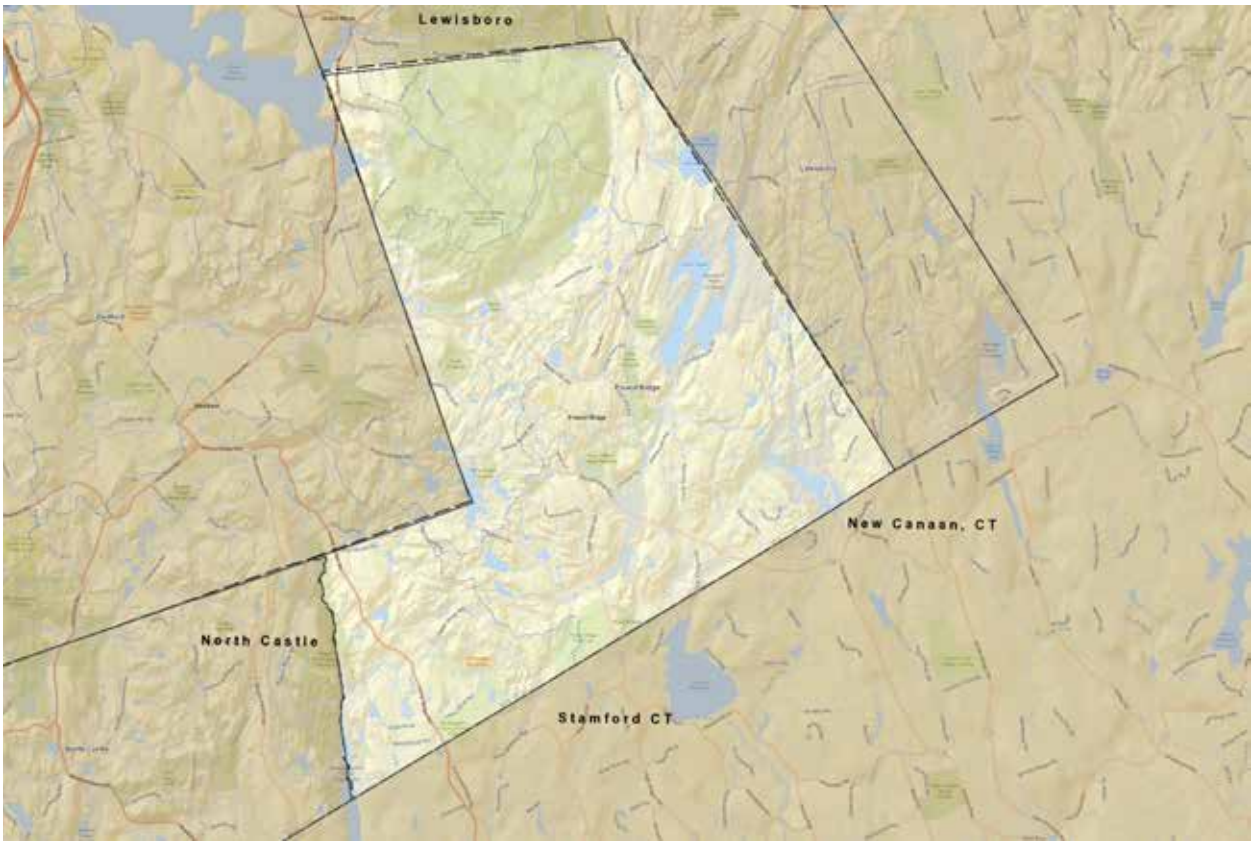
Since the kinetic energy of water increases as it travels down a steep slope, any disturbance of a steep slope is a concern to our town as it can:

- *Create hazards and public safety risks:* Increase the potential for roads and driveways to wash out; increase car accidents on icy sloped roads; and impede access of emergency vehicles
- *Damage property:* Cause erosion or land slippage damage to homes and property; increase runoff and sediment damage to downhill property; and contribute to stream instability, resulting in increased stream bank erosion
- *Harm water quality and habitats:* Increase transport of pollutants by runoff due to fewer opportunities for sediments to settle and/or be filtered by vegetation; increase potential for septic system failure
- *Raise costs to the community:* Increase need for road repair, maintenance of roadside culverts and ditches due to runoff issues; increase stream maintenance costs

In addition to codes, municipalities use a variety of approaches to regulate the use or disturbance of steep slopes. Some municipalities have started to increase their steep slope protection efforts by adding more than one set of zoning ordinance provisions or zoning overlays that address the use or disturbance of steep slopes.

Near the Pound Ridge Fire Dept.
C. Reppert 2018

WATERSHEDS AND DRAINAGE BASINS



Quick Reference: Drainage Basins

The terms watersheds, drainage basins, and catchment, along with subwatersheds and sub-drainage basins, are often used interchangeably.

DRAINAGE PATTERNS

Mapped watershed and drainage basin boundaries (divides) provide a quick visual reference of how surface waters relate to each other and features such as adjacent steep slopes or floodplains. Watershed boundaries provide logical units for evaluating surface water resources and reveal that issues such as water quality and water quantity commonly extend beyond property and political boundaries.

A divide, visible on the map as a diagonal line running from NE to SW, divides the town. The northern half of Pound Ridge (41%) lying within the Croton River Basin, drains into the Hudson River Estuary and provides drinking water for millions of people in lower Westchester and New York City. The southern half of Town (59%) drains via two watersheds, the Mill River and the Mianus River, into the Long Island Sound Basin. These watersheds provide drinking water to Stamford, Greenwich, and many other Connecticut and New York communities.

A helpful interpretive text of local drainage patterns is found in *Town of Pound Ridge: Environmental Synthesis Report* (F.P. Clark Associates.1978 *Comprehensive Plan* Appendix D, p. 2-8).

Under Westchester GIS, refer to **Major Watersheds Map** and **Drainage Basins Map**. Under Pound Ridge, water resources, refer to **Aquarion-Pound Ridge Watersheds Map**.

For planning purposes, it is often convenient to divide major watersheds into smaller watersheds, also referred to as subwatersheds or drainage basins. The PRUP report was based on dividing the Town into 11 subwatersheds (Table 1). This study differs from the NYS Waters Index. According to NYS Waters Index, there are 10 drainage basins: three drainage basins in the northern portion of town (Cross River Reservoirs, Lake Kitchawan, and Stone Hill River plus tributaries), with boundaries similar, but not identical to the PRUP watersheds, and seven drainage basins (Mianus, East Branch, Mill River, two parts of Laurel Reservoir, Siscowit, West Branch Silvermine)

in the southern portion of town. Appendix E is a guide comparing the NYS Waters Index and the PRUP Report. Not all of the ten NYS Waters Index drainage basins (particularly those draining into Connecticut) are clearly delineated; the best available watershed delineations are presented on the Town GIS. The Town GIS follows the NYS Waters Index.

LOCAL CONCERNS

Two reports on watersheds partially located in Pound Ridge, at opposite edges of town, serve to focus attention on concerns relevant to the area:

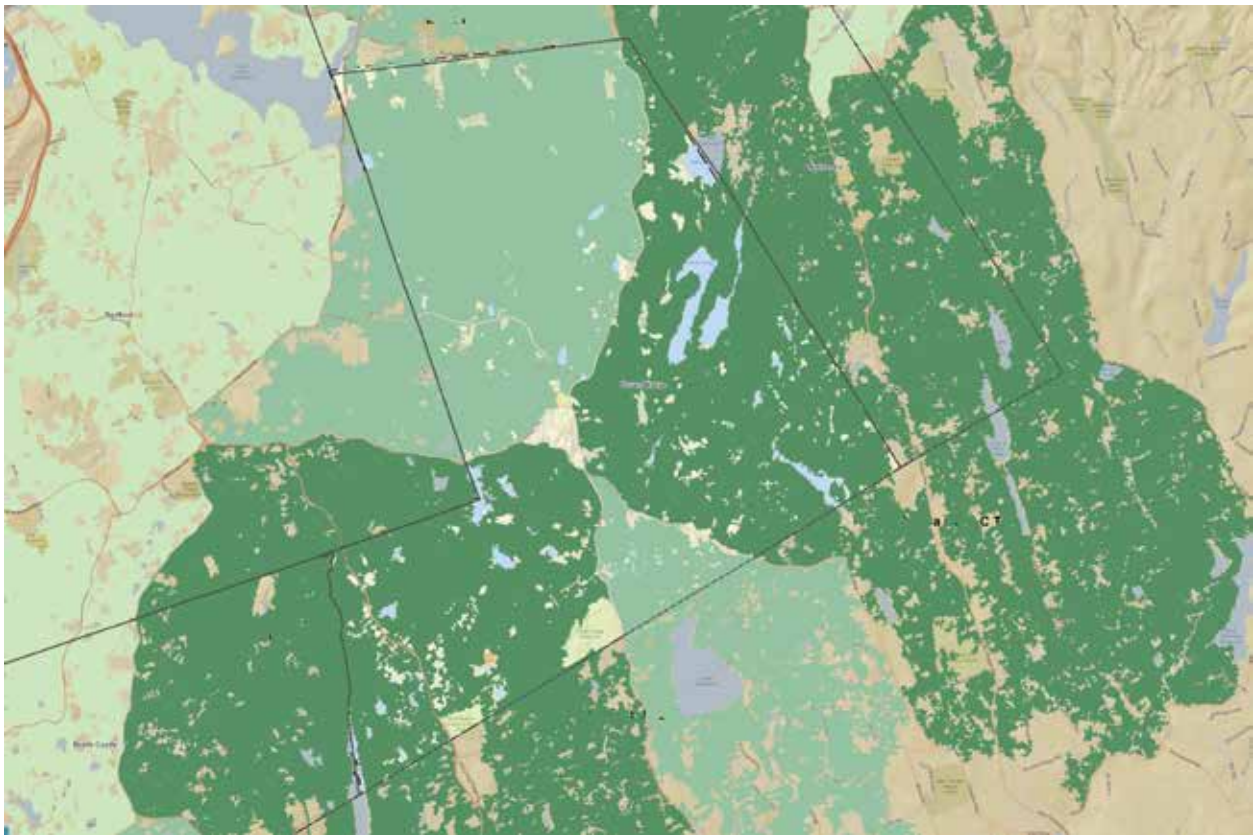
In 1999, a Riverkeeper report on the Croton watershed and two others, all providing New York City with drinking water, reported the watersheds were "suffering an onslaught of real estate development." Particular concerns impacting water quality were: impact of increased impervious surfaces associated with development and urban sprawl, construction of septics on steep slopes with 'cut and fill' methods, filling-in of wetlands, and the need for more advanced stormwater review programs with prevention plans and monitoring.

In 2012, similar concerns were expressed in the *Mianus River Watershed Based Plan*: Development in some locations within the Mianus River Watershed has resulted in less-than-ideal water quality and degraded natural habitats. Many of the land areas draining to the Mianus River (known as the Mianus River Watershed), particularly near Route 1, along Strickland Brook, and in and around Bedford Town Center, have experienced significant residential development. Stream assessments and water quality data suggest that streams flowing through more developed areas have lower water and habitat quality than streams flowing through less developed areas. As with many other rivers, urban land use has affected the Mianus River by changing the amount and pattern of water flowing to the Mianus River and creating new sources of pollution. Specifically, the introduction of impervious surfaces associated with urban development, such as rooftops, roads, driveways, and parking lots, have altered the flow of water through the watershed.

TABLE 1: SUBWATERSHEDS (PRUP REPORT)

SUBWATERSHED	ACREAGE	WATERSHED	SIGNIFICANT SURFACE WATER BODIES
Lake Kitchawan	442.9	Croton	Lake Kitchawan
Stone Hill	2,167.9	Croton	Stone Hill River
Blue Heron	633.8	Croton	Blue Heron Lake
Mill River North	1,908.1	Long Island Sound (Mill River)	
Mianus	1,139.5	Long Island Sound (Mill River)	
Siscowit	1,259.4	Long Island Sound	Siscowit Reservoir
Shad Roads	1,140.95	Long Island Sound (Mianus)	Branch Mianus River
Mill River South	2,293.0	Long Island Sound (Mill River)	Mill River, Mallard Lake
Barnegat	638.0	Long Island Sound (Mill River)	
Ward Pound Ridge	17,730.0	Croton	Cross River
Honey Hollow	734.4	Croton	Cross River

WATERSHEDS AND WOODLANDS



Quick Reference: Large Forest Patches

Our woodlands serve an incredible role in maintaining healthy watersheds, recharging our surface and groundwater supply, reducing stormwater, mitigating floods, and removing or filtering pollutants that would otherwise wind up in our water bodies, aquifers, and ultimately in us. These characteristics contribute to the health and safety of our community and minimize the need for public infrastructure to deal with storm water or water treatment.

The DEC **Large Forest Patches Map** identifies large swathes of forest patches. Almost all of Pound Ridge is covered by either "locally important (2,000-5,999 acres)" or "regionally important (6,000-14,999 acres)" forest patches. The relationship of forest size to forest-dependent species is further described in the Habitat report (Part I).

Maintaining forest cover benefits water quality as well as wildlife. The *Comprehensive Plan* contains recommendations for protecting our intact woodland (p. C-18), controlling the whitetail deer population (p. C-17), and regulating the removal of naturally-occurring vegetation (p. C-17).

Land utilization leading to forest fragmentation is primarily limited through building, wetlands, zoning, and subdivision regulations and by permanently protecting acreage as open space. In addition, increasing pressure from new challenges, such as the impacts of climate change and invasive species (plants, insects, and diseases), suggest the need for forest management plans for large forested tracks.

Although the ecological services provided by forests are widely accepted in the scientific community, they have not really been translated into the language that most often drives planning and land use decisions at the local level: Dollars. Local government officials often make difficult decisions about growth at the expense of natural resource conservation. These decisions are often made without the benefit of economic data that measure the true costs of development and the real value of natural resources.

SUPPORT WATER QUALITY

PLANT A TREE

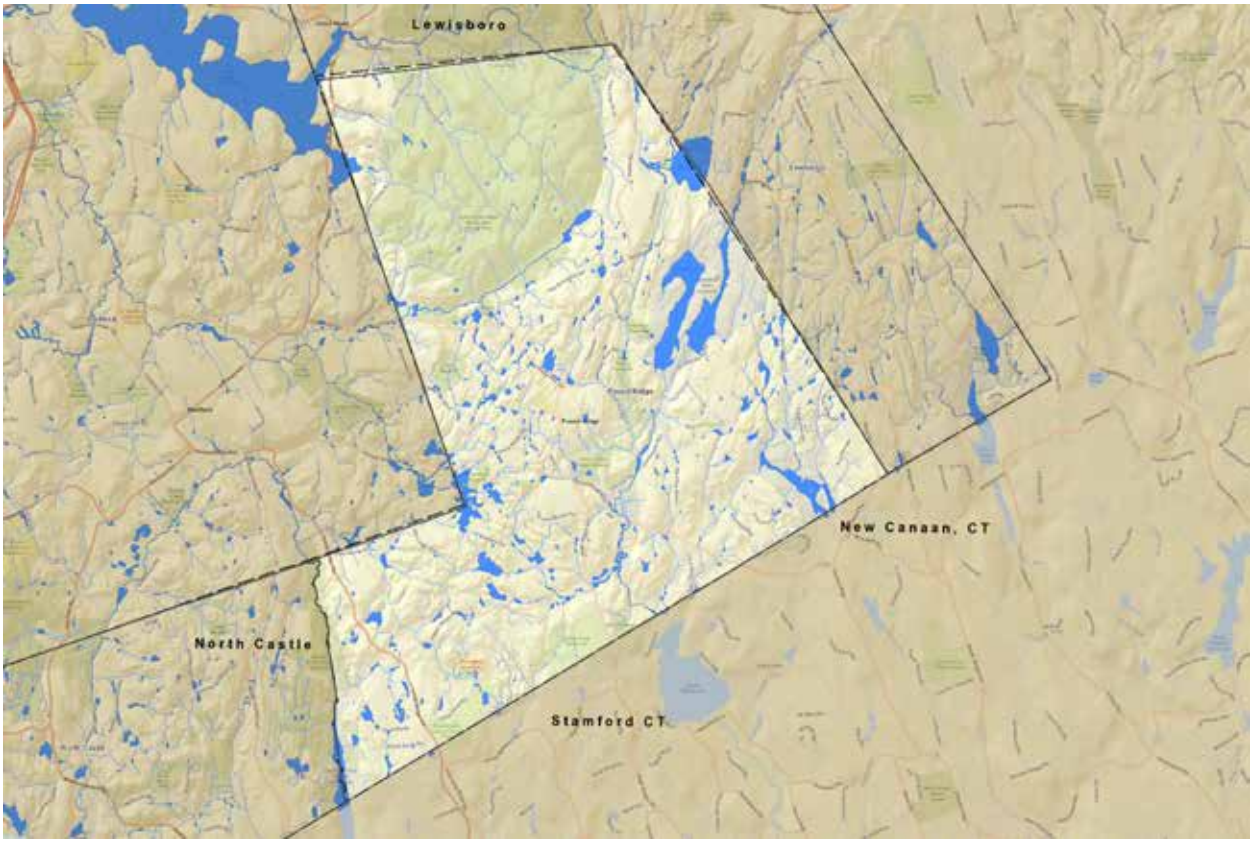
Homeowners support water quality when they plant a tree. A homeowner may plant a tree or shrub for its beauty and calming effect, or to provide privacy and reduce noise, but the benefits exceed those reasons and extend to the community. Trees and shrubs (especially native species) shelter wildlife, improve air quality, and protect the watershed as they intercept water, store some of it, and reduce stormwater runoff.

For more information about the important role of trees go to http://extension.psu.edu/plants/green-industry/landscaping/culture/the-role-of-trees-and-forests-in-healthy-watersheds.

Above: A native flowering dogwood
C. Reppert 2013

Below: Near 46 Westchester Avenue
C. Reppert 2018

SURFACE WATERS



Quick Reference: Lakes, Rivers, and Streams

LAKES, RIVERS, STREAMS

Our streams, rivers, ponds, lakes, reservoirs and riparian (streamside) areas do more than provide lovely vistas and viewsheds. These water bodies provide critical benefits to communities, including clean water, flood control, water storage, fishing, and wildlife habitats. Streams allow light to penetrate the canopy, keep surrounding soils moist, and distribute nutrients. These water bodies are nurseries for a variety of invertebrate and vertebrate animal life and provide resting places during migrations. The health of the Hudson River estuary and Long Island Sound is linked to the health of our tributaries and watersheds.

In a community with our long history, changes were made to the surface waters. Ponds were created in the process of mining bank run gravel deposits that were used for road base and septic fill. A number of small ponds derive water from road drainage. Some bodies of water, like the lakes on Fancher Road and Fox Run, were created by essentially widening and deepening the stream bed and utilizing the uplands to create the larger area. Another common practice has been to excavate small wetland areas to create ponds. In other places, streams were dammed to flood the low-lying areas. To understand the historical changes requires looking back in time and belongs in another study. A second possible study would involve identifying the names used locally for water bodies that remain unnamed on maps.

A look at the **Lakes, Rivers, Streams Map** shows how many streams and water bodies originate in Pound Ridge. According to EPA:

> Headwater streams are the smallest parts of river and stream networks, but make up the majority of river miles in the United States. Headwaters flow briefly when snow melts or after rain, but shrink in dry times to become individual pools filled with water. They trap floodwaters, recharge groundwater supplies, remove pollution, provide fish and wildlife habitats, and sustain the health of downstream rivers, lakes and bays. Because small streams and streams that flow for only part of the year are a major source of the nation's fresh waters, changes that harm these headwaters affect streams, lakes and rivers downstream.

Water bodies known as ponds, lakes, and reservoirs are areas of permanent water retention fed by springs or

natural drainage systems. New York Code, Rules, and Regulations differentiates large water bodies from water bodies smaller than 10 acres. Pound Ridge water bodies greater than 10 acres include: Blue Heron Lake, Cross River Reservoir, Lake Kitchawan, Gilmore Pond, Mianus River Reservoir, Trinity Lake, Mill River North, and Siscowit Reservoir. Many of the water bodies smaller than 10 acres are unnamed. Some of the named smaller water bodies are Blue Heron Pond, Lost Lake, Mallard Lake, Highland Lake, Robin Hood Lake, Miller's Pond, Twin Pond, and Shackleford Pond.

Natural drainage systems include rivers, streams, creeks and brooks which contain running water at least six months of the year. Small ponds or lakes with a surface area of less than 10 acres and located in the course of a stream are defined as part of the stream (6 NYCRR Part 608.1). Perennial streams in a drainage system have a well-defined channel and continually convey water during a year of normal rainfall. Groundwater is the primary water source with the stream bed located below the water table. A drainage area may include intermittent streams (streams that do not flow continuously during the year). These streams are usually located in the uplands and provide the important ecological services mentioned earlier.

USGS, National Wetland Inventory (NWI), and statewide stream maps do not capture all intermittent streams, vernal ponds, wetlands, and small water bodies. Several existing maps provide approximate locations and extent of these water bodies, but are inherently inaccurate and not a substitute for site visits and on-the-ground delineation.

As part of the Town's natural resource inventory, Hudsonia Ltd. mapped habitats of Pound Ridge. These useful references regarding water resources are available through the Town GIS viewer and described in the Habitat report. It is recommended that the Water Control Commission be consulted to see if any water bodies should be inventoried further.

WETLANDS

Wetlands are areas saturated by surface water or groundwater sufficient to support distinctive vegetation adapted for life in saturated soil conditions. In addition to providing critical habitat for many plants and animals, wetlands provide important benefits to human communities. They help control flooding, reduce damage from storm surge, act as filters to cleanse water of impurities, and provide recreation opportunities for many people, such as bird watching, fishing, and boating. Pound Ridge has a few created wetlands. For example, there is a constructed wetland at Pound Ridge Golf Course.

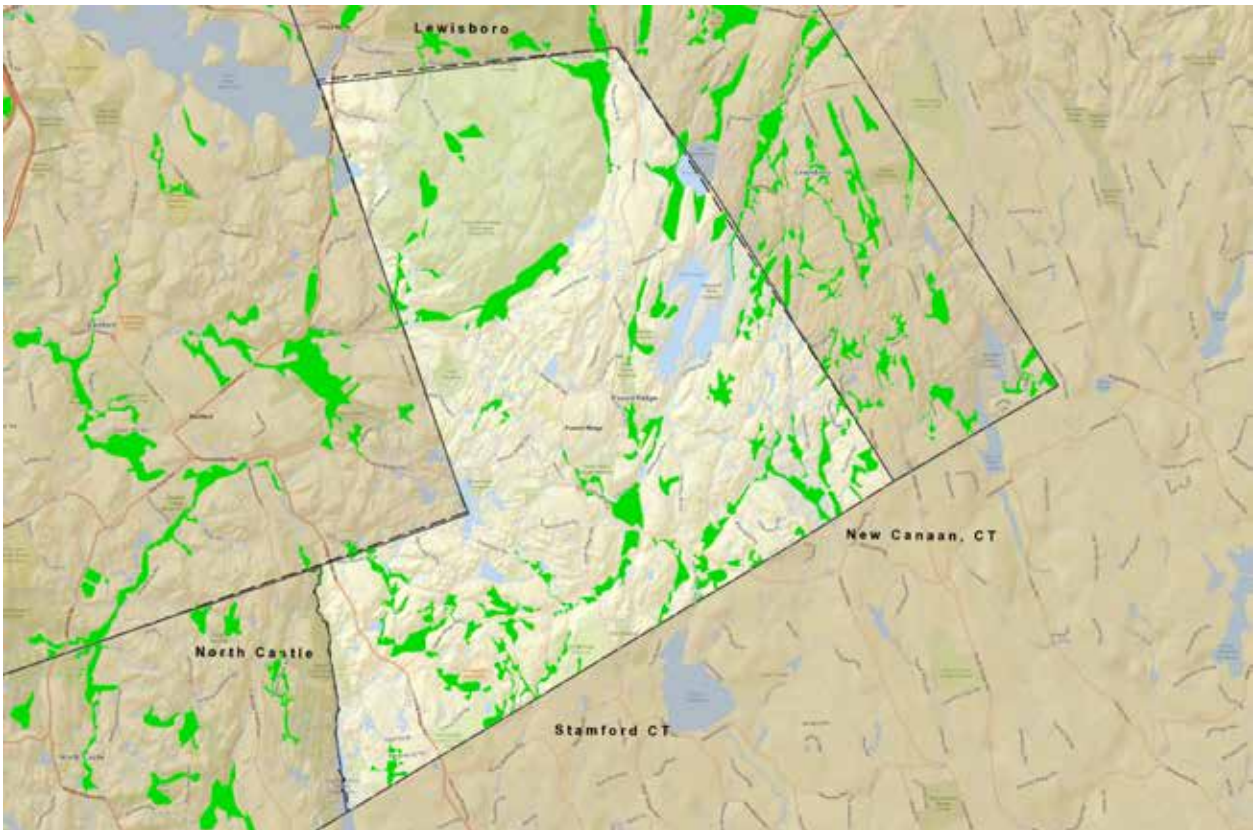
Quick Reference: NWI Wetlands

Fire Pond on Winterbottom Lane
Pamela Corey 2013

To understand how land-use decisions impact wetlands, it's important to consider adjacent upland areas and connected hydrologic features such as streams. The Town GIS maps illustrate the relationship between these different resources, but are not to be used for development decisions. They are created with aerial photo interpretation and limited field checking. Wetland areas may be underestimated or omitted, in particular vernal pools, wet meadows, and swamps.

The National Wetland Inventory (NWI) map from the US Fish and Wildlife Service (USFWS) has been completed for the region that includes Pound Ridge. **NYS Freshwater Wetland Maps** depict mainly large wetlands (12.4 acres or larger) and a few smaller ones with special attributes. The maps are not intended to be accurate depictions of the limits of state wetland jurisdiction on any site. Many of DEC's regulatory maps are outdated and have similar inaccuracies to the NWI maps (Huffman and Associates 2000). Digital data are available from Cornell University Geospatial Information Repository (CUGIR). For an up to date map refer to NYS DEC Environmental Resource Mapper (Appendix H).

If you are considering a project or activity in or near any of the natural features shown on these maps, contact Town Building Department to determine if town, state of federal permits are required. Final determinations for state-required permits are made by NYS DEC.



Quick Reference: NYS Regulated Wetlands

WETLANDS ORDINANCE AND WATER CONTROL COMMISSION

Pound Ridge adopted Water Control Commission Legislation in 1969 (Local Law 4, amended 1971), perhaps being the first town in the state to have a wetlands ordinance. The existing code was adopted in 1986 to protect ponds, lakes, reservoirs, natural drainage systems, and wetlands from encroachment, alteration, pollution, or elimination. Complete information about FreshWater Wetlands requirements can be found in Chapter 63 of the Town Code.

The FreshWater Wetlands Ordinance created the Water Control Commission and provides the tools to benefit all residents by protecting and preserving our existing water resources. The Water Control Commission consists of five appointed Town residents who meet once a month to review applications for proposed work. The Commission reviews proposals with concern for the preservation of the fresh water wetlands, protection from pollutants, and the maintenance of existing water flows.

The Ordinance defines all of our water resources as a "Controlled Area" and the distance of 150 feet from the area as a "Minimum Activity Setback Area." Permits are required from the Water Control Commission before alteration or new construction can take place in these areas. Alterations to the Controlled Area are very restricted, but the Minimum Activity Setback Area allows utilization that is not detrimental to our water resources. Information about and applications for activities in the Controlled Area and Minimum Activity Setback Area can be obtained from the Town's Building Department.

Regulations include poorly drained soil as controlled areas. Poorly drained soils can indicate the presence of smaller wetlands (less than .25 acres) including vernal and woodland pools. Smaller wetlands and vernal pools are unique for several reasons and often undervalued by homeowners. Vernal pools are found in the forested, glacial areas of the Northeast, and provide critical habitat for certain rare animal species. If you are fortunate to have one on your property, be sensitive to the fragility of these small depressions that may appear and disappear seasonally and enjoy their mystery and scenic beauty. They can be easily overlooked during dry periods.

Knowing about local wetlands enables municipalities to proactively conserve this critical resource and the *Comprehensive Plan* includes recommendations (p. C-6; C-17). The wetlands ordinance should be reviewed every 15 years. At that time, the ordinance might be revised to include wetlands smaller than .25 acres.

The Town's Water Control Commission obtains information with every application they review. Applicants are required to provide a detailed survey of the wetlands. At this time, the Town does not have the means to collect and coordinate this information. One recommendation for the Town is to collect information from the surveys as applications are filed. The Town should seek to hire administrative personnel with GIS skills and purchase a GIS license. Over time, the information compiled from the surveys would produce more accurate wetland maps of the Town.

Water Control Commission. From left, John Loveless, Esq., Phil Sears, Betsey Miller, Bill Bedford (Chair), Pete Marchietti
C. Reppert 2018

NOTE TO HOMEOWNERS

Excerpt from *A USER'S GUIDE:*

The purpose of the Town's Wetlands Ordinance is to protect, preserve and ensure proper maintenance and use of ponds, lakes, etc., as well as to protect the potable surface and groundwater supplies. Included in the law are specific guidelines:

- Wetland categories
- Permits for activities in controlled areas
- Minimum activity setback
- Activities permitted by an administrative permit

The ordinance is very detailed and covers many areas that a homeowner might not consider, such as gardening, deposition of material, driveways, clear cutting of small trees, accessory buildings or structures, and changes to existing buildings. Before you begin any work on your home or property, or before any hired worker or contractor begins work, drop by the Town House and get a copy of the Wetlands Ordinance. You will protect not only yourself, but also the vitality of our community. In addition, you may need a Waters Permit from NYSDEC. This website http://www.dec.ny.gov/permits/6335.html addresses the question, *"Do I Need a NYS Protection of Waters Permit?"* Always contact the local DEC office directly.

An excellent, and quite charming, resource for homeowners with wetlands can be found on the Town website. While an older document, the information in *A Guide to Preserving Pound Ridge Wetlands* is still relevant. http://www.townofpoundridge.com/sites/default/files/fileattachments/pr_wetlands_0.pdf.

SURFACE WATER: SOURCES OF CONTAMINATION

Pollution, or the introduction of contaminants into the environment, remains a constant concern when a whole town's water supply is supported by wells and septic systems.

Atmospheric particles attached to rain or snow, known as wet deposition, is thought to be the source of mercury found in Cross River Reservoir.

Homeowners' overly generous use of fertilizers and the lack of maintenance to repair leaky septic tanks have been attributed as threats to Cross River Reservoir, Kitchawan Lake, and several stream segments (Table 3). Both practices introduce excess nutrients, phosphorus (P) and nitrogen (N), into the environment.

STORMWATER RUNOFF

Of particular concern in any discussion of water quality is stormwater runoff caused by extreme weather events. At these times, water flows hard and fast from rooftops, over paved surfaces, bare soil and sloped lawns. Along the way it collects and transports litter, excess fertilizers and pesticides, bacteria from animal wastes, oil and grease from road surfaces, and sediments. These pollutants accumulate in surface waters and degrade the quality of water used for drinking, recreation, and habitats. According to DEC, urban stormwater runoff is identified as a major source of pollution in 37% of impaired water bodies assessed in New York State.

It is easier to manage stormwater runoff than to remove pollution from water. Therefore, careful consideration is required whenever the natural landscape is replaced with impervious surfaces such as buildings, driveways, parking lots, and roads. Impervious surfaces impact water quality by changing drainage patterns, streamflow and impeding the filtration of water. The Town adopted regulations in 2008 to minimize, to the maximum extent practicable, the total annual volume of stormwater runoff which flows from any specific site during and following development (Chapter 91B).

Stormwater retention basins have been constructed at Dann Farms (included in NYSDEC Dam Inventory), Joshua Hobby Lane, and a residence on Old Stone Hill Road. Certain small ponds receive water from roadway drainage.

A federal regulation, commonly known as Stormwater Phase II, requires permits for stormwater discharges from Municipal Separate Storm Sewer Systems (MS4s) in urbanized areas. Permittees are required to develop Stormwater Management Program (SWMP), including BMP, and submit annual reports to the Department. Stormwater control has become a significant NYSDEC Water Program initiative and this is the cornerstone of that effort.

Recommendations regarding the Town's Phase II Stormwater Management Plan and MS4 Requirements are found on p. C 10-11 of the *Comprehensive Plan* and include:

- use of vegetated swales instead of curbs, drainage pipes and catch basins
- use of bioretention basins, filtrations systems and other BMP in parking lots
- addition of trees and landscaping to town parking lots
- retrofit catch basins with sumps to trap sediments and the addition of oil-water separators
- map the entire stormwater conveyance system
- seek additional funding.

These recommendations and the Town's stormwater management plan should be compared and reviewed for progress.

HOW HOMEOWNERS CAN HELP

Due to the characteristics of our Town, with its lack of industries, sewage treatment plants, and limited business district, homeowners can significantly limit the introduction of pollutants into our streams and reservoirs by following two inexpensive suggestions:

Prevent pollutants from getting into runoff through the proper storage of chemicals, disposal of dog feces, limiting the use of fertilizers and pesticides, and regular septic system maintenance.

Observe patterns of runoff and adopt strategies to reduce them with gutters, rain barrels and rain gardens. Planting trees and shrubs also helps to slow down runoff.

NOTE TO HOMEOWNERS

If you observe sheets of water running off your lawn or down your driveway during a rainstorm, consider the value of creating a rain garden. For more information, go to http://nemo.uconn.edu/raingardens/
As with any garden, a permit is not required for the installation of a rain garden by a homeowner.

The Town Planning Board may require an applicant to include plans for controlling stormwater. Rain gardens can be installed as a method for the controlled infiltration of smaller quantities of stormwater into the ground.

Larger quantities of stormwater runoff may be managed with ponds, concrete structures, pipe and stone installations. A stormwater pollution prevention plan (SWPP) must meet DEC regulations and Town Code (see § 91B-7 Stormwater pollution prevention plans) and generally requires the services of an engineer.

For more about The Dangers of Stormwater Runoff go to the Conservation Board's webpage on the town website.http://www.townofpoundridge.com/sites/default/files/fileattachments/stormwaterfinal_0.pdf

Craig Miller/KQED

CASE STUDY

Rain Gardens

Nestled between NYS Route 172 and an unnamed dirt spur, the Moat Family Green has long been the reception point for sheet runoff from the adjacent highway. As part of its 75th Anniversary Celebration, the Pound Ridge Garden Club conceived a plan for naturally controlling and cleansing the runoff utilizing a rain garden. A rain garden is a planted depression that allows rainwater runoff from roads and other impervious surfaces to be absorbed back into the ground.

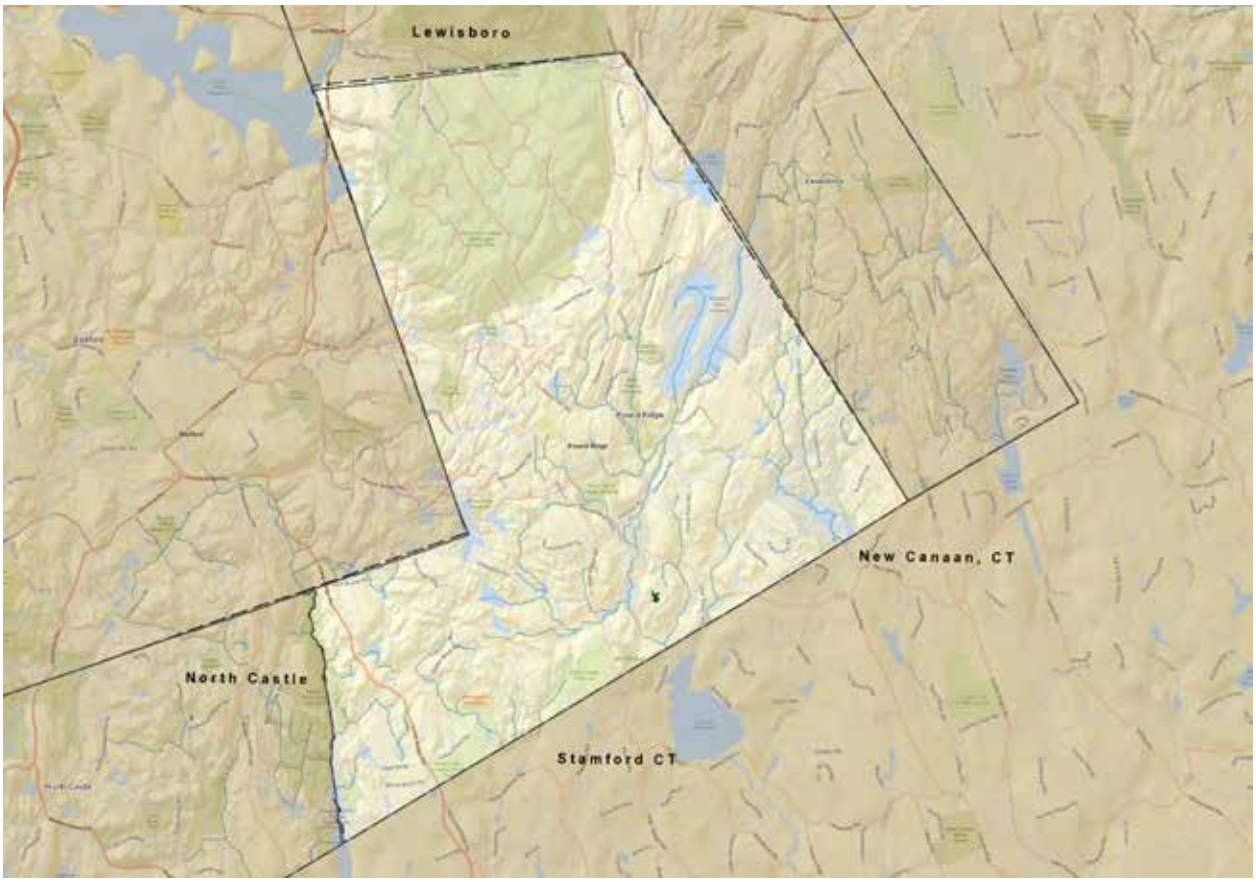
First partnering with The Invasives Project-Pound Ridge (TIP-PR), invasive plant species were eradicated from the Green. Following that operation, Landscape Architect Sid Burke, a Senior Associate of RGR Landscape based in Manhattan, was brought in to professionally design the project. Once the plan was approved by the Town Board and Water Control Commission, the Pound Ridge Highway Department performed the excavation work and set the drain base and back stones.

The Garden Club then had the appropriate planting medium brought in, supplied all of the plant material and performed the actual planting thereby improving water quality and ensuring that rainwater becomes available for plants as groundwater instead of being sent through stormwater drains. By preventing surface runoff in this way, rain gardens can reduce the amount of pollution reaching waterways by up to 30 percent.

The rain garden is now flowering and successfully controls the runoff from Rte. 172. The plants selected for the rain garden have deep and variable root systems for enhanced water infiltration and drought tolerance. The Moat Family Green Rain Garden provides a “state of the art” example of what can be accomplished through natural means.

At work in the rain garden Joan Goldberg (front) and members of the Pound Ridge Garden Club
Heather Thon 2016

WATER QUALITY CLASSIFICATIONS



Quick Reference: Water Quality Classifications Map

State Water Quality Standards and State Water Quality Standards and Classifications designate the "best uses" that water bodies should support. Best uses include: sources of drinking water, swimming, boating, and fishing. The federal Clean Water Act imposes strict standards on water quality and pollutant levels and New York State's Environmental Conservation Law outlines water quality and priority classifications and standards for water bodies. The federal and state governments developed water quality standards as a basis for monitoring and protecting water bodies. Refer to the **Water Quality Classification Map** and Table 2.

Freshwater stream segments and open water bodies are classified by the letters AA, A, B, C, or D, which is the lowest classification. Additional designations of "T" or "TS" can be added to Class A, B, or C streams if a water body has sufficient amounts of dissolved oxygen to support trout (T) and/or trout spawning (TS). It is important to note that the DEC water body classification does not relate directly to water quality; rather, it reflects the quality expected of a water body, or, stated differently, the "goal" for the use of that water body.

The streams that flow through Pound Ridge originate within the Town boundaries with the exception of Mill River. The source of Mill River is about three miles east of Ridgefield, CT. In general, the streams in the northern portion of Pound Ridge (the Croton Watershed) are Class B or C. Segments of a stream may have different classifications. For example, part of Stone Hill River south of Sachs Park is classified as B and the part to the north is classified as C. The standards are determined to be B (T) and C (T), or sufficient to support trout.

Those streams in the southern portion (Inland Long Island Sound Basin) are typically Class AA-S streams (S=special), or protected surface water source of drinking water, a classification applied by water utilities in Connecticut and one that affords the streams greater protection.

Water bodies that are designated as "C (T)" or higher (e.g., "C (TS)," "B," "A," or "AA") are collectively referred to as protected streams, and are subject to additional regulations and require a State permit for disturbance

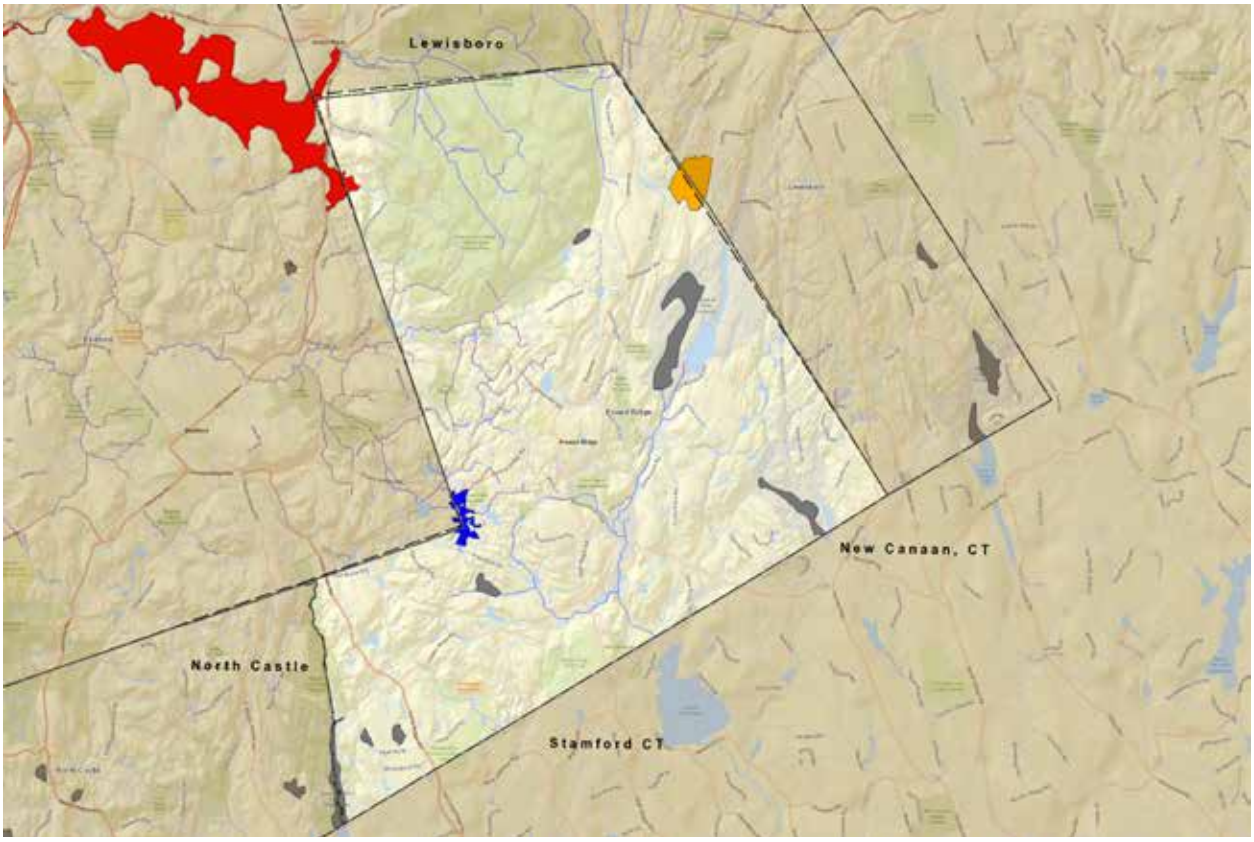
of the bed or banks. Water bodies can receive more comprehensive protection at the municipal level. In Pound Ridge, the Town's freshwater wetlands regulations protect all waters of one-quarter acre or greater in size, including the banks. A permit from the Town's Water Control Commission is required for activities within 150 feet of the freshwater feature, including intermittent streams and ponds.

A reference for state classifications and regulated streams is the Environmental Resource mapper located at the NYS DEC website. http://www.dec.ny.gov/gis/erm/. For any questions, contact the regional DEC office for more information.

TABLE 2: STREAM AND WATERBODY CLASSIFICATIONS IN POUND RIDGE, NY

WATER SEGMENT	CLASSIFICATION	MANAGED/PROTECTED TO SUPPORT
HUDSON RIVER ESTUARY WATERSHED		
Cross River Reservoir	AA (T), A(T)	(AA) Drinking water, culinary or food processing purposes, primary and secondary contact recreation, and fishing.
Minor Tribubtaries to Cross River Reservoir	A, B, C	(A) drinking water, fishing, and contact recreation. (B) fishing and contact recreation. (C) fishing and non-contact recreation.
Upper Cross/Waccabuc River and tributaries	A(TS), A(T), C	(A) Drinking water, fishing, and contact recreation. (C) Fishing and non-contact recreation. (TS) segments may support trout spawning. (T) segments may support trout.
Lake Kitchawan	B	Fishing and contact recreation.
Stone Hill River, Upper and tributaries	B(T), B, C(T), C	(B) Fishing and contact recreation. (C) Fishing and non-contact recreation. (T) segments may support trout.
Stone Hill River, Lower and tributaries	B(T), B, C	(B) Fishing and contact recreation. (C) Fishing and non-contact recreation. (T) segments may support trout.
Blue Heron Lake	B	Fishing and contact recreation.
LONG ISLAND SOUND WATERSHED		
Trinity Lake	AA-S	Drinking water, culinary or food processing purposes, primary and secondary contact recreation, and fishing.
Mallard Lake	AA-S	See above.
Mill River and tributaries	AA-S	See above.
Minor Tributaries to Connecticut	AA-S	See above.
Siscowit Reservoir	AA-S	See above.
Mianus River and tributaries	AA-S	See above.
Mianus Reservoir and tributary Lakes	AA-S	See above.
Tributary to Siscowit Reservior (all these segments have their own entry in the Priority Waterbody Inventry except this one)	A	See above.

PRIORITY WATERBODIES



Quick Reference: Priority Waterbodies Map

On the **DEC Waterbody Inventory map**, several water bodies are marked as unassessed (e.g., Trinity Lake); no known impact is indicated for Blue Heron Lake; and minor impacts are indicated to Lake Kitchawan (Class B). Croton Reservoir is indicated as impaired.

Two **DEC Waterbody Inventory/ Priority Waterbodies Lists** track the degree to which water bodies are meeting their "best uses" based on their DEC classification (Table 3). They summarize general water quality conditions, and monitor progress towards the identification and resolution of water quality problems, pollutants, and sources.

1. The *Lower Hudson River Waterbody Inventory and Priority Waterbodies List* (http://www.dec.ny.gov/chemical/36740.html) is based on data and information collected through the 2007 NYSDEC sampling session. For this report, the Lower Hudson River Basin is subdivided into ten smaller watersheds. Portions of the report for the Croton Watershed apply to Pound Ridge (http://www.dec.ny.gov/docs/water_pdf/wilhudscroton.pdf) and reports on two local water bodies are of interest.

- Cross River Reservoir is listed as "impaired segment." Fish consumption use of the Cross River Reservoir is considered to be impaired by mercury. In addition, water supply uses are considered to be threatened by nutrients and other pollutants from various nonpoint sources.
- Lake Kitchawan is reported as having "minor impact." Water supply and recreational uses in Lake Kitchawan may experience minor impacts, such as algal blooms, due to elevated nutrient concentrations (phosphorus) from urban runoff, septic systems, and other nonpoint sources. Due to the lack of any current information, conditions in the lake need to be verified.
- The classification of upper Stone Hill River and tributaries are "unassessed."
- Other water bodies within Pound Ridge in this report are listed as having "no known impact" or "unassessed."

2. The portions of the *Atlantic Ocean/ Long Island Sound Basin Waterbody Inventory and Priority Waterbodies List* (http://www.dec.ny.gov/dohcs/water_pdf/pwlalis11v2.pdf.) that apply to Pound Ridge are:

- Mill River and its tributaries are reported as having "no known impacts"
- Siscowit Reservoir is reported as "unassessed"
- Trinity Lake is reported as "unassessed"

TABLE 3: WATERBODIES AND IMPACTED USES IN POUND RIDGE, NY

(From The Waterbody Inventory/Priority Waterbody List, 2008
Http://www.dec.ny.gov/Chemical/36730.Html)

WATERBODIES	ID	CLASS	WATER QUALITY	USES IMPACTED	POLLUTANTS	POLLUTANT SOURCE
HUDSON RIVER ESTUARY WATERSHED						
Cross River Reservoir	1302-0005	AA(T)	impaired	Impaired: Fish consumption Threatened: Water Supply	Known: Metals (mercury) Suspected: Nutrients (phosphorus)	Known: Atmospheric deposition Suspected: urban/storm runoff
Minor Tributaries to Cross River Reservoir	1302-0138	A	Unassessed			
Upper Cross/ Waccabbuc River and tributaries	1302-0139	A(T)	No Known Impact			
Lake Kitchawan	1302-0002	B	Minor Impacts	Stressed: Water supply, recreation	Known: algal/ weed growth (algal blooms, vegetation) Suspected: Nutrients (phosphorus)	Suspected: urban/storm runoff, other source (wildlife)
Stone Hill River, Upper and tributaries	1302-0143	B(T)	Unassessed			
Stone Hill River, Lower and tributaries	1302-0059	C(T)	Need Verification	Stressed: Aquatic Life	Suspected: D.O./ Oxygen demand, nutrients, pathogens, salts Possible: Silt/ sediment	Suspected: Private/Comm/ Inst (Taconic Correction), urban storm runoff, other source (wildlife)
Blue Heron Lake	1302-0144	B	No Known Impact			
LONG ISLAND SOUND WATERSHED						
Trinity Lake	1702-0252	AA-S	Unassessed			
Mallard Lake	1702-0251	AA-S	Unassessed			
Mill River and tributaries	1702-0137	AA-S	No Known Impacts			
Minor Triubtaries to Connecticut	1702-0135	AA-S	Unassesed			
Siscowit Reservoir	1702-0253	AA-S	Minor Impacts	Threatened: Water Supply Stressed: Public bathing, recreation, aquatic life	Suspected: Unknown pollutants (biological impacts), Nutrients (phosphorus) Unconfirmed: Low D.O./oxygen demand	Suspected: urban/Storm runoff
Mianus River and tributaries	1702-0136	AA-S	Minor Impacts	Threatened: Water Supply Stressed: Public bathing, recreation, aquatic life	Suspected: Unknown pollutants (biological impacts), Nutrients (phosphorus) Unconfirmed: Low D.O.?oxygen demand	
Mianus Reservoir and tributary lakes	1702-0255	AA-S	Unassessed			

Trinity Lake Reservoir
C. Reppert 2014

ADDITIONAL SOURCES FOR WATER QUALITY DATA

Existing data from the following studies can be viewed as baseline data. Future data can be collected and, when in sufficient quantity, analyzed for trends.

1. Aquarion Water Company (AWC), a public water supply company for more than 625,000 people in 51 cities and towns, tests for total coliform bacteria levels in the streams feeding Trinity, Mill River, and Siscowit Reservoirs. Violations are reported to Westchester County Department of Health. In addition, the company routinely collects reservoir water samples for chemical, physical, and biological analysis. Water quality of the Pound Ridge reservoirs is generally high due, in part, to the low population density.

Trinity and Mill River Reservoirs supply water to Laurel Reservoir in Connecticut (CT). Approximately two years of testing shows the water quality of the two reservoirs is good. The following bullet points summarize a presentation by Brad Hanover, Manager of Water Quality at Aquarion, to the Conservation Board (Conservation Board. Minutes and Tape. 27 September 2017). Column headings in the DEEPS (CT Department of Energy and Envoronmental Protection) reports are parenthesized.

- The water from these reservoirs is hard, due to the underlying marble bedrock layer. With higher levels of calcium and other minerals, hard water has higher conductivity measures or ion activity (Cond).
- Periods of greater sunlight and higher temperatures lead to increased plant growth and higher dissolved oxygen and pH readings on the surface.
- Seasonal and depth differences in temperatures cause variations in the levels of dissolved oxygen (DO).
- Color, odor, and turbidity (Turb) are of particular interest to consumers of the water supply.
- Nitrates (NO_3) and phosphates (P) can come out of the sediments with low dissolved oxygen on the bottom, perhaps at spring/fall turnover, and cause nutrient loading.
- Measures of organic matter (Total Organic Carbon or TOC) spike during a drought, when plants die, and in the fall, with leaf drop. It can spike with increased animal or fish wastes or in the event of a fish kill.

The amount of organic matter affects management practices in the filtration plant.

- Trihalomethanes (THM) and haloacetic acids (HAA) will not be seen in storage reservoirs. These chemicals form at filtration plants with the addition of chlorine and flocculants to control organic material. Reservoir waters are tested for forming potential to help in management practice at the filtration plant downstream.
- The chemicals carried by runoff (road salts, petroleum products, fertilizer, pesticides, and herbicides, also known as SOC or Synthetic Organic Chemicals) are reduced by volatizing to air, soil absorption, and beneficial bacterial activity and are not detected in the reservoirs.

Natural processes largely account for what is observed in Trinity and Mill River Reservoirs throughout the year and at different depths. Aquarion specialists are watching for issues that may be due to three events associated with climate change: increased periods of drought, more severe storms, and rising temperatures.

- Droughts lead to lower water levels, the death of aquatic life forms, concentration of materials, and changing water conditions.
- More severe storms cause an increased flushing of materials held in the watershed. Water, the universal solvent, picks up and carries materials held in the soil into the reservoirs, changing water conditions.
- Rising temperatures cause longer periods of plant growth and possibly to the cascading events leading to eutrophication, or excessive plant and algal growth.

Questions and requests for water test results (DEEPS reports) should be addressed to Aquarion.

2. Golf courses in Pound Ridge conduct regular, independent water tests:

- Rockrimmon Country Club voluntarily conducts water quality tests twice per year as part of New York State BMP, and plans to do so each year along with the Audubon Cooperative Sanctuary Certification Program going forward. It tests its irrigation water supply, as well as the inflow coming into the property and the outflow leaving the property.

- Pound Ridge Golf Course, as a part of its operating permit, adheres to surface and groundwater testing on a regularly scheduled basis as required by its water quality monitoring plan. All test results are submitted to the Town's third party environmental monitor and are available for inspection by the public upon request.

3. Daily reservoir levels can be accessed at: http://www.nyc.gov/html/dep/html/watershed_protection/index.shtml

4. Data from monitoring stations for the Croton and Mianus River can be accessed at:

- http://waterdata.usgs.gov/nwis/inventory/?site_no=01209797
- http://waterdata.usgs.gov/usa/nwis/uv?01374701
- http://waterdata.usgs.gov/nwis/uv/?site_no=0137462010&agency_cd=USGS
- http://waterdata.usgs.gov/ny/nwis/uv?site_no=01374581
- http://waterdata.usgs.gov/ny/nwis/uv/?site_no=01374559&PARAmeter_cd=00065,00060

5. If funds become available for obtaining water samples for standard analysis in the future, 121 surface water sampling sites were identified and recommended under the supervision of a hydrologist for the PRUP Report. In addition, a study commissioned by the Town between 1974 and 1976 dealing with water quality assessment of both surface water and well water could provide valuable baseline data (referenced and summarized in *Comprehensive Plan* Appendix D, p. 23-28). The value of replicating this study was discussed earlier.

CITIZEN SCIENCE AND LOCAL DATA

Volunteers can engage in collecting data. A limited number of samples collected in the past (listed below) would become more meaningful if the same protocol were adopted and samples regularly conducted. The value of accumulating data often becomes apparent over time. The following methods are low-cost, educational, and fun. If adopted by a student intern, school group, scout troop, summer camp, or Homeowner's Association, they would provide a community service. The Conservation Board could coordinate and possibly fund these efforts.

1. Biomonitoring: Identifying the macroinvertebrate organisms (crayfish, aquatic beetles, insect larvae, etc.) that live in a particular environment provides an assessment of water quality. A popular method involves placing a net bag packed with leaves into the stream and collecting it a few days later to examine the invertebrates that have moved in to feed. More information can be learned at The Leaf Pack Network, an initiative of Stroud™ Water Research Center. The Stroud Center seeks to advance knowledge and stewardship of freshwater systems through global research, education, and watershed restoration. https://leafpacknetwork.org/learn/linking-trees-streams/

The *30 Year Trends in Water Quality of Rivers and Streams in New York State* (Bode et al. 2004) report that summarizes the findings of DEC's biomonitoring from 1972-2002 by watershed does not include information applicable to Pound Ridge. Just north of Pound Ridge, one biomonitoring sample was taken (2005) on the Cross River, downstream of where it flows through Pound Ridge. The sample has a "Non-Impacted" score. It had improved from a sample in 2000 that had "Slight Impact." The point can be found on the NYS DEC Environmental Resource Mapper (http://www.dec.ny.gov/gis/erm/). The Environmental Resource Mapper is an interactive mapping application that can be used to identify some of the state's natural resources and environmental features that are state or federally protected or of conservation concern. No additional data sets were available from Westchester County, NYC DEP, or WAVE (see #2).

2. WAVE (Water Assessment by Volunteer Evaluators) (http://www.dec.ny.gov/chemical/92237.html) assess the health of a few select streams for aquatic life, recreation, and drinking water. All data since 2002 are informally online here: https://drive.google.com/open?id=17UWrgF_OBkv34owgbmDy_KpC02U&usp=sharing

Due to its proximity to Pound Ridge, the data for Station (17021113) on the Mianus River (Latitude 41.1938888 Longitude -73.6241666) are most relevant and can be retrieved here: http://www.hrecos.org/WAVE.Data/RIBS/17021113.csv or http://www.dec.ny.gov/gmk/index.html?url=http://www.dec.ny.gov/maps/wave2016.kmz

3. Streamwalkers: Between 2002 and 2004 Westchester County used volunteer streamwalkers to evaluate streams in the Croton Watershed, including the Town of Pound Ridge. Table 4 shows the location of the evaluated streams in Pound Ridge. The characteristics that are examined in the stream segment survey include channel condition, hydrology, riparian zone, bank stability, water appearance, nutrient enrichment, barriers to fish movement, instream fish cover, pools, insect/invertebrate habitat, canopy cover, embeddedness, stream depth, stream width, temperature, pH, and overall land use characteristics. Each stream segment assessed received a rating for each characteristic listed above. All characteristic ratings for a segment were averaged and each stream segment received a rating as to whether or not the stream was in excellent, good, fair or poor condition.

As per the 2004 *Croton Watershed Streamwalk Report*, Earth Team volunteers in the Town of Pound Ridge assessed three stream sections and walked a total of nine stream segments. Areas that were assessed lie within the Stone Hill River and Cross River Reservoir subwatersheds. One stream segment was rated to be in EXCELLENT condition; six stream segments were in GOOD condition; one stream segment was in FAIR condition; and one stream segment was in POOR condition. See Tables 4A and 4B.

	SUBWATERSHED	PRIORITY
POUND RIDGE	Cross River	4
	Cross River Reservoir	4
	Lake Kitchawan	2
	Stone Hill River	4

UNASSESSED AREAS (2004)
PRIORITY FOR COMPLETION
1=Highest priority known impact
4= Lowest priority no known impact

4. New York State Citizens Statewide Lake Assessment Program (CSLAP) is a long term water quality monitoring program. The data collected through the program are used to identify water quality issues, detect seasonal and long term patterns, and inform volunteers and lake residents about water quality conditions in their lake.

Blue Heron Lake (45 acres) is a CSLAP lake and was sampled in 2016. Water quality conditions in Blue Heron Lake were mostly favorable. Although water clarity was slightly lower than usual, no shoreline blue green algae blooms were apparent. Overall water quality conditions were mostly similar to those measured in previous years. Blue Heron Lake was first sampled in 2005 through CSLAP Sampling Activities.

5. Monitoring Vernal Pools: A different kind of citizen science project is the monitoring of vernal pools. A monitoring project often begins with photographing and mapping the pond. A detailed description and scheduled visits would offer the basis for some oversight of a sensitive water feature. Any diminishment or loss of a vernal pool not due to natural processes should be reported to the building inspector or Water Control Commission.

A resource to guide a team of citizen scientists is *Volunteer Wetland Monitoring: An Introduction and Resource Guide*. Although the value of one small wetland or pool may be difficult to discern from a watershed perspective, the collective benefits of many small wetlands to a watershed may be profound.

CROTON WATERSHED STREAMWALK REPORT (2004)
TABLE 4A: STONE HILL RIVER SUBWATERSHED

STREAM	SECTION 1P	LOCATION	FLOW	DESCRIPTION		USE	ASSESSMENT	CLASSIFICATION
	SEGMENT			Average Depth (ft)	Average Width (ft)			
	A	Pine Brook Road and South Bedford Road	south east	2	10.5	mix residential, commercial forested	Virtually dry. Channel condition, riparian zone, bank stability, canopy cover - GOOD	GOOD
	B	Past South Bedford Road	north towards Blue Heron Lake		17		Virtually dry. Channel condition, riparian zone, bank stability, canopy cover - GOOD	GOOD
	C	East of Segment B	north and converges with inlet at Blue Heron Lake		18		Noted water quality concerns. Channel condition and bank stability questionable. Significant litter and debris along the segment.	POOR
	D	Small pond south of Bedford Rd which forms the southern end of Blue Heron Lake			120	residential	Water quality good to excellent. Floating algae a concern	GOOD
STREAM	SECTION 6P							
	A	Just south of Hoyt Road	southwesterly into segment C			residential	Signs of channel alteration around culvert under Tatomuck Road. Hydrologic conditions, riparian zone, bank stability, water appearance, canopy cover GOOD.	GOOD
	B		southwest direction until it converges with A and C			residential	Erosian due to vehicle crossing.	GOOD
	C	600 feet past Pound Ridge Tennis Club				residential and forested	Naturally vegetated, some invasives. Bank stability moderate, some severe undercutting.	FAIR

TABLE 4B: CROSS RIVER RESERVOIR SUBWATERSHED

STREAM	SECTION 16P	LOCATION	FLOW	DESCRIPTION		USE	ASSESSMENT	CLASSIFICATION
	SEGMENT			Average Depth (ft)	Average Width (ft)			
	A	Parallel to Honey Hollow Road	westerly direction into Cross River Reservoir	0.8	4		Little evident. Water quality characteristic relatively good with the exception of canopy cover.	GOOD
	B	Wetland area which flows into A from intersection of Honey Hollow Road and Schoolhouse Road	west	0.8	3	residential	All water quality parameters favorable	EXCELLENT

A NEW PROBLEM: INVASIVE OR NUISANCE SPECIES

Both native and invasive species can create problems. Invasive species (sometimes called alien, exotic, non-indigenous or non-native) are plants or animals that become established in ecosystems beyond their natural, historic range and outcompete native species. Locally, their presence may harm native ecosystems, limit recreational activities, or impact the water quality of local reservoirs providing drinking water for other communities.

Carol Sherwood, a concerned resident with property bordering Lake Kitchawan, reports that her community has been working to control the following (an asterisk indicates the species is on the NY Invasive Species List) :

Curly Pondweed	*Potamogeton crispus**
Coontail	*Ceratophyllum demersum*
Common Waterweed	*Elodea canadensis*
Duckweed	*Lemna* sp.
Eurasian Milfoil	*Myriophyllum spicatum**
Fern Pondweed	*Potamogeton robensii*
Illinois Pondweed	*Potamogeton illinoensis*
Pickerel Weed	*Pontederia cordata*
Spatterdock	*Nuphar piolysepaia*
Wild Celery	*Vallisneria americana*
White water lily	*Nympheae* sp.
White Water Crowfoot	*Ranunculus longirostris*
Yellow Water lily	*Nuphar* sp.

The efforts are supported with a permit from the Town Water Control Commission and follow DEC regulations. Lilypad growth (unidentified *Nuphar* sp. and, as such, can be native or Eurasian in origin) is managed as part of an effort to limit algal growth. Efforts have been made to educate residents about the unwitting introduction of invasive aquatics and additionally, as to how to properly manage them in order to prevent their spread. As mentioned previously, elevated nutrient concentrations (phosphorus) from runoff, septic systems, and other nonpoint sources affect Lake Kitchawan. The lake is improved with an observable increase in human activities (swimming, boating, kayaking, and fishing) as well as an increase in the wildlife populations (frogs, turtles, herons, as well as a nuisance species, resident Canadian geese, and an invasive bird species, mute swans). At this time, there has been no effort to control emergent invasives such as purple loosestrife (*Lythrum salicaria**) and phragmites (*Phragmites australis**).

A table of Aquatic Invasive Species of Lower Hudson PRISM (Partners in Regional Invasive Species Management) can be found at the LHPRISM.org website. More information about aquatic invasive species can be found at New York State Department of Environmental Conservation website. Two troublesome aquatic invasive plants in surrounding areas are water chestnut (*Eichhomia crassipea*) and *Hydrilla verticillata*.

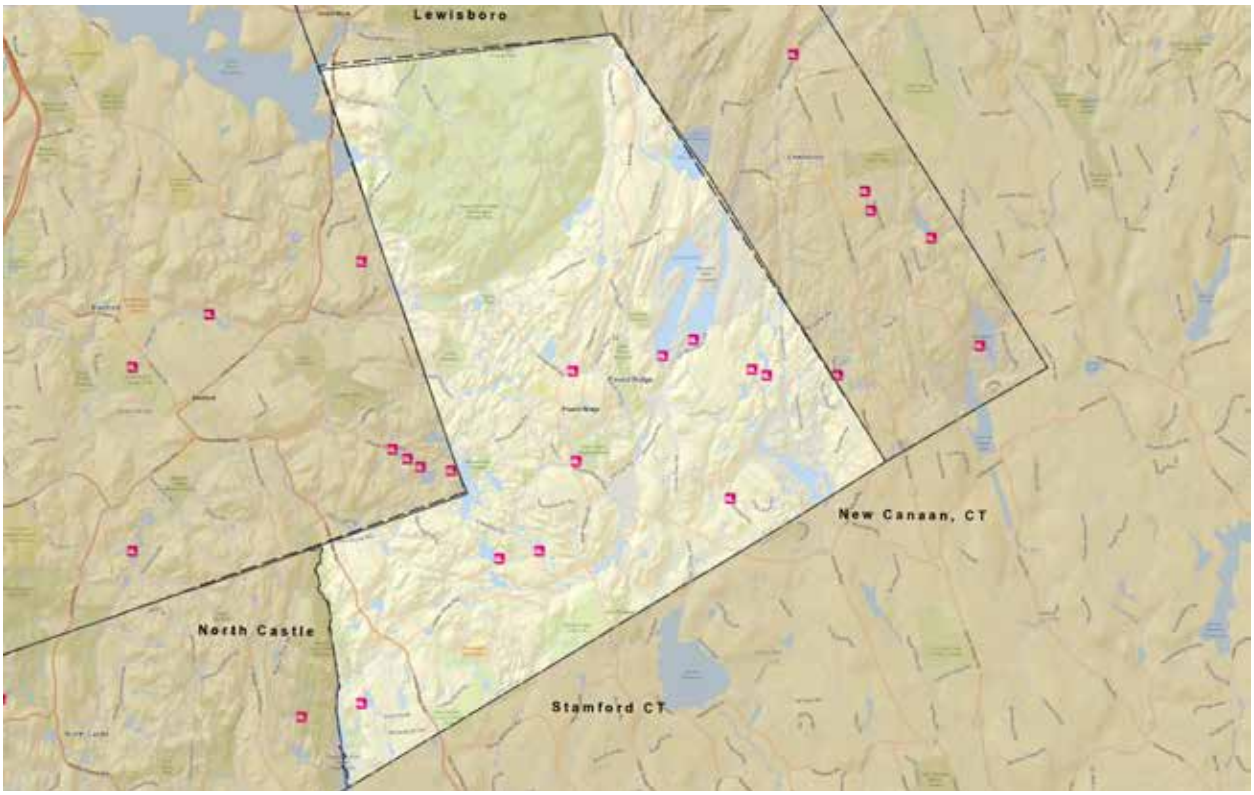
Another species, Didymo (*Didymosphenia geminata**) or rocksnot, has been reported in the west branch of Croton River. A native plant previously thought to be invasive, it is a microscopic algae (diatom) that produces large amounts of stalk material to form thick brown mats on stream bottoms.

Water quality can be impacted by terrestrial invasive species. Terrestrial plants such as Japanese knotweed *(Fallopia japonica)* and barberry *(Berberis* sp.), are less able to stabilize soil than native counterparts. The die-off of native trees due to invasive pests such as Hemlock Woolly Adelgid (*Adelges tsugae)* and Emerald Ash Borer *(Agrilus planipennis)*, can similarly affect water quality.

Duckweed
Gardenpool.org

Duckweed is a common aquatic plant growing on the surface of still or slow-moving water that may be a nuisance. This plant has the smallest known flower. There are several genera of duckweed. Small but bountiful, duckweed is a valuable food supply for waterfowl. It is easily carried and spread on the feet of birds. Duckweed growth increases with available nutrients and can lead to eutrophication, depriving a pond of oxygen and leading to the death of fish and beneficial algae. Basic solutions to preventing an abundance of duckweed are to reduce the nutrient supply and provide bubble aeration. It is not considered an invasive species.

STREAM BARRIERS: CULVERTS AND DAMS



Quick Reference: Dams Map

Culverts and dams may affect hydrology, sediment transport, water quality, reduce available habitat or impede migrations, and cost towns money for replacement and maintenance.

CULVERTS

A culvert is a short tunnel carrying a stream under a road. Culverts can play an important role in local infrastructure, but when poorly designed or maintained, culverts can increase local flooding risk and lower water quality. Culverts, and also dams, can isolate and severely limit the range of aquatic species, including fish such as native brook trout and American eel (a species of greatest conservation need-high priority, observed within Town in the Mill River by DEC in 1956). Restored passage through these dams and culverts can benefit aquatic organisms as well as terrestrial wildlife that travel along stream corridors.

Unfortunately, culvert data sets have not been comprehensively mapped in Pound Ridge. The Hudson River Estuary program is working to address culvert data sets in the Hudson River watershed. Further inventory and assessment of culverts would be valuable to identify priorities for reconnecting stream habitats.

According to the Highway Department, three areas in Pound Ridge experience flooding because the culverts are inadequate during severe storm events:

- along Rte.137 and west of Honey Hollow Road
- on Old Church Lane and Old Mill Road
- at Fancher Road near Westchester Avenue (within the 100–year flood zone).

In addition, a culvert on the Pound Ridge-Lewisboro border, off Boutonville Road, has been identified by the Nature Conservancy as a Biologically Important Stream Barrier. The culvert restricts stream access for wild brook trout, classified as a New York Species of Greatest Conservation Need. See the Streams map on the Hudson Valley Natural Resource Mapper (Appendix H)or the interactive Google Map at https://www.google.com/maps/d/viewer?mid=1yjfPSCYwn7tGtGNU2x5eSZRVWAE&ll=41.264582042057086%2C-73.63794121484375&z=11. For more information see “Aquatic Connectivity and Barrier Removal.” Aquatic Connectivity and Barrier Removal - NYS Dept. of Environmental Conservation, www.dec.ny.gov/lands/99489.html. See also Habitats p. 116.

DAMS

As early as the 1700s, local settlers built dams on streams to run mills. Later, in the 1950s and 1960s, small dams were built to create small ponds, often to reduce wetlands

TABLE 5 NYS DEC REGISTERED DAMS IN POUND RIDGE

NAME	LATITUDE LONGITUDE	STATE ID	HAZARD CODE	STREAM	TYPE	PURPOSE	YEAR COMPLETED	MOST RECENT INSPECTION
Mill River Dam	41.2166666667 -73.5547222222	32-3369	C	Mill River	RE-Earth	Water Supply - Secondary	1966	4/30/15
Trinity Dam	41.2144444444 -73.5488888889	232-3370	C	TR-Mill River	RE-Earth	Water Supply - Secondary	0	4/30/15
Brokaw Dam	41.1866666667 -73.5780555556	232-5746	A		CN-Concrete RE-Earth	Recreation	0	9/19/12
Dann Farm Subdivision	41.1941666667 -73.54194444	232-5315	A		RE-Earth	Flood Control and Storm Water Management	0	11/19/10
H J Halle Dam	41.2122222222 -73.5716666667	232-1060	A	TR-Mill River	RE-Earth	Recreation	1939	8/10/99
Mallard Lake Dam	41.1855555556 -73.58555556	232-1152	A	TR-Rippowam River	MS-Masonary	Recreation	1939	8/10/99
Pound Ridge Skating Pond	41.1994444444 -73.57111111	232-2031	A	TR-Mill River	RE-Earth	Recreation	1965	4/4/72
Robinhood Lake Dam	41.2116666667 -73.535	232-2031	A	TR-Mianus River	RE-Earth	Recreation	1951	3/25/97
Shackelford Pond Dam	41.2116666667 -73.535	232-1330	A	TR-Rippowam River	MS-Masonary RE-Earth	Recreation	1949	4/10/07
C.C. Wang Pond Dam	41.2125 -73.537778	232-4853	D	TR-Rippowam River	RE-Earth	Recreation	0	4/10/07

and large dams were built to create reservoirs. Now, decades later, the impact of dams and other stream barriers on the environment is receiving attention.

Local examples of small dams abound. A small dam is located at Ambler Way. Pound Ridge Golf Course has two dams to make water hazards (Rockrimmon Golf Course has no dams). The pond behind the Town House was created by deepening and damming the stream. Smaller dams that do not hold back enough water are not included in the **New York State Inventory of Dams.** The NYSDEC Hudson River Estuary Program is collecting information on dams and culverts in the Hudson Valley.

The *New York State Inventory of Dams* identifies nine dams within town boundaries.

Large earthen dams can be found at the Trinity and Mill River Reservoirs. The site of Trinity Lake was once a large meadow with three ponds (hence the name) strung out north to south, and used as a picnic area. When the water level drops enough, three depressions, remnants of the ponds, are visible in the lake bottom. To create Mill River Reservoir, Old Mill River Road had to be moved from the valley up the hill and to the east. Both the Trinity and Mill River Dams were constructed in 1966 and are owned and operated by the Aquarion Water Company for the purpose of public water supply.

AQUARION Water Company

Aquarion Water Company has an active program of inspection, maintenance and capital investment for this critical infrastructure. Operations staff visit the dams weekly for the purpose of recording water levels and observing any changes at the sites. Quarterly, operations staff make a written record of observations on a standard report. A licensed professional engineer hired by the company performs a formal inspection at each dam on a two-year cycle. The State of NY Department of Environmental Conservation, Dam Safety, also inspects the dams on a two-year cycle. The dams receive routine maintenance, which includes regular mowing of the slopes, removal of brush, filling animal burrows, repair of ruts, etc. The company manages a robust capital program with an annual average of $3,000,000 earmarked for dam infrastructure.

H.J.Halle Dam on Salem Road
C. Reppert 2018

DAM SAFETY

The potential energy of the water stored behind a dam can create a hazard to life and property downstream of the dam. The construction, operation, and maintenance of a dam requires the knowledge of skilled professionals. Appropriate hazard classification is determined by the height of a dam, its maximum impoundment capacity, the physical characteristics of the dam site, and what is located downstream. NYSDEC has established three hazard classes for dams:

Class A — Low Hazard Potential
Class B — Intermediate
Class C — High Hazard Potential

As the hazard class increases so do dam owner responsibilities.

Information about dam safety can be found on the NYSDEC website http://www.dec.ny.gov/lands/4991.html.

Upper Trinity Lake Reservoir Dam
Pamela Corey

CONSTRUCTING OR REMOVING A DAM

The Town Code includes regulations regarding the construction or removal of a dam. A permit is required for impacts upstream and downstream on water flow.

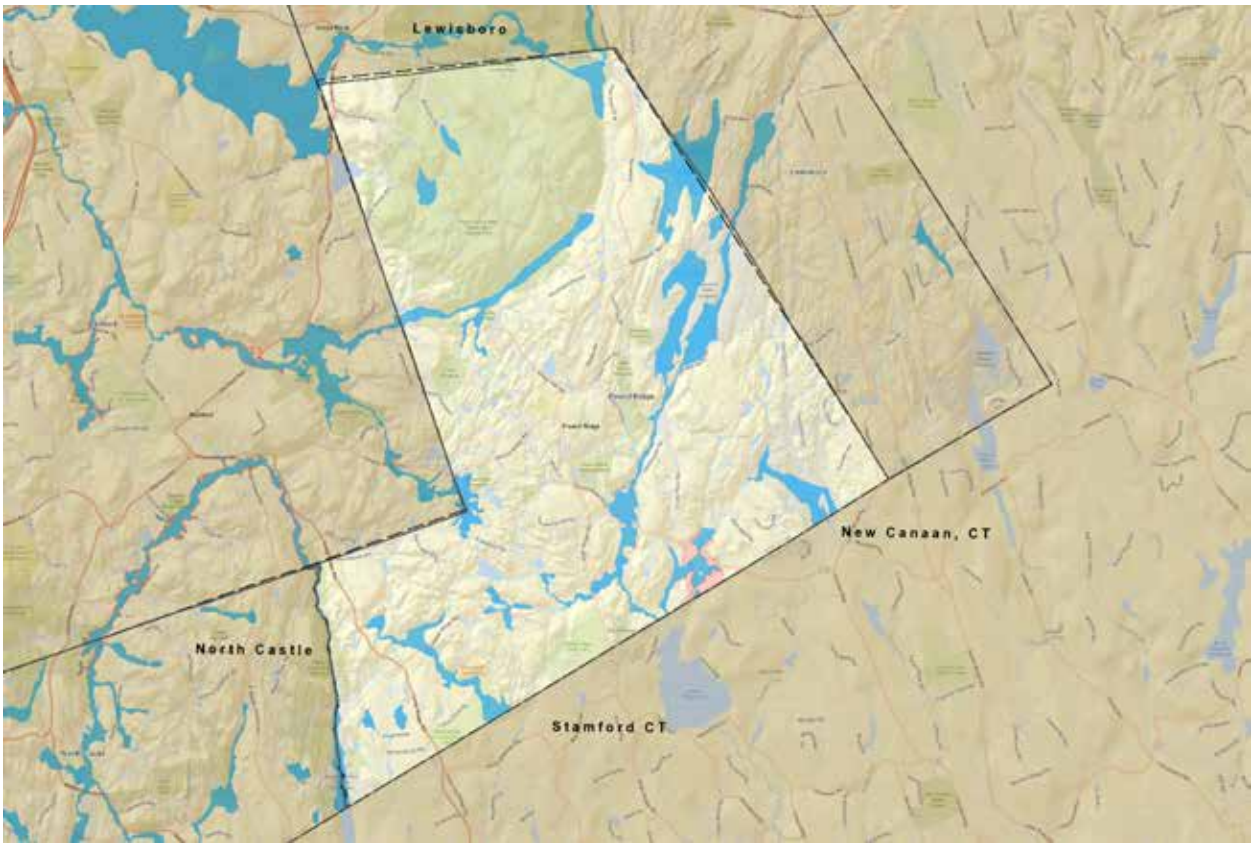
UNINVENTORIED CULVERTS AND DAMS

Further discussion regarding uninventoried dams and culverts in Pound Ridge is recommended. One reason for an inventory would be to assess the impact of stream barriers on habitats, local flooding, and water quality.

The following outline is intended to guide but not restrict a discussion of the task:

- Establish a clear need for a study of the dams and culverts in Pound Ridge. Consider historical records and habitat studies to learn if spawning migrations are impacted, fish habitat truncated, and if summer water temperatures are elevated and oxygen levels lowered.
- Review aerial maps and others for small ponds and/or soil types that indicate the presence of small dams.
- Interview Highway Department regarding maintenance demands and routines.
- Field check presence and condition of small dams, existing site conditions (siltation, depth of water), and quality of habitat.
- Prior to recommending the removal of a dam or culvert, conduct an assessment of factors such as: 1) the productivity of still water versus running water in that location; 2) the number of dams located between Long Island Sound and the dam or headwaters of the stream in Pound Ridge; 3) the historical value of dams; 4) the purpose or functions of the dam; 5) a determination of what lies downstream for local and regional impact; and 6) a history of flooding incidents.

FLOODING



Quick Reference: FEMA Floodplain Map

The FEMA Flood Map should be viewed together with streams and water bodies. The Federal Emergency Management Agency (FEMA) and the US Department of Housing and Urban Development (HUD) traditionally delineated floodzones based on flood frequency according to the extent of land expected to have a one percent or greater chance of being inundated in any given year (often referred to as the "100-year flood"). The 100-year floodzone is defined as the stream channel and adjoining floodplain areas that are reasonably required to carry the 100-year flood without increasing the flood surface elevation by more than a foot. It is the area where flood hazard is generally highest in the floodplain, i.e., anywhere water depths and velocities are the greatest. The 500-year floodzone refers to the area that has a 0.2% chance of being inundated in any given year. It is important to note that floodzones and their statistical flooding intervals are estimations based on the best data and technology available at the time of mapping. Due to many variables, such as the unpredictable nature of floods, local drainage problems, and the variable intensity of land development in watersheds, some flood-prone areas may not appear on designated floodzone maps, and floodzone designations may change over time as more information becomes available. Zone VE refers to velocity energy, and is applicable to sites along the ocean and Great Lakes, not to Pound Ridge.

FLOODPLAINS

Floodplains are low-lying areas adjacent to streams and other water bodies that become inundated during heavy precipitation or snowmelt.

By slowing and storing floodwaters, floodplains reduce downstream flood damage and serve as a safety zone between human settlement and the damaging impacts of floods. Naturally vegetated floodplains help prevent erosion, recharge groundwater, and can serve as travel corridors for wildlife. These highly productive ecosystems are home to a unique suite of plants and animals that tolerate occasional flooding and support the in-stream food web. When left in their natural state, they provide space for the fluctuations in flow that cause streams to expand, contract, and sometimes change course. Floodplains and other streamside areas are also where land-use change will most easily influence stream quality.

As development occurs in a watershed, pavement and other impervious surfaces (e.g., roofs of buildings, driveways) increase runoff volume and velocity, leading to more frequent and damaging floods. Preserving floodplains and minimizing the extent of impervious surfaces are ever more important as uplands are developed and as the frequency and magnitude of flood events increases with climate change. Floodplain maps provide a starting point for proactive conservation planning.

LOCAL FLOODING PATTERNS

Pound Ridge experiences few episodes of flooding:

- Flooding has occurred at South Bedford Road, but not within the past 15-20 years.
- Flooding occurs at the T-intersection of East Woods and Siscowit. At this location, the roadway actually bisects the reservoir and lies within the 100 year flood zone.
- The parking lot in the Town's business district, Scotts Corners, floods during severe storms. Unfortunately, the business district was poorly sited by the Town's early settlers. It is located within the 100- and 500-year floodplains as mapped by FEMA on both sides of Westchester Avenue at the intersection with Trinity Pass and the New Canaan (CT) border. The impervious surfaces concentrated in this area further aggravate the situation.
- As described previously, roadways in three areas flood during severe storm events, due to undersized culverts.

At this time, the flooding experienced in Pound Ridge is a temporary inconvenience. As a short term problem, the water dissipates within 24 hours. With an anticipated increase in storm events due to climate change, these areas should be monitored for effects on stream habitats and human activity. Stormwater retrofits, such as properly sized culverts, vegetative or riprap swales, check dams, and forebays, can be explored.

Looking at the residential areas of Pound Ridge, where the 100-year flood line runs through properties, it appears toward the back of the lots. Homeowners are advised to research their properties to assess the risk.

Zwick Fountain in Scotts Corners
C.Reppert 2017

Redbud flowering at Sachs Park
C. Reppert 2018

RECOMMENDATIONS FOR WATER RESOURCES

The following section reflects recommendations for water resources from the Town's Comprehensive Plan:

1. Consider the placement of a conservation easement, conservation overlay zone, Critical Environmental Area designation, or larger minimum lot size over all public water supply lands to protect critical watershed land from development. In addition, consider rezoning all lands that fall within the town's most environmentally sensitive areas, or in scientifically established biotic corridors to R-6A (6-acre minimum lot size. (C. P. B-11)

2. Consider amending the Zoning Law to establish a maximum percentage of impervious surface coverage for each lot. Consider requiring no net change in quality or quantity of stormwater between pre- and post-development conditions. (2a. P. C-8)

3. Consider amending land development regulations so as to incorporate best management practices for Low Impact Development, in accordance EPA, DEP, and DEC. (2b. P. C-8)

4. Consider prohibiting large-scale withdrawal of groundwater without significant recharge, other than for public water supply purposes. The same should apply to water withdrawal from surface waters. Significant water consumers should be required to prepare and implement a water supply and quality management plan. (2c. P. C-8)

5. Continue water quality monitoring program begun in the 1980s in the business district; institute similar monitoring programs in any other area showing similar stress. Pursue all reasonable means to minimize stress conditions. Coordinate with Westchester County's water quality testing program. (2f. P. C-9)

6. Consider creating Aquifer Protection Overlay Zones, with low impact development standards, and increase protective buffers to limit impervious surfaces, set forth prohibited uses, and require use of alternative construction materials and practices to allow water infiltration. (2g. P. C-9)

7. Implement public education initiative to promote the conservation of water. Consider limiting the use of groundwater for irrigation purposes. Require that roof water be directed to lawns and landscaped areas and away from impervious surfaces. Encourage the use of stormwater collected through roof gutters, rain barrels, and other devices for landscape watering. (2h. P. C-9)

8. Empower the Planning Board to improve overall site drainage through the use of depressional storage areas, bioretention areas, dry wells, and infiltration trenches, and other stormwater best management practices. (2i. P. C-9)

9. Use of road salt should be reduced to the minimum required for public safety. Continue to implement a salt reduction plan employing new equipment, application rates relative to road characteristics, environmentally sensitive areas, weather conditions, etc. Require Highway Department to develop a manual of its practices, maintenance and standard operating procedures, maintain records, and participate in training sessions. Engage with State and County agencies to balance their road maintenance practices with the Town's environmental concerns.

10. Implement best management practices to divert, retain, or detain stormwater flows from all sources of drinking water. Minimize use of road salt and prevent it from accumulating in the proximity of wells and surface waters. (3 a-b. P. C-10)

11. Review Phase 2 Stormwater MS4 Regulations and the Town's efforts to meet requirements. Review and address specific recommendations put forth in the Comprehensive Plan 2010. (4 a.-d. P.C-10-11).

12. Require periodic proof of integrity for existing underground fuel storage tanks. Require above-ground storage tanks for all new construction. Educate the public about the hazards of leaking underground fuel tanks. (5a.-d. P. C-11)

13. Encourage the repair and upgrade of existing septic systems. Implement a public education initiative regarding water conservation and wastewater management, proper disposal of hazardous waters, etc. (6a.-d. P. C-12)

14. Educate the public about the impacts of pesticides, herbicides, and fertilizers on water resources in Pound Ridge. Require Town departments to use environmentally safe alternatives. Investigate model ordinances designed to regulate use of pesticides and herbicides. (7a.-c. P. C-12)

15. Review open space recommendations as they relate to watershed protection and wetland loss. (8f.1-2 and g.1-6 P. C-14)

16. Review Tree Preservation ordinance to improve compliance and enforcement. Consider regulating removal of naturally-occuring, native vegetation, including shrubs, small trees, and understory vegetation. Promote the use of native plants and reduction of invasive plants. (11a.-b. and 12. P. C-18)

Additional Recommendations

The following recommendations are outcomes of this narrative:

• **Conduct a basic inventory** of the Town's fuel storage tanks (location, tank size, material, installation date, inspection schedule, etc) and establish an appropriate schedule for assessing storage tank integrity.

• **Seek funds** to replicate surface water and well quality testing previously conducted in Pound Ridge (Land Use Through Ecology. P.41 and a study referenced and summarized in Comprehensive Plan Appendix D, p. 23-28. See also Recommendations 2d P.C-8).

• **Evaluate the need for further inventory** of small water bodies and intermittent streams and ponds after the Hudsonia habitat mapping is complete and available to the Water Control Commission for use.

• **Evaluate the need for a more detailed inventory** of dams and culverts to assess the impact of stream barriers on habitats, local flooding, and water quality.

• **Support the acquisition of land and methods** to mitigate possible impacts from future developments.

• **Consider requiring extra precautions** regarding changes to the infrastructure in the business district in Scotts Corners because the area lies within the FEMA 100-year and 500-year floodplains, has concentrated impervious surfaces, and is vulnerable to climate change impacts.

• **Review Town ordinances** relevant to water and watershed protection every 10-15 years and align with best practices.

• **Consider revising the Wetlands Ordinance** to include wetlands smaller than .25 acres such as vernal or woodland pools. (11a.1-2. P. C-17).

• **Hire administrative personnel with GIS skills** and purchase a GIS license. Collect information as surveys filed with permit applications in order to produce more accurate wetland maps of the town.

• **Educate homeowners' associations and residents** living around lakes about invasive and nuisance aquatic species, such as water chestnut and Hydrilla.

• **Evaluate the need for Town property forest management plans.**

WHAT NEXT?

No resource is more important than the water we drink. As the cost of digging and laying underground pipes for septic and water in our town is prohibitive, we have no alternative source. We depend on our surface and groundwater and we depend on each other not to spoil this resource. This narrative, with all its limitations, only provides a starting point for understanding the quality of water resources in Pound Ridge.

Many best management practices and recommendations are made in this document, the *Comprehensive Plan*, and in the Town's stormwater management plan. In many cases, BMP depend upon the goodwill and cooperation of individuals and businesses and are the focus of the education and outreach efforts of the Pound Ridge Conservation Board. The recommendations made, however, require the focus of a variety of agencies — from youth groups and homeowners' associations to the Town's boards and commissions. A review of the many unaddressed recommendations in the documents mentioned provides evidence of the challenge regarding implementation. Therefore, it is fitting to include one last element to this document: how to implement the recommendations.

First, task a member of the administrative staff to prepare a spreadsheet to track recommendations from this document, the *Comprehensive Plan,* stormwater management plan, and others throughout the implementation phase. All recommendations should be listed in the first column and the document(s) and page(s) where each recommendation is found in adjacent columns. The spreadsheet can guide the next step, with additional columns added as the implementation phase evolves.

Secondly, with the spreadsheet, Town leaders need to develop a process for the community-at-large (Town officials, members of boards, community leaders and residents) to add recommendations and to prioritize the most pressing recommendations.

Next, Town leaders would need to designate a board, commission, or task force responsible for addressing the recommendation(s).

The charge to this body might be to:

- clarify the goals for the recommendation(s)
- determine additional resources required to address the priorities, such as time, skills, funds, available sources (personnel, specialists, grants, contracted services, etc.)
- outline a strategy and establish a timeline
- submit progress reports to the Town Board.

Life experience confirms again and again that a task as large and daunting as protecting the Town's water resources is only accomplished one small step at a time. The paramount importance of keeping a clean, reliable source of water to support the daily lives and prosperity of today's residents and future generations motivates taking on the challenge.

Rock bench along the Bike Path
C.Reppert 2017

ENDNOTES

1. http://www.dec.ny.gov/pubs/103459.html

2. Glowczewski, J.E. Land Use Through Ecology: *A Case Study of Pound Ridge, New York.* Sponsored by Pound Ridge United for Planning (PRUP) Trust. 1980.

3. *Comprehensive Plan: Town of Pound Ridge, New York.* Adopted November 4, 2010.

4. Haeckel, Ingrid, and Laura Heady. *Creating a Natural Resources Inventory: A Guide for Communities in the Hudson River Estuary Watershed.* New Paltz, NY: New York State Department of Environmental Conservation, Hudson River Estuary Program. 2014.

5. Methyl Tertiary-Butyl Ether (MTBE) is a chemical compound that is manufactured by the chemical reaction of methanol and isobutylene. MTBE is produced in very large quantities (over 200,000 barrels per day in the U.S. in 1999) and is almost exclusively used as a fuel additive in motor gasoline. It is one of a group of chemicals commonly known as "oxygenates" because they raise the oxygen content of gasoline. At room temperature, MTBE is a volatile, flammable and colorless liquid that dissolves rather easily in water. http:/www.archive.EPA.gov

6. Bulk Storage of petroleum and chemicals in New York State. https://www.dec.ny.gov/chemical/287.html

7. Perchloroethylene (PCE) is a manufactured chemical compound widely used for the dry cleaning of fabrics (often commonly called dry-cleaning fluid) and for metal-degreasing. http://EPA.gov.

8. *Comprehensive Plan: Town of Pound Ridge, NY.* (Nov. 4, 2010). The Comprehensive Plan is available on the Town's website.

9. F. P. Clark Associates. *Town of Pound Ridge: Environmental Synthesis Report.* Rye, NY. May 22, 1978.

See p. 6 Appendix D: *Comprehensive Plan.*

10. Ibid.

11. *Town of Pound Ridge, NY Code.* www.ecode360.com

12. Wastewater Treatment Systems - Residential Onsite Systems (Appendix 75-A). https://www.health.ny.gov/environmental/water/drinking/docs/appendix_75a.pdf

13. *Preserving Natural Resources Through Local Environmental Laws: a Guidebook for Local Governments.* Land Use Center, Pace University School of Law, 2001.

14. *Town of Pound Ridge, NY Code,* www.ecode360.com

15. Personal correspondence. dfreehaf@usgs.gov. June 9, 2017.

16. Kennedy, Sullivan, Postman, Riverkeeper, Inc. *Watershed for Sale: Explosive Development Threatens New York City's Drinking Water Supply.* November, 1999. http://lawweb.pace.edu/envclinic/Report.html

17. AKRF, Inc. *Mianus River Watershed Based Plan.* 2012.

18. "Forests and Drinking Water." *Center for Watershed Protection,* 30 Sept. 2017, www.cwp.org/forests-and-drinking-water/

19. *Streams.* https://archive.epa.gov/water/archive/web/html/streams.html

20. *New York Codes, Rules and Regulations.* Web. 16 Sept. 2017.

21. *Town of Pound Ridge, NY Code.* http://ecode360.com/6833186?highlight=wetlands#6833186

22. "Our Environment and Town Codes" from *Pound Ridge: A User's Guide.* Undated.

23. Urban Stormwater Runoff. https://www.dec.ny.gov/chemical/69422.html

24. *Stormwater.* http://www.dec.ny.gov/chemical/8468.html

25. *Urban Stormwater Runoff.* www.dec.ny.gov/docs/water.pdf/305btopten.pdf

26. Water Quality Standards and Classifications. http://www.dec.ny.gov/chemical/23853.html

27. Glowcseski, J. E. *Land Use through Ecology*. PRUP. 1979.

28. F. P. Clark Associates. *Town of Pound Ridge: Environmental Synthesis Report.* 1978. in Appendix D, *Comprehensive Plan. Town of Pound Ridge, New York.* Adopted Nov. 4, 2010.

29. *Croton Watershed Streamwalk Report for the Development of a Comprehensive Croton System Water Quality Protection Plan in Westchester County.* Westchester County Department of Planning 2004.

30. Ibid.

31. *CSLAP Sampling Activities.* http://www.dec.ny.gov/chemical/81616.html

32. *Blue Heron Lake CSLAP Summary.* https://www.dec.ny.gov/docs/water_pdf/cslrpt16blueheronl.pdf

33. Heady, L. *Woodland Pool Conservation.* http://www.dec.ny.gov/lands/52325.html

34. Personal correspondence. Sherwood, C. Sept. 6, 2017

35. *Didymo* (Rocksnot). http://www.dec.ny.gov/animals/54244.html

36. Ibid.

37. Personal interview. Duffield, V. (Superintendent of Highway). Sept. 2017.

38. Brown, M. and C. Cheeseman. *Identification of Biologically Important Barriers in the Hudson River Estuary.* The Nature Conservancy, Undated. https://wri.cals.cornell.edu/sites/wri.cals.cornell.edu/files/shared/documents/TNC_HRE_Barriers_FinalReport_April2013.pdf.

39. Personal interview. Perry, James (Building Inspector). Dec. 5, 2017.

40. *New York State Dam Safety.* http://www.nysaccny.org/content/resources/nys_dam_safety.pdf.

WORKS CITED

A Guide to Preserving Pound Ridge Wetlands. http://www.townofpoundridge.com/sites/default/files/fileattachments/pr_wetlands_0.pdf.

AKRF, Inc. Mianus River Watershed Based Plan. 2012.

"Aquatic Connectivity and Barrier Removal." *Aquatic Connectivity and Barrier Removal* - NYS Dept. of Environmental Conservation, www.dec.ny.gov/lands/99489.html.

Archive.epa.gov http:/www.archive.EPA.gov

Atlantic Ocean/ Long Island Sound Basin Waterbody Inventory and Priority Waterbodies List (http://www.dec.ny.gov/dohcs/water_pdf/pwlalis11v2.pdf.

Blue Heron Lake CSLAP Summary 2016. https://www.dec.ny.gov/docs/water_pdf/cslrpt16blueheronl.pdf.

Bode, R.W. et al. *30 Years Trends in Water Quality of Rivers and Streams in New York State Based on Macroinvertebrate Data 1972-2002.* Albany, NY: NYS DEC Stream Biomonitoring Unit. 2004.

Brown, M. and C. Cheeseman. *Identification of Biologically Important Barriers in the Hudson River Estuary.* The Nature Conservancy, Undated.

Bulk Storage of petroleum and chemicals in New York State. https://www.dec.ny.gov/chemical/287.html.

Clean Water Act, section 502.

Comprehensive Plan: Town of Pound Ridge, New York. Adopted November 4, 2010.

Conservation Board. Minutes and Tape. 27 September 2017.

Croton Watershed (portion of *Lower Hudson River Waterbody Inventory and Priority Waterbodies List).* (http://www.dec.ny.gov/docs/water_pdf/wilhudscroton.pdf.

Croton Watershed Streamwalk Report for the Development of a Comprehensive Croton System Water Quality Protection Plan in Westchester County. Westchester County Department of Planning 2004.

CSLAP Sampling Activities. dec.ny.gov/chemical/81616.html.

DEC Environmental Resource http://www.dec.ny.gov/gis/erm/.

DEC Natural Resources and Environmental Protection Maps. http://www.dec.ny.gov/lands/52325.html.

DEC Waterbody Inventory/Priority Waterbody List 2008 http://www.dec.ny.gov/chemical/36730.html.

Didymo (Rocksnot). http://www.dec.ny.gov/animals/54244.html.

"Forests and Drinking Water." *Center for Watershed Protection,* 30 Sept. 2017, www.cwp.org/forests-and-drinking-water/.

Frampton, T. A. *Private Well Owners Pay Price as MTBE Contamination Exposes the Lack of Groundwater Protection.* Pace Environmental Law Review. Vol 18 Issue 1 Winter

2000. http://digitalcommons.pace.edu/cgi/viewcontent.cgi?article=1555&context=pelr.

F. P. Clark Associates. *Town of Pound Ridge: Environmental Synthesis Report.* Rye, NY. May 22, 1978.

Glowczewski, J.E. *Land Use through Ecology: A Case Study of Pound Ridge,* New York. Sponsored by Pound Ridge United for Planning (PRUP) Trust. 1980.

Haeckel, Ingrid, and Laura Heady. *Creating a Natural Resources Inventory: A Guide for Communities in the Hudson River Estuary Watershed.* New Paltz, NY: New York State Department of Environmental Conservation, Hudson River Estuary Program. 2014.

Heady, L. *Woodland Pool Conservation*.

Kennedy, Sullivan, Postman, Riverkeeper, Inc. *Watershed for Sale: Explosive Development Threatens New York City's Drinking Water Supply.* November, 1999. http://lawweb.pace.edu/envclinic/Report.html.

List of regulated and prohibited invasive species. http://www.dec.ny.gov/docs/lands_forests_pdf/islist.pdf.

Lower Hudson River Waterbody Inventory and Priority Waterbodies List http://www.dec.ny.gov/chemical/36740.html.

Merriam-Webster Dictionary https://www.merriam-webster.com/dictionary/renewable.

New York Codes, Rules and Regulations. Web. 16 Sept. 2017.

New York State Dam Safety. http://www.nysaccny.org/content/resources/nys_dam_safety.pdf.

"Our Environment and Town Codes" from *Pound Ridge: A User's Guide. Undated.*

Preserving Natural Resources through Local Environmental Laws: a Guidebook for Local Governments. Land Use Center, Pace University School of Law, 2001.

Personal correspondence. dfreehaf@usgs.gov. June 9, 2017.

Personal correspondence. Sherwood, C. Sept. 6, 2017.

Personal interview. Duffield, V.(Superintendent of Highway). Sept. 2017.

Personal interview. Perry, James (Building Inspector). Dec. 5, 2017.

Pound Ridge: A User's Guide. Undated.http://www.townofpoundridge.com/sites/default/files/fileattachments/prcb_users_guide_0.pdf.

Soil Survey of Putnam and Westchester (US Department of Agriculture. Soil Conservation Service). Undated. https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/new_york/putnam_westchesterNY1994/putnam_westchester.pdf.

Stormwater. http://www.dec.ny.gov/chemical/8468.html.

Streams. https://archive.epa.gov/water/archive/web/html/streams.html

The Dangers of Stormwater Runoff. http://www.townofpoundridge.com/sites/default/files/fileattachments/stormwaterfinal_0_0.pdf.

Town of Pound Ridge, NY Code. www.ecode360.com.

Urban Stormwater Runoff. http://www.dec.ny.gov/chemical/69422.html.

Urban Stormwater Runoff. www.dec.ny.gov/docs/water.pdf/305btopten.pdf

US EPA Vernal Pools: Wetlands Protection and Restoration. https://www.epa.gov/wetlands/vernal-pools.

Wastewater Treatment Systems - Residential Onsite Systems (Appendix 75-A). https://www.health.ny.gov/environmental/water/drinking/docs/appendix_75a.pdf.

Water Quality Standards and Classifications. http://www.dec.ny.gov/chemical/23853.html.

A secret spot
Sally Semonite Green

Open Space

Rock ledge along Old Stone Hill Road
C. Reppert 2017

At a Glance

Open Space

Pound Ridge is one of the last remaining low density, predominately residential towns in the tristate region. Until the advent of the automobile, the town was relatively isolated and its natural resources benefitted from its distance from major transportation and commercial corridors. Now within commuting distance from New York City, and for other more pressing reasons, the town's open space requires greater attention to preservation and protection. Preservation, the setting aside of a land or water area to remain undeveloped, and protection, the care of open space reserves and natural resources, strengthens community resilience and supports sustainability. These reasons plus the availability of GIS technology gave impetus to updating the Town's open space inventory. The development of this narrative was partially funded with a grant from the New York State Environmental Protection Fund through the NYS DEC Hudson River Estuary Program. The following introduction to the Open Space narrative describes the characteristics of the town's open space and defines terms associated with open space.

Pound Ridge has open space lands that are inaccessible to the public and lands that are accessible.

Inaccessible lands are not available to the public for a variety of reasons. These include small 'landlocked' parcels owned by the Town, watershed properties with restricted access, and privately owned parcels with conservation easements. Of the 18 preserves held by by Pound Ridge Land Conservancy (PRLC), ten are inaccessible. These small preserves, listed on the PRLC website, have no trails and are managed as protective refuges for wildlife and ecosystems.

Accessible lands are available for active or passive recreation. Some of those lands are used for active recreation, such as the Town Park, and have buildings, plus other built structures (playing courts, swimming pools, etc). Except for hiking trails, open space land used for passive recreation remains undeveloped. Under the category of accessible lands, town open space includes:

• *Green space* or land that is partly or completely covered with grass, trees, shrubs, or other vegetation, including portions of Aquarion and DEP watershed lands, the Town Park, the Henry Morgenthau Preserve, the Zofnass

DEFINITION

Open Space

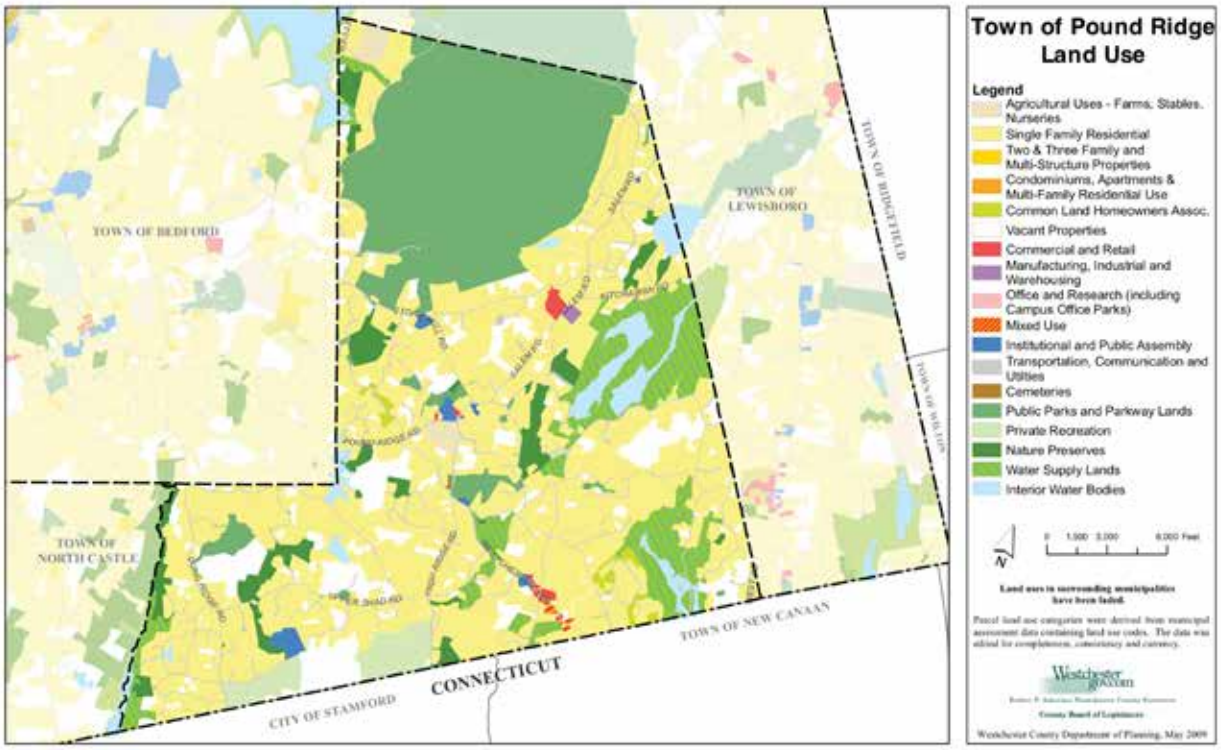
Open space may be defined as an area of land or water that either remains in its natural state or is used for agriculture, free from intensive development for residential, commercial, industrial or institutional use.[1] In Pound Ridge, open space is both publicly and privately owned. Here it includes forested land, some agricultural acreage, undeveloped scenic lands, parks and preserves, and water bodies such as streams, lakes, and reservoirs. The definition of open space depends on the context. In the business district, a passageway between buildings or a stream and its banks can be open space. Even the macadam bike path connecting the Town Park and business district creates open space. Cultural and historic resources, as part of our local heritage, are often protected along with open space.[2] In addition to landmarked homes and buildings, small wooden or stone well houses, family cemeteries, and stone walls add to the character of the Town.

Preserve, and most of the 18 preserves owned by PRLC. Small green spaces in Pound Ridge include the Moat family green and triangles at road intersections, the community garden at Lions' Park, Bertrand Park, the Town cemetery (Burial Hill) and small, historic cemeteries throughout town. The Bike Path can be considered a linear park. Privately owned recreational facilities that provide open space are the Pound Ridge Golf Course, Pound Ridge Tennis Club, and Rockrimmon Country Club.

• *Schoolyards, play areas, and sports fields* or land designated for children's play and community recreation, owned by either the town or Bedford Central School District, are clustered at the Pound Ridge Elementary School and at the Town Park.

• *Public seating areas and plazas* or small areas of land designated for public use can be found at the Town House, along the Bike Path, in Scotts Corners, and at the Pound Ridge Library.

TABLE 1: TOWN OF POUND RIDGE LAND USE



Town of Pound Ridge

	Acres	Percent of total acreage
Town of Pound Ridge, Total Acreage:	***14,771.20***	***100.00%***
RESIDENTIAL	**6,930.97**	**46.92**
Single Family	***6,930.97***	***46.92***
Single Family Residential	*6,916.30*	*46.82*
Estate and Rural Residential	*14.67*	*0.10*
NON-RESIDENTIAL	**186.78**	**1.26**
Commercial and Retail	***81.67***	***0.55***
Commercial and Retail	*34.14*	*0.23*
Agricultural Nurseries and Greenhouses	*41.33*	*0.28*
Parking Garages and Lots	*0.33*	*0.00*
Motor Vehicles, Sales and Service	*3.49*	*0.02*
Restaurants	*2.38*	*0.02*
Office and Research	***0.74***	***0.01***
Manufacturing, Industrial and Warehouses	***12.51***	***0.08***
Storage, Warehouse and Distribution Facilities	*12.51*	*0.08*
Institutional and Public Assembly	***80.46***	***0.54***
Schools	*15.99*	*0.11*
Libraries	*3.48*	*0.02*
Social and Health Services	*0.67*	*0.00*
Religious	*39.44*	*0.27*
Public Safety Facilities	*5.47*	*0.04*
Government Buildings and Facilities	*15.40*	*0.10*
Transportation, Communication and Utilities	***11.40***	***0.08***
Utilities	*6.58*	*0.04*
Communication	*4.82*	*0.03*
MIXED USE	**18.15**	**0.12**
Other Mixed Use	*18.15*	*0.12*
OPEN SPACE AND RECREATION	**5,249.64**	**35.54**
Agricultural	***52.74***	***0.36***
Horse and Livestock Farms	*52.74*	*0.36*
Private Recreation	***302.16***	***2.05***
Other Private Recreation	*12.31*	*0.08*
Private Golf Courses	*289.85*	*1.96*
Cemeteries	***4.51***	***0.03***
Common Land Homeowners Association	***74.23***	***0.50***
Nature Preserves	***584.85***	***3.96***
Public Parks and Parkway Lands	***3,051.92***	***20.66***
County Parks, Golf Courses and Conservation Lands	*2,824.12*	*19.12*
City/Town/Village Parks and Conservation Lands	*227.79*	*1.54*
Water Supply Lands	***1,179.23***	***7.98***
VACANT/UNDEVELOPED	**1,505.01**	**10.19**
Vacant Land	*1,430.82*	*9.69*
Vacant Land with Improvements	*74.19*	*0.50*
RIGHTS-OF-WAY	**476.07**	**3.22**
INTERIOR WATER BODIES	**404.58**	**2.74**

TABLE 2: PARKS AND PRESERVES

PARKS & PRESERVES IN POUND RIDGE	ACREAGE	OWNER
Ward Pound Ridge Reservation**	3,000/4700	County
Westchester Wilderness Walk/ Zofnass	150	WLT
Henry Morgenthau Preserve	34	Private
Bye Preserve	23.5	PRLC
Carolin's Grove	5	PRLC
Clark	76	PRLC
Laurel Ponds*	5.5	PRLC
Halle Ravine	38	PRLC
Russell Preserve	9	PRLC
Richards Preserve	15	PRLC
Armstrong Preserve	43	PRLC
Honey Hollow Preserve*	16	PRLC
Isaacson Preserve*	32	PRLC
Della Torre Preserve*	3.5	PRLC
Fancher Meadow*	3.5	PRLC
Goldfein Preserve*	2.8	PRLC
Old Stone Hill*	9	PRLC
Robert Whitehead Preserve*	29	PRLC
Sand Preserve*	9.5	PRLC
Schwartz Preserve*	8	PRLC
Thalheim Preserve*	47	PRLC
Eastwoods Preserve	48	Town
Sachs Park	19	Town
Lawther	22	Town
Town Park	54	Town

* inaccessible lands (no hiking trails)

** Westchester County owns 4,700 acres with 3,000 acres in Pound Ridge

All kinds of open space are socially valuable, but it is the **large areas of open space,** left undeveloped and naturalized, which residents cherish the most.

Pound Ridge, approximately 23.1 square miles or 14,771 acres in size, has over 4,800 open space acres.[3] Comprised of extensive parklands, preserves, and watershed lands, these large swathes of land provide quality wildlife habitat and significant ecological benefits to a town of unparalleled scenic beauty and wildlands. With rolling hillsides containing second-growth woodlands, small meadows, and old stone walls stacked by pre-Revolutionary settlers, with low-lying areas, wetlands, ponds and streams, and vistas created by lakes and reservoirs, these large areas of open space are central to the town's identity.

Aerial view of Pound Ridge Town Park
Anonymous drone operator 2016

The Town Park was generously given to the Town by the Pound Ridge Fire Department and includes areas for active and passive recreation. Beyond the pool and courts are many acres of woodlands contiguous with Halle Ravine Preserve. Three hiking trails run through the wooded area of the park and connect with a trail in an adjacent preserve.

THIS NARRATIVE

Focusing on the large undeveloped, naturalized open spaces of Pound Ridge, this narrative serves to update the Town's Open Space Inventory and accompanies the Town Geospatial Information System (GIS) viewer.

Referenced in the narrative are maps and shapefiles (a file format used by GIS). Many of the shapefiles were developed by an intern, Paul LaBella (2017), specifically for this narrative with funding provided by the Beverly Bender Fund (Westchester Community Foundation). Additional shapefiles come from Westchester County GIS and other sources. The sources of these layers are poorly identified on the Town website. This shortcoming is addressed through the addition of a Data Warehouse (Appendix A). In addition, Appendix F is a profile of Pound Ridge from Westchester County Department of Planning and Appendix G references two computer-based toolkits for planning . The Pound Ridge Conservation Board relied upon *Creating a Natural Resources Inventory: A Guide for Communities in the Hudson River Watershed* by Ingrid Haeckel and Laura Heady[4] and the Town's *Comprehensive Plan*[5] for guidance throughout this narrative.

THE IMPORTANCE OF OPEN SPACE IN A COMMUNITY

With a population of 5,233 (2016 census), Pound Ridge is ranked with the lowest residential density in Westchester County.[6] Pound Ridge has been consistently commended for low density residential development and open space preservation by county, regional, and state planning agencies.[7] In a survey taken in spring 2000, Pound Ridge residents indicated they were highly in favor of preserving open space to maintain the rural and wooded character of the town, protect drinking water supplies and the streams and wetlands that replenish them as well as to protect the habitats that allow wildlife to flourish.[8]

Open space greatly enhances the quality of life and character of Pound Ridge. Open space broadly benefits the population by providing recreational areas, habitats for flora and fauna, and ecological services. Open space is known to help decrease healthcare costs among populations through increased physical activity and mental health benefits.[9] Preserving open space also helps towns and municipalities to eliminate sprawl and unrestricted building in critical habitats through planning,

Scofield Meadow
C. Reppert, 2017

directing, and concentrating development in town centers or other designated areas.[10] The natural functions of plants and soil provide ecological services such as the reduction of stormwater, prevention of flooding, the filtration of water, provide habitats for pollinators, and improvement in air quality. Woodlands lower ambient temperatures. Our forests provide an important ecosystem service in the form of carbon sequestration – the uptake and storage of carbon in forests. This service is becoming more valuable as the impacts of greenhouse gas emissions are becoming more fully understood and experienced.[11]

RECENT HISTORY OF PRESERVING OPEN SPACE

According to 2017 tax records, there are 23 municipal, not-for-profit and private entities that hold approximately 33% of the town's acreage in open space. The largest of these holdings, for a total of 4,576 acres, are managed as utilities and watershed lands, and by the Town of Pound Ridge, Westchester County, Pound Ridge Volunteer Fire District, and not-for-profit organizations such as the Henry Morgenthau Preserve (HMP), the PRLC, and Westchester Land Trust (WLT). Just over 452 acres are held by private homeowner associations, Wellspring Monastery, Pound Ridge Golf Course, Rockrimmon Country Club, Pound Ridge Tennis Club, and Pound Ridge Nursery. Pound Ridge has a large percentage (36%) of its land dedicated as open space.[12] With relatively small numbers of housing units Pound Ridge has a significant amount of open space acreage per dwelling unit at 2.51 acres.[13]

In 2000 and again in 2010, taxpayers voted to authorize the use of tax-generated revenue to purchase undeveloped land. Following the town-wide referendum, the Open Space Acquisitions Committee (OSAC) was established. The goal of the town's OSAC is to protect as much land as possible as permanent open space. The plan calls for a partnership among the Town, private preservation groups such as the PRLC, WLT, and individual landowners.

Historically, the OSAC vision focused on lands surrounding three reservoirs: Trinity Lake, Mill River and Siscowit[14] and built upon the original PRLC Mapping Committee's list of priority parcels (2000) plus criteria for evaluating land. This framework identified priority acreage for preservation and provided a strong foundation for local decisions regarding the preservation of open space.[15] The three primary approaches to achieve the Town's open space goals and objectives set forth in the *Comprehensive Plan* are Preservation, Regulation, and Education.[16]

PRESERVATION: The key to preservation is protecting areas of open space and water resources while they are still in their natural state. Pursuing remediation after land is to be developed is often costly and impossible to achieve. Towns that take conscious steps to designate, acquire and preserve important parcels of land before development effectively eliminate concerns regarding the adverse impacts of improper use. Methods available to municipalities for the preservation of open space include purchasing land outright, purchasing conservation easements which restrict development, and partnering with nonprofit organizations and conservancies to acquire land or easements.

REGULATION: Regulation of critical environmental resources is important when it is not possible or appropriate to preserve land or resources through direct ownership or the restriction of development rights. Appropriate regulation is necessary to ensure individual property rights are balanced with protecting natural resources that benefit the town's human and environmental health. The Town's *Comprehensive Plan* references the Nature Conservancy's established Mitigation Hierarchy Steps[17] which include: Avoidance, Minimization and Mitigation.

Avoidance: As mentioned above, the easiest, most cost effective method of preserving open space and natural resources is to proactively protect land areas that are vulnerable to loss, disturbance or other impacts, such as development. Permanent preservation of open space is often accomplished through fee-simple ownership and use of conservation easements. Environmental and land development regulations are also designed to protect the values and functions of specific resources.

Minimization: Where development cannot be avoided, disturbance and loss of important resources, including open space and environmental features, should be minimized to the greatest extent possible and practicable. In Pound Ridge, this typically means permitting residential development when it has been demonstrated that the impact to wetlands, water quality and quantity, wildlife habitat and other community, historic, and cultural resources have been minimized as much as possible. The variety of tools and methods available to minimize these impacts include:

- implementation of best land management development practices
- low-impact development, which refers to systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration or use of stormwater in order to protect water quality and associated aquatic habitat[18]

• conservation subdivision, where residential building areas are reduced in order to preserve larger, contiguous areas of open space. Ideally 50 to 70 percent of the buildable land is set aside as open space by grouping homes on the developed portions of the land. It begins by identifying land to be conserved and ends with drawing in lot lines for the planned homes. These design steps occur in an order opposite that of conventional subdivisions.[19]

In Pound Ridge, conservation subdivisions are only possible with the consent of the developer. It is recommended the Town adopt provisions that allow the Planning Board to mandate the submission of a conservation subdivision plan under certain prescribed conditions including preservation of (1) important scenic features, including mature forests, streams, gorges, rock outcroppings, scenic vistas, and other existing opens spaces; (2) open space in highly visible areas such as roadsides, ridgelines, entrances, etc.; and (3) continuous linked open space networks throughout the town.

Mitigation: Where impacts cannot be avoided, and after they have been minimized to the extent practicable, mitigation offers reasonable and practical solutions to help curtail impacts to environmental resources. An essential principle of mitigation is to achieve a "no net loss" of the functions and values of the environmental features that otherwise cannot be avoided. Examples include treatment of stormwater runoff or water quality prior to release or discharge; full documentation of historic, cultural, and archeological resources; relocation and reconstruction of stone walls, buildings, or other historic or cultural resources; restoration, enhancement or creation of wetlands and preparation of planting plus

Blue Heron Pond
S. Levethan 2016

Water bodies are included in open space definitions and surely add beauty to the town. Surrounding woodlands and associated wetlands also purify air and water, essential ecosystem services.

landscaping plans to restore, enhance, and offset lost vegetation as a result of development including, but not limited to, transition areas and meadows.

EDUCATION: The dissemination of the Town's plans to preserve open space lands, options for landowners, and policies to protect the environment is essential to engage the community's support.

Recently the Conservation Board recommended (Feb. 2018) that the OSAC be required to meet annually and file an annual report updating its plans with the amount of available funds in the Open Space account and the names of the chair and members appointed to the Committee. The term of the Open Space fund runs through 2023.

There can be benefits to landowners who donate land or place an easement on it. Several agencies are available to discuss with landowners these and other options. Interested landowners can contact: WLT, PRLC, HMP, OSAC, or the Town tax assessor.

The Town has many ordinances for the purpose of protecting the environment (see Town Code available on the Town website).[20] Ongoing education and outreach, routine reassessment of policies and regulation, as well as gainful actions by all members of the community can have a positive, or at least a minimally adverse impact, upon the environment. Educating people about the local ordinances and best practices is an ongoing goal of the Conservation Board.

Conservation Board Announcement
S. Levethan 2017

The Conservation Board strives to inform residents of Town policies and best practices.

RECOMMENDATIONS FOR OPEN SPACE PRESERVATION AND PROTECTION

PRESERVATION: The following section reflects recommendations for the preservation of open space from the Town's *Comprehensive Plan*.[21] Language has been slightly modified to reflect new understandings regarding climate change impacts and land resiliency:

1. Continue to seek the permanent preservation of ecologically significant and aesthetically important properties by gift, purchase-in-fee, or conservation easements. Such acquisitions can be made by the Town and/or by local not-for-profit land organizations. An additional strategy to ensure these lands are properly preserved and managed is through the use of "cross easements" between the Town and community conservation organizations. (8a.P.C-13)

2. Consider offering property tax incentives for landowners who place conservation easements on their properties for the protection of water resources, scenic viewsheds and/or wildlife habitats. Conservation easements on land which is not subdividable, should be included, so long as the Conservation Board determines the land is important for biotic/aquifer protection, or acts as an important buffer to critical land. Decisions on the purchase of land and development rights should be guided by using the selection criteria established by the Open Space Acquisitions Committee. The OSAC should periodically review and update the Committee's list of desired acquisitions reflecting new information gained from GIS mapping and other sources including working in partnership with nearby communities and regional partner organizations. (G4.P.C-15)

3. Seek to preserve as much of the Trinity Lake-Mill River Reservoir-Siscowit Reservoir corridor, in a manner consistent with Aquarion Water Company's management needs. This area generally encompasses the water company land bordering the Mill River near Trinity Pass and Winterbottom Lane, as well as individually-owned lands on Donbrook Road, Trinity Pass, Old Mill River Road, Old Church Lane, Eastwoods Road, Siscowit Road, Hack Green Road, Laurel Road and Barnegat Road, Halle Ravine, the Town's Indian Hill open space, and the Town Park. Similar goals and objectives should be mapped and inventoried as it pertains to other watersheds. (8b.P.C-13)

4. Maintain an inventory of all open space parcels that includes critical, threatened or endangered habitat, or resilient areas in Pound Ridge. Note: This recommendation is at least partially addressed by this narrative plus shapefiles recently uploaded to the Town GIS. (8d.P.C-13)

5. Implement a comprehensive open space mapping program to identify critical properties in need of preservation and a plan to acquire and support them. Emphasis should be given to incorporating composite environmental analysis maps such as were prepared for the 1981 *Town Master Plan* and for the *Land Use Through Ecology* (PRUP) study.[22] The Town should utilize its GIS system for this purpose. As noted above, this is partially addressed by shapefiles recently uploaded to the Town GIS. In addition, a habitat inventory by Hudsonia Ltd. is due to be completed in 2018. (8c.P.C-13)

6. Promote and use a variety of techniques for open space preservation including, but not limited to, obtaining rights of first refusal, the purchase or leasing of development rights, conservation easements, overlay zones, and other mechanisms that may be developed in the future. (8e.P.C-13)

7. Seek to permanently protect existing open space, including natural areas within golf courses, reservoir and water supply lands, large parcels and estates, scenic roads and viewsheds, as well as large tracts of unfragmented woodlands and wildlife habitat. Toward this end the Town should:

- work with Aquarion and other watershed partners, including DEC and DEP Agricultural Watershed Council, to determine the current level of open space protection of watershed lands
- work to preserve water supply and aquifer recharge areas through conservation easements and/or appropriate rezoning
- encourage the preservation of additional lands within the Mill River Corridor and other watershed corridors essential to the protection of the public water supply, habitats, viewsheds, and local aquifer recharge.
- create Biotic Protection Overlay District(s) for all properties located within the Eastern Westchester Biotic Corridor (EWBC)[23] as well as for those biotic protection corridors that have yet to be formally studied and defined (there may be some overlap between biotic corridor lands and aquifer protection overlay districts, thereby giving more reason to create conservation overlay districts in these areas)
- consider designating the EWBC as a Critical Environmental Area (CEA) in accordance with New York's State Environmental Quality Review Act (SEQRA or SEQR)

- with respect to property located within environmentally protected overlay districts:
  - ~ the Town should continue to pursue strategic partnerships with neighboring towns to maximize protection of aquifers and environmentally sensitive biotic corridors that traverse multiple jurisdictions
  - ~ whenever possible, work in conjunction with local open space organizations to facilitate Town and multi-town initiatives in the creation of biotic/aquifer protection districts. (8f.P.C-14)

8. Consider requiring a "heightened review" of proposed activities on environmentally sensitive lands and in designated biotic corridors for all new construction based upon specific standards. Such standards should include an analysis of areas in proximity to wetlands, streams, and water bodies. The Planning Board would use this information, at its discretion, to establish increased buffers, minimize impervious surfaces, regulate special lighting requirements, and other measures necessary to protect the integrity of the biotic/aquifer corridors. (G2.P.C-14)

9. Discourage driving through sensitive areas by adopting a policy, consistent with safety concerns, to avoid the creation of connector roads and to hinder shortcuts from one part of Town to another. (G3.P.C-15)

10. Include low impact development standards establishing narrower pavement widths and no curbs in road construction guidelines. (G3.P.C-15)

11. Educate citizens of the special care that is required when living in critical and sensitive environmental areas. (G5.P.C-15)

12. Create a "no net wetland loss" requirement for all new construction. (G6.P.C-15)

13. Decrease the minimum required size of locally controlled wetlands to include protection for vernal pools, seasonal and intermittent watercourses/wetlands.

The Town should also seek to implement these recommendations in all vulnerable environmental areas and, as much as possible, throughout the Town. (G6.P.C-15)

PROTECTION: Once open space has been preserved, it needs to be managed along with all the Town's natural resources. In the past, open space areas required minimal care. Over time, however, increased recreational use can result in good or bad environmental impacts, i.e., from preserving viewsheds and parklands to overuse of hiking trails, and destruction of habitat.[24] Other stewardship challenges are increased deer herbivory, disturbances caused by off-leash dogs, the ongoing introduction and spread of invasive plant species, extended periods of drought, and the increasing occurrence of violent storms associated with climate change. These complexities and their resolutions present great challenges to the protection of open space lands.

The Town Board, through the Town Code and with recommendations of its Water Control Commission, Planning, Conservation, and Zoning Boards, works to maintain a reasonable balance between the environment, the needs of the community, and individual landowners. The *Comprehensive Plan,* adopted in 2010, includes extensive recommendations for protecting the environmental quality and ecological integrity of the Town's open space and natural resources. Major topics include:

- impervious surfaces and groundwater recharge
- use of road salt
- stormwater management plan
- underground fuel storage tanks
- septic systems
- use of pesticides, herbicides, fertilizers, and other chemicals
- open space preservation and protection of non-threatened flora and fauna
- public access and public education
- deer impacts
- changes to existing regulations
- native and non-native plants: invasive species
- energy conservation

(p.C-8 to C-18).

Additional Recommendations

Through this narrative, it is recommended that additional emphasis be placed on the following:

- **Need for handicap accessibility** to open space areas, connecting walking paths and hiking trails,[25] and additional biking paths and/or bike lanes[26]
- **Importance of protecting the eco-services** (the benefits of natural functions) provided by open space areas
- **Addressing the impact of climate change** on forest regeneration and woodland health to maintain biodiversity and connectivity

ROLE OF THE CONSERVATION BOARD

Established in 1973, the Conservation Board has a vested interest in all matters that affect the environmental health and condition of the Town including its rural character and values, the collective quality of life, climate resiliency, responsible economic growth, sustainable development, and housing patterns, as well as the protection and preservation of the Town's natural resources and aesthetic treasures.

The Conservation Board is required by New York State Law to participate in the review of any actions on properties listed in the municipality's Open Space Index.[27] New York's State Environmental Quality Review Act (SEQRA or SEQR)[28] requires local government agencies to consider environmental impacts equally with social and economic factors during discretionary decision-making. This means these agencies must assess the environmental significance of all actions they have discretion to approve, fund, or directly undertake. SEQRA requires the sponsoring or approving governmental body to identify and mitigate the significant environmental impacts of the activity it is proposing or permitting. Environmental assessments are standardized through use of an Environmental Assessment Form (EAF). The Environmental Assessment Forms (short and long) are in a PDF format that can be filled out and saved. On completing an EAF, the lead agency determines the significance of an action's environmental impacts. The agency then decides whether to require (or prepare) an Environmental Impact Statement (EIS) and whether to hold a public hearing on the proposed action.

TOWN GIS AND OPEN SPACE

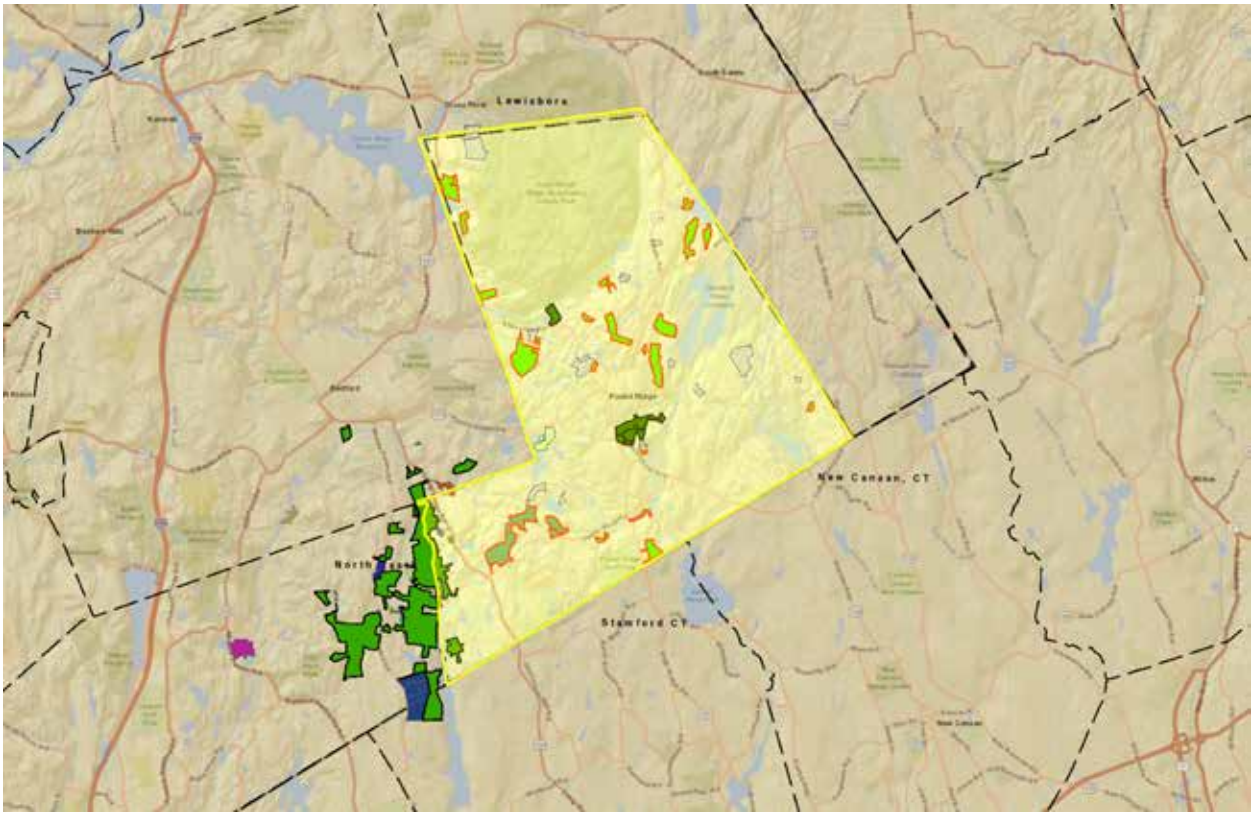
The Town Geospatial Information System (GIS) viewer, located on the Town's web site (www.townofpoundridge.com) provides detailed information about the Town's open space in several different ways. Base maps allow users to capture information from sources such as Digital Elevation and Surface Models, Aerial and Google maps, and Environmental Systems Research Institute Imagery (ESRI). In addition, data layers related to open space are available under two major headings: Westchester County Environmental Features and Pound Ridge. Under Pound Ridge and the subheading "Open Space Maps" are shapefiles of AWC properties, WLT preserves, PRLC preserves, and several others. Particularly valuable are shapefiles of the EWBC (land connecting core wildlife habitat areas) and its extension under Habitats and Wildlife maps.

Additional shapefiles are in the "Staff Folder." Requests for access to the Staff Folder may be made to the Chair of the Conservation Board or Town Clerk. In the Staff Folder are shapefiles and maps regarding open space compiled in 2017. The Conservation Board, with the assistance of a college intern, created GIS shapefiles of open space from data sets and maps previously hand-drafted by volunteers. These shapefiles were cross-referenced with data provided by the Assessor's Office of Pound Ridge, but are not to be substituted for Westchester County records.

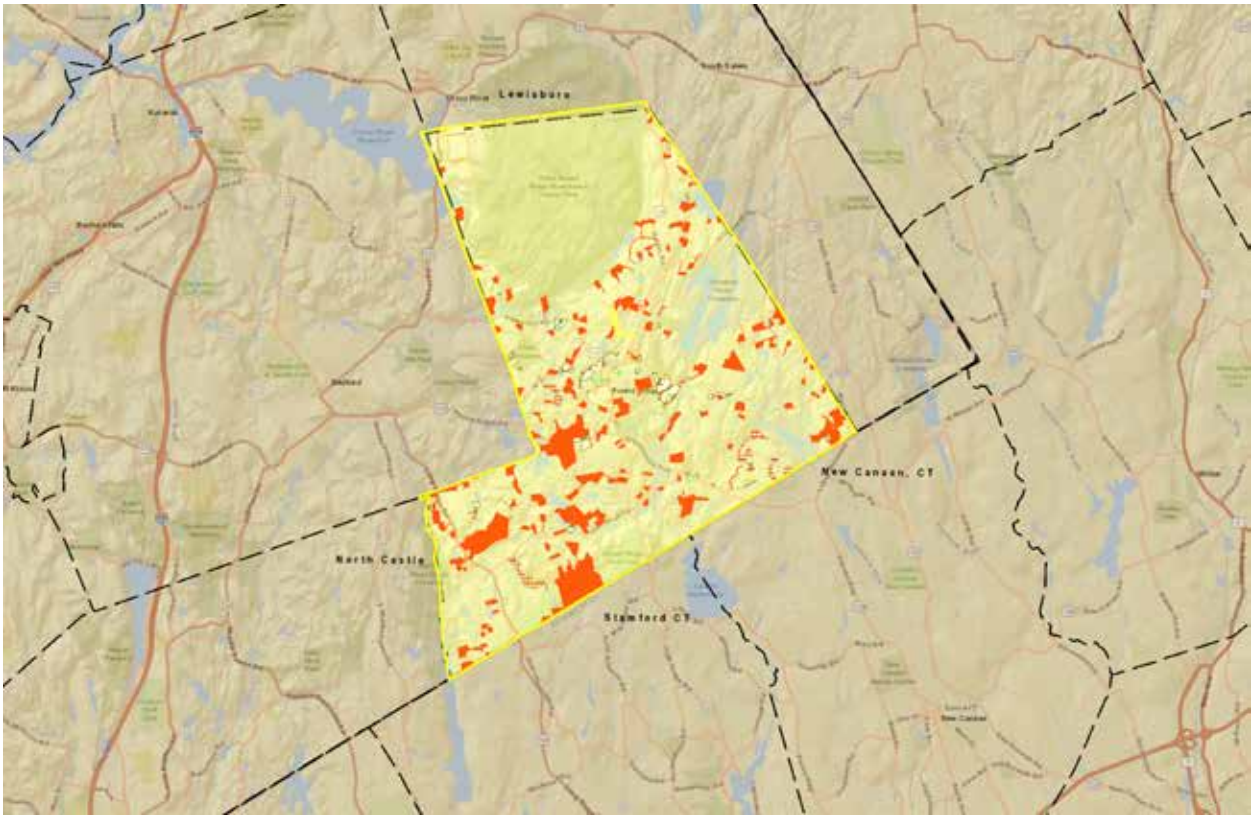
These materials were used to identify areas of town where protected land, dedicated parkland, and undeveloped private large lots create "green corridors." Also noted are buffer sensitive areas and large swaths of undeveloped, private land. All are important for water quality and undisturbed wildlands. Because this documented information can be used in combination with other shapefiles and overlays such as zoning districts, bedrock geology, sediments, steep slopes, wetlands, habitats, and EWBC, its usefulness is magnified. In addition, layered, visual information can be easily accessed and utilized for decision-making purposes by all members of the Town's Planning, Zoning, and Conservation Boards and the Water Control Commission, the Open Space Acquisitions Committee, local and regional non-profit land protection organizations as well as County planning agencies.

"Protected Open Space" consists of parcels owned outright by organizations authorized by federal law to hold undeveloped, protected lands for the public interest under IRS Rules, delineated as of November 2017. These protected lands are owned by the following organizations: PRLC, Inc., HMP, Inc., WLT, WPRR (owned and operated by Westchester County), properties owned jointly by Mianus River Gorge Preserve and The Nature Conservancy, and protected lands (dedicated park lands) owned by the Town of Pound Ridge.

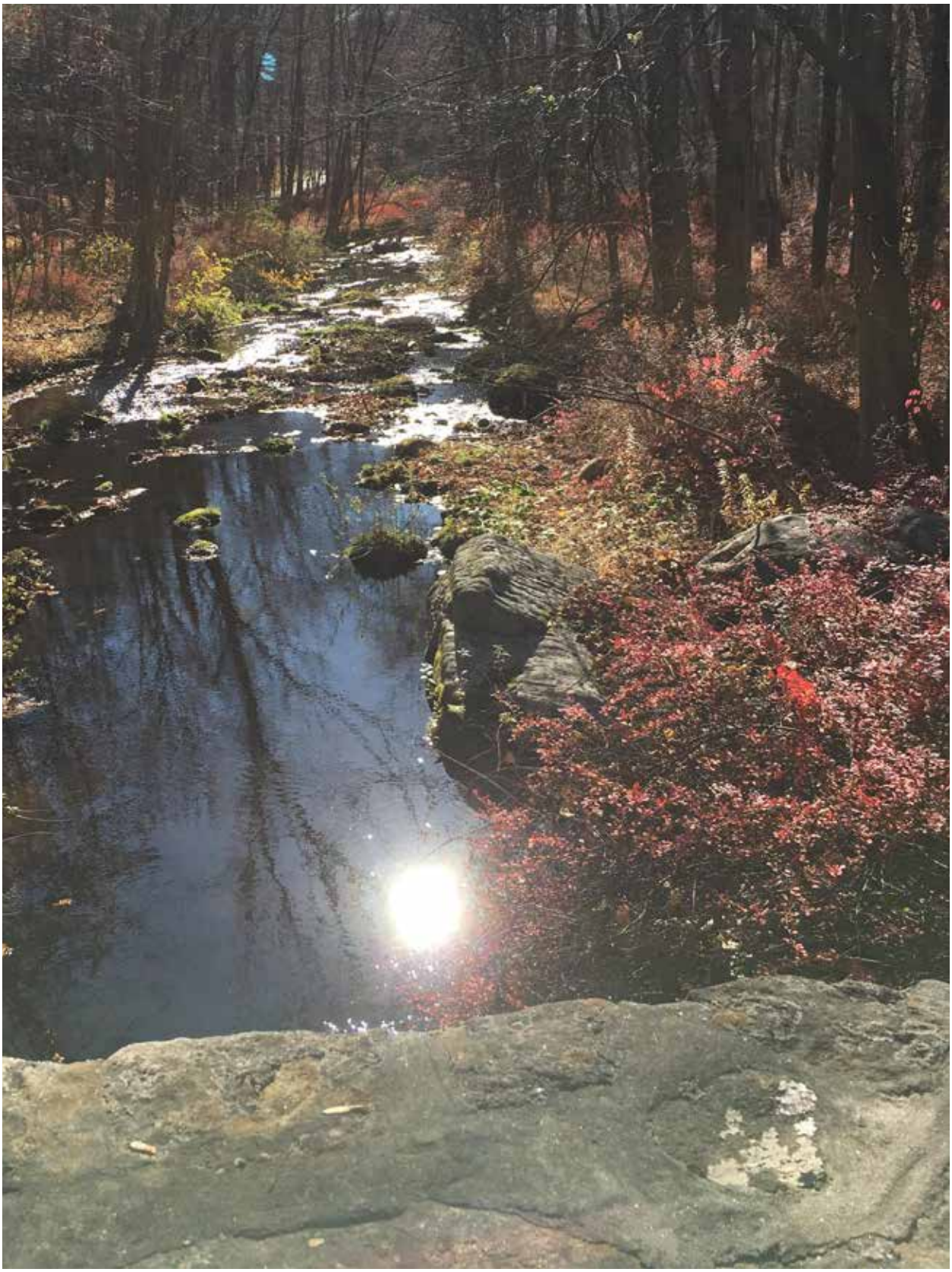
"Unprotected Open Space" consists of privately-held, unprotected and undeveloped land in the Town of Pound Ridge. Included are vacant lands selectively prioritized by the PRLC (2008) as well as the Town's OSAC (2008). These parcels, combined with other unprotected, vacant, undeveloped lands as well as lands shown on the **Protected Lands Map** are mapped in a separate "Green Corridors" overlay. This overlay, originally created by PRLC volunteers (2008), identifies connected parcels serving as wildlife corridors.



Quick reference: Pound Ridge Protected Open Space



Quick reference: Pound Ridge Unprotected Open Space



Old Mill River
P. Corey 2015

The Unprotected Open Space category also includes unprotected lands (non-dedicated parkland) held by the Town of Pound Ridge, several parcels of zoned Agricultural Lands, lands owned by public institutions such as the Bedford Central School District and Pound Ridge Library (formerly Hiram Halle Library), several parcels owned by religious organizations as well as those owned by formally filed and registered Homeowners Associations. These lands are subject to underlying residential zoning and are therefore considered "unprotected."

In addition, the Staff Folder includes special use overlays (Green Corridors, Priorities Parcels) for use by the OSAC and PRLC. Other overlays include such properties encumbered by formally filed conservation easements and therefore protected in-perpetuity. These easements are predominantly held by the WLT. Also included are Unverified Town Easements held by the Town of Pound Ridge, but not verified at the time of publishing. Dedicated and therefore protected cemeteries will have their own overlay, as do Landmarked Properties. This designation pertains only to land and viewshed protection immediately surrounding landmarked residences, barns, outbuildings.

VISION FOR THE FUTURE

New understandings about our planet inform us that what we know as "open space" sustains life. Trees, soil, and soil organisms, the components of our open space environments, actually provide stewardship for the planet. The relevance of our open space extends beyond local habitats, flora, and fauna. It extends beyond our short-sighted definitions of time and space, beyond our life expectancies, and geographic boundaries. Open space cleans away the impacts of human activity on the environment. Open space improves the overall quality of our lives. Open space is a sustaining life force for our species, *Homo sapiens*.

Pound Ridge, located only 45 miles from the center of New York City, provides residents with the rare privilege of living in the midst of a peaceful, semi-rural wooded environment with an abundance of freshwater bodies and wildlife. The efforts of many people, in the past and present, have preserved and protected the open space that makes Pound Ridge a special place to live. With the privilege of living here comes a challenge and a responsibility for Pound Ridge leadership and residents. A question often asked has been, "How do we maintain the town character and quality of life that drew many of us here in the first place?" A quickly changing climate has added new urgency and dimensions to this question.

There exists a critically important opportunity to preserve, protect and steward open space in Pound Ridge through informed decision-making and action at the local and regional levels. Individuals, landowners, public leaders, and those working in environmental organizations— all of us—need to steward our town's environment through sustainable practices and the protection and preservation of cherished open spaces. What we do makes a difference.

New information from local natural resource inventories and data sets of all kinds, combined with research-based findings and field-driven science, make better decision making possible. The answer to the question, "How do we maintain the town character and quality of life that drew many of us here in the first place?" lies in daily behaviors at home and in a long-term commitment to work with others, both influencing and being influenced by them, to preserve, protect, and steward open space for the benefits and rewards to be had. The impact of the choices we make to ensure that future generations will enjoy Pound Ridge reach beyond this time and place.

Stacked Rocks
C. Reppert 2016
The town's dramatic scenery varies from sheer rock ledges and bedrock of granite and gneiss dating to the late Precambrian (2,500 to 541 mya), to glacial erratics and boulder fields deposited during the late Pleistocene (18,000 to 11,700 years ago).

ENDNOTES

1. *"Open Space 101."* Open Space 101//LandScope America http:// www.landscope.org/explore/open_space_101/

2. *Open Space.* NYS DEC. http://www.dec.ny.gov/lands/317.html

3. *Land Use in Westchester.* Town of Pound Ridge. Westchester County Dept. of Planning. p. 93

4. Haeckel, Ingrid, and Laura Heady. *Creating a Natural Resources Inventory: A Guide for Communities in the Hudson River Estuary Watershed.* New Paltz, NY: New York State Department of Environmental Conservation, Hudson River Estuary Program, 2014.

5. *Comprehensive Plan.* Town of Pound Ridge, New York. Adopted Nov. 4, 2010. http://www.townofpoundridge.com/sites/default/files/fileattachments/compplannov4_2010.pdf

6. Residential density is calculated as total number of units per residential or homeowners' association lands. *Land Use in Westchester.* Westchester County Dept. of Planning, 2010, p. 19. https://planning.westchestergov.com/images/stories/reports/LandUseReport1.pdf

7. *Comprehensive Plan.* p. 6

8. *Your Pound Ridge Open Space Committee Update.* Letter. Feb. 2002.

9. Lee, A.C.K., and R. Maheswaran. *Health Benefits of Urban Green Spaces: a Review of the Evidence.* Journal of Public Health | Oxford Academic." OUP Academic, Oxford University Press, 10 Sept. 2010, academic.oup.com/jpubhealth/article/33/2/212/1585136.

10. *Climate Smart Communities Toolkit.* NYS Dept. of Environmental Conservation. Web. 03 Aug. 2017.

11. *"Climate Change."* Climate Change | US Forest Service, www.fs.fed.us/science-technology/climate-change.

12. *Land Use in Westchester.* Westchester County Dept. of Planning. 2010. P. 14 https://planning.westchestergov.com/images/stories/reports/LandUseReport1.pdf

13. Ibid.

14. *Your Pound Ridge Open Space Commitee Update.* Letter. Feb. 2002

15. *Comprehensive Plan.* P.C.-4

16. Ibid. P. C-6.

17. McKenney, Bruce and Jessica Wilkinson. *Achieving Conservation and Development: 10 Principles for Applying the Mitigation Hierarchy.* The Nature Conservancy. 2015

18. *"Urban Runoff: Low Impact Development."* EPA, Environmental Protection Agency, 17 Oct. 2017, www.epa.gov/nps/urban-runoff-low-impact-development.

19. Arendt, R. et al. *Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks*. Washington, DC: Island Press. 1996.

20. *"Town of Pound Ridge, NY Table of Contents."* Town of Pound Ridge, NY Code, www.ecode360.com/PO0893?needHash=true.

21. *Comprehensive Plan.* Town of Pound Ridge, New York. Adopted Nov. 4, 2010.

22. *Land Use Through Ecology.* Jerzy E. Glowczewski. Sponsored by Pound Ridge United for Planning (PRUP) Trust. 1980.

23. As defined in the Eastern Westchester Biotic Corridor Report, Nicholas Miller and Michael Klemens, Wildlife Conservation Society/ Metropolitan Conservation Alliance, 2002.

24. *What Is Open Space/Green Space?* Region 1: EPA New England. Environmental Protection Agency. Web. 22 Nov. 2017.

25. *Comprehensive Plan.* P. C-16; E-10.

26. Ibid. P. D-7.

27. New York General Municipal code-Section 239-Y

28. 6 NYCRR Part 617 State Environmental Quality Review (SEQR)

WORKS CITED

Arendt, R. et al. *Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks.* Washington, DC: Island Press. 1996.

"Climate Change." Climate Change | US Forest Service, www.fs.fed.us/science-technology/climate-change.

Climate Smart Communities Toolkit. NYS Dept. of Environmental Conservation. Web. 03 Aug. 2017.

Comprehensive Plan. Town of Pound Ridge, New York. Adopted Nov. 4, 2010. http://www.townofpoundridge.com/sites/default/files/fileattachments/compplannov4_2010.pdf

Glowczewski, J. E. *Land Use Through Ecology.* Sponsored by Pound Ridge United for Planning (PRUP) Trust. 1980.

Haeckel, Ingrid, and Laura Heady. *Creating a Natural Resources Inventory: A Guide for Communities in the Hudson River Estuary Watershed.* New Paltz, NY: New York State Department of Environmental Conservation, Hudson River Estuary Program, 2014.

Land Use in Westchester. Westchester County Dept. of Planning. 2010.

Lee, A.C.K., and R. Maheswaran. *Health Benefits of Urban Green Spaces: a Review of the Evidence* | Journal of Public Health | Oxford Academic. OUP Academic, Oxford University Press, 10 Sept. 2010, academic.oup.com/jpubhealth/article/33/2/212/1585136.

McKenney, Bruce and Jessica Wilkenson. *Achieving Conservation and Development: 10 Principles for Applying the Mitigation Hierarchy.* The Nature Conservancy. 2015.

Miller, Nicholas,. and M. Klemens. *Eastern Westchester Biotic Corridor Report.* Wildlife Conservation Society/Metropolitan Conservation Alliance. 2002.

New York General Municipal Section 239-Y.

Open Space. NYS DEC. http://www.dec.ny.gov/lands/317.html

"Open Space 101." Open Space 101//LandScope America. Web.

http:// www.landscope.org/explore/open_space_101/

Personal communication. Lori Ensinger, President, Westchester Land Trust. Jan.18. 2018.

Town of Pound Ridge, NY Table of Contents. Town of Pound Ridge, NY Code, www.ecode360.com/PO0893?needHash=true.

"Urban Runoff: Low Impact Development." EPA, Environmental Protection Agency, 17 Oct. 2017,

www.epa.gov/nps/urban-runoff-low-impact-development.

"What Is Open Space/Green Space?" Region 1: EPA New England. Environmental Protection Agency, Web. 22 Nov.. 2017.

Your Pound Ridge Open Space Committee Update. Letter. Feb. 2002.

Habitats

Fall day
Curtis Lew

PART 1

Habitats

At a Glance

PART 2

Significant Habitats in the Town of Pound Ridge

Hudsonia Ltd.

At a Glance

PART 1 • Habitats

Within the 23 square miles of our Town lie many different habitats, and some are on your property. In fact, according to Hudsonia Ltd., **The first important message of this narrative is that "Pound Ridge is home to an impressive diversity of high-quality, large habitat patches and unusual habitat types" (Part II p.115).** Habitats are defined as the places where plants, animals, and other organisms live, and are characterized by what lives there (particularly the plants) and the impacting environmental factors (rainfall, seasonal temperatures, etc.).

Surrounding spaces, or buffers, protect habitats by limiting the spread of noise, chemical pollution, and invasives species. The connecting spaces, or corridors, are needed to ensure the safe travel of animals to a variety of places used throughout the year for feeding, mating, nesting, and shelter. **The second important message of this narrative is that we need to care for our valuable habitats, as well as the areas that connect and surround them.** Fortunately, we benefit from the care that we extend to the environment in which we live!

As part of the Town's Natural Resource Inventory, this narrative is intended to support residents, planners, Town officials and agents in their decision-making processes. Part I of this narrative was prepared by the Conservation Board and is intended to be a resource for you, as someone who lives in Pound Ridge and cares about the land. Part II, *Significant Habitats of Pound Ridge*, is a technical report with descriptions of habitats, maps and recommendations. The report was prepared by Hudsonia Ltd. (a not-for-profit institute for research, education, and technical assistance in the environmental sciences). Members of permitting agencies, the Planning Board and the Water Control Commission, will find the habitat maps and recommendations from Hudsonia Ltd. especially helpful. A large-scale map with greater detail is available for reference at the Town House.

Red Fox on a snowy day
Rhonda Spevak

USING THE TOWN GIS

This narrative combined with the Town GIS (Geospatial Information System) adds extensively to our knowledge about where we live and the variety of habitats where plants, animals, and other organisms live. It is important to remember the limitations of all base maps and data layers. They merely approximate locations and the extent of surface and underground features. They are inherently inaccurate and not a substitute for site visits and on-the-ground delineation or surveys. While the data is updated periodically, it may not always be current and should be used for illustrative purposes only. The User's agreement for the Town GIS specifies: any use of the information contained herein should be accompanied by (1) a reference to its source, (2) a caveat that the Town of Pound Ridge makes no warranties, guarantees, or representations to the accuracy or completeness of this information, and (3) a statement that the information contained herein is NOT a legal description. Hudsonia Ltd. requests (Part II p.15) that any maps printed from their database for public viewing be printed at scales no larger than 1:10,000, and that the map data be attributed to Hudsonia Ltd. Although the maps were carefully prepared and extensively field-checked, there are inevitable inaccuracies. Because of this, Hudsonia requests that the following caveat be printed prominently on all its maps: *This map is suitable for general land-use planning, but is unsuitable for detailed planning and site design or for jurisdictional determinations. Boundaries of wetlands and other habitats depicted here are approximate.*

Many maps are available on the Town GIS, accessed through the Town webpage. Some maps, such as these four examples: **Lakes, Rivers, Streams Map, Dams, Geology, and Soils,** support an understanding of the conditions affecting local habitats and are described in the Water Resources Inventory. Other maps, provided by Westchester County GIS and on the Town website, are more specific to habitats.

Under Westchester County Environmental Features:
- **Fish and Wildlife Habitats**
- **Critical Environmental Areas**
- **Important Areas for Rare Plants; Rare Animals;** and **Natural Communities** (DEC)
- **Significant Biodiversity Areas and Significant Natural Communities** (DEC)

Under Pound Ridge, NY, Habitats and Wildlife:
- **Eastern Westchester Biotic corridor** (DEC)
- **Eastern Westchester Biotic corridor and extension** (DEC)
- **Ecozone** (DEC)
- **Ecoregions** (EPA)
- **Habitats maps** Figures 1-7; 9-10 (Hudsonia Ltd.)

Several of the maps listed above are described in the following section with source information provided in the Data Warehouse (Appendix A). As similar maps are presented in Part II (the Hudsonia Ltd. report, Figures 1-10), images of the maps are not included here.

ECOZONE AND ECOREGIONS MAPS

An ecozone is a large geographic area characterized by similar terrestrial organisms. The **Ecozone Map** is not inserted here as all of Pound Ridge falls within the Manhattan Hills ecozone. The ecozone map is based on *Boundaries of the Ecological Regions of New York State,* taken from Will et. al. (1982) and Dickinson (1983). The following description of the Manhattan Hills ecozone is from *Bull's Birds of New York State:*

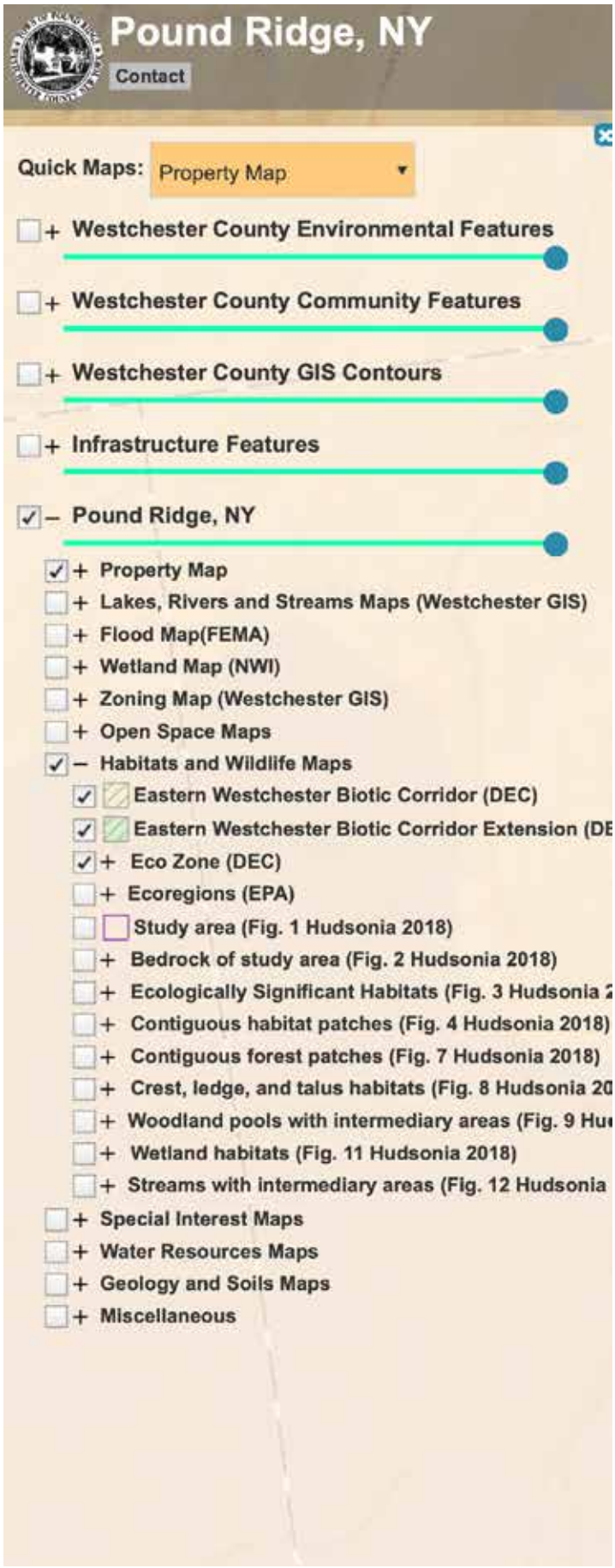
Covering 500 sq mi, with elevation ranging from near sea level close to the Hudson River to over 700 ft on many hilltops, the Manhattan Hills ecozone has mild wet winters and warm humid summers. Oak and oak-northern hardwoods predominate, with pioneer trees most common as in the Hudson Highlands.[1]

An ecozone is subdivided into **ecoregions.** Ecoregions can be viewed on the **Ecoregions Map** on the Town GIS and in an interactive map: https://geodata.epa.gov/arcgis/rest/services/ORD/USEPA_Ecoregions_Level_III_and_IV/MapServer

EASTERN WESTCHESTER BIOTIC CORRIDOR AND EXTENSION MAPS

The Eastern Westchester Biotic Corridor (EWBC) was delineated based on the results of data and map analyses by Miller and Klemens in 2002.[2] As described in that report (p. 8-9),[3] the EWBC constitutes a broad swath of habitat that trends primarily from south to north within the three towns of Pound Ridge, Lewisboro, and North Salem. Ward Pound Ridge Reservation is at the heart of the corridor with the potential to act as source habitat for wildlife over the entire corridor. For dispersal of wildlife to happen between hubs, good habitat must be available within the corridor. It has been determined that the wooded tracts comprising the EWBC possess regionally significant conservation values. A copy of the study, which includes a list of species of conservation concern in Pound Ridge (p. 10) and recommendations (p. 14-15), is available in Appendix B of the *Town of Pound Ridge Comprehensive Plan* (2010) and on the web at: https://www.lewisborogov.com/sites/default/files/fileattachments/conservation_advisory_council/page/4727/bioticcorridor.pdf

The DEC **Large Forest Patches Map** (under Westchester County Environmental Features) illustrates the value of our community as forest habitat. The size of a contiguous forest patch is a determining factor for forest-dependent species. Almost all of Pound Ridge is covered by either "locally important (2,000-5,999 acres)" or "regionally important (6,000-14,999 acres)" forest patches. Smaller but locally important forest ecosystems often represent the lower limit of intact, viable forest size for forest-dependent birds. Such bird species often require 2,500 to 7,500 acres of intact interior habitat. Smaller patches are often less able to maintain the entire range of needed habitats and successional stages after large-scale disturbances. These forests, like the larger regionally important forests, can provide important corridors and connectivity among forest ecosystems. Regionally important patches provide habitat to more area-sensitive species and can accommodate large-scale disturbances that maintain forest health over time.



Pound Ridge GIS features

Great meadow (Long Ridge Road). Early residents clear cut the land.

Photo Courtesy Pound Ridge Historical Society.

EARLY FORESTS

Forests covered Pound Ridge, like most of the northeast, following the Pleistocene ice ages. For more than 10,000 years, Native Americans, the earliest people inhabiting Pound Ridge, cleared small areas of the forest for settlements and burned small areas of the understory,[4] possibly to increase the food supply for deer.

For the colonists, and for many others over the past 250 years, the forests were an obstacle[5] to agricultural practices, including dairy farming and the cottage industries, notably basket and shoe making, that characterized Pound Ridge. The forests were clear cut in nearly all of Pound Ridge save certain steep slopes where stately hemlocks remain today. Logging was commonplace. Rocks were regularly frost-heaved and then stacked by hand. The stone walls lacing our community stand as silent witnesses to this extended time period.[6]

By the turn of the century, the problems created by disappearing forests and bare hillsides and the need to replace trees were recognized. To reduce erosion, evergreen trees were planted in rows by the New York State Conservation Department established in 1922. Conifer plantations were also planted by the Civilian Conservation Corps (CCC), a public work relief program established by Congress in 1933 during the Depression, that operated until 1942. These conservation programs were part of a movement begun in the late 19th century to preserve and protect America's wildlife, wild lands, and other natural resources. Around this time period, the land was farmed less intensely and fast-growing tree species that reseed prolifically —red oak, red maple, white ash, birches, and black cherry— re-established naturally. In keeping with patterns of succession, these were followed later by shade-tolerant species (Eastern hemlock, sugar maple, American beech).

After WWII, the baby boom combined with the accessibility to cars, improved roadways, and a consumer economy drove young families from urban cores to suburban communities. The automobile made it faster to reach train stations and highways and shortened the travel time from Pound Ridge to New York City. It wasn't long before these events awakened Pound Ridge from its sleepy, rural existence. With time, the forest matured. The woods, like the stone walls, can be read for clues of the past. The

odd growth of a tree that matured from a multi-stemmed sprout clump (a natural response to being cut, burned, or gnawed) or the unusual girth and spread of a wolf tree (a large old tree that had once been allowed to remain in a pasture) tell stories of the past.

TAKING CARE OF THE LAND IN POUND RIDGE

On a daily basis, those who live in Pound Ridge appreciate nature as it exists on wooded properties, in the spaces between their homes, and along unruly, tree-lined roadsides. Less valued and understood are the many quality habitats that lie within and near Pound Ridge. Yet, during the last 25 years, several residenta have emerged as leaders in efforts to conserve open space, preserve the natural beauty, and enhance the habitats of Pound Ridge.

Sara Stein, now deceased, is perhaps the best known on the national level. Her success in transforming her Pound Ridge garden into vibrant habitat spaces, continues to inspire others to this day. Both the narrative and illustrations in her book, *Noah's Garden: Restoring the Ecology of Our Own Backyards,* published in 1993, have special meaning to those who live here. Her efforts helped to redefine the meaning of gardening as "taking care of the land." Her former garden, located in Pound Ridge, and lovingly maintained by owners James and Ellen Best, can sometimes be visited on the Garden Conservancy's Open Days.[7]

The Invasives Project-Pound Ridge (TIP-PR or TIP) has gained regional attention since it was formed in 2012. An initiative of Marilyn Shapiro, of the Henry Morgenthau Preserve Board, and Carolynn Sears, from the Town's Conservation Board, TIP was established over coffee on a winter day at Blind Charlie's, the local luncheonette. TIP was created to actively address the care of the land by highlighting the pressures of invasive species. With a mission to protect the natural beauty of Pound Ridge, preserve wildlife habitat, encourage the use of native plant species, and limit the spread of invasive species, TIP has involved residents through education and outreach and in volunteer activities. A popular component of the program features free site visits by two volunteers who identify native and invasive species at a property owner's request.

Westchester Wilderness Walk/Zofnass Family Preserve encompasses a network of trails through rocky terrain, woods, hillside streams, lakes, and wetlands within its 150 acres. Paul Zofnass conceived the idea of creating a preserve and worked for over 10 years to put the project together. Paul and his family donated land, persuaded their neighbors to donate land, and created the impressive trail system. The preserve is a jewel among those protected by Westchester Land Trust. Unknown to many, an ambitious botanical inventory of the Westchester Wilderness Walk/Zofnass Preserve was initiated in 2013 by Scott Mori, Ph.D., a resident of a nearby community, and a team of botanists from the New York Botanical Gardens (NYBG). The inventory has resulted in a web-based tool for use by visitors to the preserve.

Other Pound Ridge residents contribute in large and small ways. Some, such as members of the Morgenthau family, donate land. Others serve on a variety of boards in order to protect our natural resources; volunteer to help within the preserves; help youth groups with projects in the woods; garden with native plants or strive to support pollinators; maintain an organic lawn or garden; apply integrated pest management practices; and sign the Healthy Yard Pledge.

NATIONAL ENVIRONMENTAL LEADERS

Now, as in the past, the messages of national environmental leaders emerge and reach Pound Ridge, forever changing the way we think about how and where we live. Still relevant today are Rachel Carson's prophetic revelations about the damaging barrage of pesticides traveling through food chains[8] and Lady Bird Johnson's presentation of beautification through wildflowers as a concept that includes clean water, clean air, clean roadsides, safe waste disposal, and the world we pass on to our children.[9] Today we listen to wildlife ecologist, Doug Tallamy, champion native plants and guide the way individual homeowners think about the environment and the role of their property in the larger ecosystem.

In *Bringing Nature Home: How Native Plants Sustain Wildlife in Our Garden,* Tallamy explains the basis of his charge to us:

> But now, for the first time in its history, gardening has taken on a role that transcends the needs of the gardener. Like it or not, gardeners have become important players in the management of our nation's wildlife. It is now within the power of individual gardeners to do something that we all dream of doing: to "make a difference." In this case, the "difference" will be to the future of biodiversity, to the native plants and animals of North America and the ecosystems that sustain them.[10]

Starting in the early 20th century, almost 84 million acres have been preserved to create our National Park System. New York City, while forever being the nation's financial and cultural center, would not be the city it is without the oasis known as Central Park. Designed in 1857 by Frederick Law Olmsted, Central Park gives testimony to his high regard for maintaining a sense of

place. In our area, land preservation started with a story of a dramatic race against time to save the Mianus River Gorge in 1953.[11] Purchased in 1955, this site was The Nature Conservancy's first land preservation project. In 1964, the federal government designated the Mianus River Gorge the nation's first registered Natural History Landmark because of its old-growth hemlock hardwood forest and rushing river. It is now managed by the Mianus River Gorge Preserve, Inc., a nonprofit land trust, which also owns 183 acres of the preserve.[12] In Pound Ridge, the land which is now the Halle Ravine preserve was purchased by the town's premier philanthropist, Hiram Halle, in 1928. In 1968, the Halle family formally created the preserve under the auspices of the Halle Committee and The Nature Conservancy, which donated the preserve to Pound Ridge Land Conservancy (PRLC) in 2004. The Natural Resources Inventory includes a narrative on the thousands of acres of open space lands in Pound Ridge.

Now, in 2018, we know that preserves are not enough to sustain nature. According to Tallamy, we have turned 54% of the lower 48 states into cities and suburbs, and 41% more into various forms of agriculture. Humans have taken 95% of nature and made it unnatural.[13] Based on research, Tallamy's full message is both urgent and hopeful:

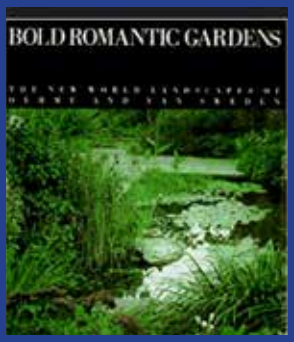
> In the past, we didn't design gardens that play a critical ecological role in the landscape, but we must do so in the future if we hope to avoid a mass extinction from which humans are not likely to recover either. As quickly as possible we need to replace unnecessary lawn with densely planted woodlots that can serve as habitat for our local biodiversity. Homeowners can do this by planting the borders of their properties with native trees such as white oaks *(Quercus alba),* black willows *(Salix nigra),* red maples *(Acer rubrum),* black walnuts *(Juglans nigra),* river birches *(Betula nigra)* and shagbark hickories *(Carya ovata),* under-planted with woodies like serviceberry *(Amelanchier canadensis),* arrowwood *(Viburnum dentatum),* hazelnut *(Corylus americanus),* blueberries *(Vaccinium spp).* Our studies have shown that even modest increases in the native plant cover on suburban properties significantly increases the number and species of breeding birds, including birds of conservation concern. As gardeners and stewards of our land, we have never been so empowered to help save biodiversity from extinction, and the need to do so has never been so great. All we need to do is plant native plants![14]

In Pound Ridge the woodlands surrounding our properties give us a head start. By thoughtfully choosing the plants to grow on our property, we can connect to preserved lands and support the biodiversity of habitats and their inhabitants. This redefinition of gardening, to embrace taking care of the land, breathes life into the underlying message of this narrative: our local habitats require our care.

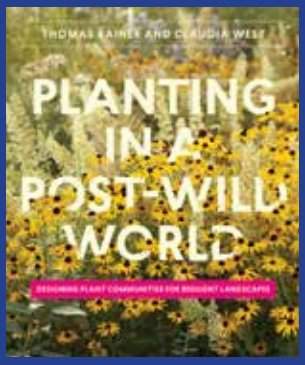
Our town has at least 23 different habitat types of ecological importance identified by Hudsonia (Part II p. 17 Table 1). Some of the habitats are rare or declining in the region or support rare species of plants or animals, while others are high quality examples of common habitats or habitat complexes (p. 5). A thought-provoking message, referenced in the Hudsonia report (Part II p. 115), is described as a "habitat approach." A habitat approach[15] is challenging as it necessitates a deeper examination of the surroundings and a detailed look at nearby habitats to understand their constituent species, both permanent and transient, and the ecological processes that support the habitats and species (and vice versa). Even a superficial understanding of the demands of this approach generates a sense of awe. This narrative started with a simple definition of a habitat as a place where a plant or animal lives. With Hudsonia's contributions, it moves us to a deeper appreciation of what we have and a respect for the fullness of Hudsonia's closing charge "of incorporating this approach into planning and decision making...to minimize the adverse effects of human activities on the landscape, integrate the needs of the human community with those of natural communities, and protect the ecological patterns and processes that support us and the rest of the living world" (Part II p. 117).

One step at a time
C. Reppert 2017

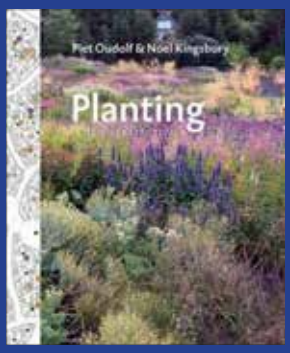
GARDENS USING NATIVE PLANTS AND SUPPORTING WILDLIFE CAN BE BEAUTIFUL, AS ILLUSTRATED IN THESE RESOURCES. Consider applying these design principles to your landscape.



Bold Romantic Gardens: The New World Landscape of Oehme and Van Sweden
By Wolfgang Oehme and James Van Sweden (1998)



Planting in a Post-Wild World: Designing Plant Communities for Resilient Landscapes
By Thomas Rainer and Claudia West (2015)



Planting: A New Perspective By Noel Kingsbury and Piet Oudolf (2013)

"My hope for what lies ahead in the field of landscape design—our own and that of the professionals—isn't a revolution against the use of non-natives, but a resolution to educate ourselves about what has worked for Mother Nature through the ebb and flow of time and to put that knowledge to work in the planned landscapes that are everywhere a part of our lives."

— Letter from Lady Bird Johnson on the Wildflower Center website. Date unknown.

An Open Letter to Residents

Echinacea flowers and pollinators
Elyse Arnow

Dear Neighbors,

To support wildlife on your property, you will want to know about the habitats in our community. Read this narrative in its entirety. Refer to the Hudsonia report (Part II) and the Town GIS to understand and appreciate the habitats embracing your property and nearby. Next, you may want to map your yard and join the Habitat Network (www.yardmap.org/), a citizen science project transforming our landscapes and created by the highly respected Cornell Lab of Ornithology. Then, consider the overall quality of your property, add some native plants and enjoy. The basic requirements for wildlife are food, water, shelter, and nesting sites. Continue reading to learn more.

FOOD

Plants, with few exceptions, are the basis of food chains. Bird feeders are rewarding, but it is the plants, the "green factories" of the world, that are capable of turning sunlight into stored food. For many reasons, plant species from exotic places do not meet the food requirements of native animal species. Invasive plant species, typically alien and aggressive, crowd out native plants. Our local native plants and wildlife, on the other hand, have evolved together since the last retreat of Pleistocene ice more than 11,700 years ago. The plants in your yard are the basis of productive and protective habitats. Get to know what plants grow on your property and the value they add!

Consider two aspects of the lawn: lawn management practices and the size and composition of the lawn itself. Some lawn management practices are simply detrimental to wildlife. For example, excess fertilizers are carried with stormwater runoff into our streams, ponds, and reservoirs and can cause algal blooms. Two practices, testing the soil and applying fertilizers as needed in the fall, can prevent this isssue. Another example is the use of pesticides and herbicides. As toxins meant to target organisms living in the environment, these chemicals are the antithesis of wildlife support. In most food chains, insects are the critical link between plants and wildlife. A chemical-free lawn supports insects for birds to eat. In a balanced environment, birds and beneficial insects such as lace wings, lady beetles, minute pirate bugs, and assassin bugs, feed on other insects and keep them in check. Instead of applying pesticides, try monitoring for pests and using non-toxic controls. To lower the use of both fertilizers and pesticides, try reducing the size of the lawn.

Less lawn can benefit wildlife in multiple ways. A typical lawn, as a monoculture, does not support a diversity of wildlife. The woodland edge is a natural starting point for this project. Create a transition between the woods and lawn by introducing a variety of native plants. Varying heights of different herbaceous plants, a range of seasonal blooms, and different flower shapes addresses the needs of a variety of wildlife, from butterflies and hummingbirds to tree frogs and woodcocks. Including some evergreens for winter cover and adding shrubs and small trees, especially some fruit or nut bearing ones, provides four seasons of beauty and interest.

SHELTER AND NESTING PLACES

In addition to food for wildlife, a change in lawn size and maintenance routines offers shelter and places to nest. By leaving an unmowed area of wildflowers, grasses and sedges, the seeds in the dead flower heads provide food throughout the winter and the standing stems in winter offer shelter. Raking leaf litter into this transition zone provides overwintering protection for reptiles, amphibians, and insects which, in turn, provide food for ground feeding birds. Avoid creating dense piles of leaves on the land or adding large quantities of leaves to wetlands or water bodies. Without a flow of oxygen, the leaves will not decompose or provide food and shelter to wildlife.

Appreciate habitat provided by stone walls, decaying logs, and dead trees. In the woodlands, you can make a brush pile with yard debris. Let 'snags' or dead trees stand and decay upright, as long as there is no target nearby should they fall. Birds, small mammals, and other wildlife use snags for nests, nurseries, storage areas, foraging, roosting, and perching. Live trees with snag-like features, such as hollow trunks, excavated cavities, and dead branches can provide similar wildlife value. When a tree falls and becomes a log, leave it to decay. Logs provide damp shelter and food for many plants and animals. Beetles, centipedes, earthworms, and many others live among the rotting wood and feed on it. These organisms, some too small to be seen, are called decomposers, and include fungi and bacteria. As the wood decays, the nutrients stored in the wood are returned to the soil. Create a log pile for wildlife on your property. Of course, you may add birdhouses and nesting boxes to your property, and it helps to keep the cat indoors. Create habitat with twigs, logs, and rocks.

Above: Stone Walls *Elyse Arnow*; **Left: Brush Pile; Below: Shaker Log stack** *C. Reppert 2016*

Skunk cabbage along Shelly's Walk, Town Park
C. Reppert 2018

WATER

Lucky is the property owner with a stream, pond, or lake frontage. Wetlands and riparian areas bordering water bodies provide important habitat for a variety of birds, mammals, amphibians, and reptiles. Allowing a buffer of native plants, specially adapted to and dependent on the unique conditions of these areas, provides many benefits. Streambank vegetation helps cool surface water and regulate stream temperatures in ways beneficial to fish and other aquatic creatures. Riparian and wetland vegetation reduces the velocity of stormwaters. Slowing stormwater down lessens flooding and erosion. The plants plus accumulated plant litter and humus allow water to be captured, filtered, and slowly released over time. Soil microbes break down pollutants. These areas serve as homes, grocery stores, and nature's water treatment facilities.

If you do not have a pond, stream, vernal or seasonal pool, or wetland, and even if you do, water can be provided with a birdbath. Adding a device to create motion will attract birds, especially hummingbirds, and a heated bird bath helps in the winter when other sources of water are frozen.

CHALLENGES

Living with nature presents challenges. We often swap stories about mice, voles, deer, beaver, groundhogs (all herbivores) and grumble about the damage they cause. Ironically, efforts to garden with native plants need to be balanced with efforts to protect them from some wildlife. Until food runs out or other limiting factors come into play, the population densities of herbivores and other small mammals (such as fox) can keep increasing. The imbalance between the density of our local deer population and its food supply leads to a visible absence of a woodland understory and potential impacts on local watersheds. For some, the sighting of this beautiful animal in the garden has lost a bit of its joy.

Mixed feelings surround another group of animals: the predators. Seeing a predator, from a safe distance, excites us. Instinctively we know their role in nature, at the top of the food chain, as "an important limiting factor." We share our sightings[16] of coyote, bobcat, and bear. To the scientist, confirmed sightings are an indication of species distribution and are not a reliable measure of population density.

Vernal pool
Elyse Arnow

Regarding local predator populations, coyotes have been here for decades and the population is fairly stable. There is little data on bobcats and members of the weasel family (fishers may be making a come back). Data indicate bears are becoming permanent residents. For most of these species, the population density will reach a maximum number that is typically low for predators. For example, sometime after initial colonization, the territory for one pair of coyotes is approximately 1.5 - 15 square miles (4-40 square kilometers). Territories needed for other species are greater. Because predators are territorial, population growth occurs primarily when younger animals have the ability to expand into new areas. If there are no new areas for expansion, then competition within the territory increases and thus survival and reproduction declines. Therefore, long-term population densities of predators remain fairly stable.[17]

The full range of challenges presented by climate change on habitats are unknown. Among the many abiotic factors shaping habitats (e.g. sunlight, pH, soil, wind, etc.) are two that are significantly impacted by climate change: temperatures and precipitation patterns. The impacts of increasing temperatures and changing patterns of precipitation are experienced as drier winters, more intense rain events, heat waves and dry periods in the summer). Predicting the impacts on local habitats is difficult. Species distribution, disruptions in life cycles, and synchronistic relationships (e.g. the arrival of a migrating species with its food supply) are a few broad categories where changes are anticipated. The reader is referred to the report on Climate Impacts within the Natural Resources Inventory and to examples of what ordinary people can do to (1) collect useful data as citizen scientists and (2) address climate change at home, on the road, and on their property. Reducing the size of the lawn, creating rain gardens and the addition of native plants are but a few of the simple action steps that address climate change.

IN CLOSING, living close to nature is not easy. May your efforts to take care of the land and the life it supports be mostly joyful and rewarding!

Regards,
Carolynn Sears
Chair, Conservation Board

TABLE 1. Summary of Climate Effects

Asset	Climate Impact	Climate Effect	Description
Natural Habitat and Biodiversity	Increased temperature; Altered precipitation patterns	Shifts in species habitat and range; Change in forest composition; Spread of invasive species; Reduced water quality	Temperature and water level fluctuations decrease the availability of habitats while causing shifts in bloom dates and pollination opportunities in plant communities. These disruptions in natural communities may alter the ecosystem services they provide. Species composition will likely change; this could increase invasive species. Species unable to migrate may become extinct. Forest composition is likely to change with implications for economically vital species such as sugar and red maple. Warmer water temperatures result in decreased water quality and diminished habitat for cold water species.
	Extreme heat and weather	Damage to habitat	Additional stress on habitats could impact the ability of species, communities, or habitat to recover. Species already vulnerable from non-climate stressors would be especially impacted.
	Reduced Snow Cover	Damage to habitat; Trophic cascades; Altered food web structure	Small mammals depend on snow cover for insulation and protection from predators. A decline in small mammals impacts predator populations but benefits large herbivores by reducing competition for vegetation.
	Flooding; Sea level rise	Damage to wetlands, shoreline, riparian areas	Inundation, changes to in salinity, and more frequent flooding can alter habitat suitability of wetlands. Loss of tidal wetlands reducing their capacity to dampen storm surges and sequester carbon. Inundation and more frequent flooding will cause land owners to harden shorelines, eliminating valuable shoreline habitat.

Mid-Hudson Regional Sustainability Plan. Table 7.9 Summary of Open Space Related Climate Effects. (2013). P. 7-15.

Visitors to a bird feeder at a home on Barnegat Road
James I. Jones, M.D. 2015

The North American beaver (*Castor canadensis*), was adopted as the official state animal of New York in 1975. These unique mammals with flat tails and shiney fur are second only to humans in the ability to change a landscape. Once nearly extirpated (no longer found) in New York, they have successfully rebounded as a species and earned their reputation as 'busy beavers', The end result of all their activity can create a nuisance. Beaver dams can threaten downstream property, cause upstream flooding of land, kill or damage trees and crops, flood homes and roadways, contaminate water supplies, damage wildlife habitats, and cause other problems. While it is ultimately the responsibility of the landowner to resolve most of these problems, no person is allowed at any time to disturb a beaver's dam, house, or den without written permission. For further information refer to the NYSDEC website (http://www.dec.ny.gov/animals/6992.html) or contact NYSDEC Region 3 Office.

Citizen Science

To assist scientists you can post observations on a variety of websites, join others making observations in the field, and/or provide leadership to start-up a project:

• **Wild Suburbia**
http://www.inaturalist.org/projects/wild-suburbia-new-york-ct
Use this survey for your sightings in Westchester, Fairfield, upstate NY, or anywhere outside of NYC or Long Island. This survey currently records observations for black bear, bobcat, coyote, fisher, and red fox.

• **iNaturalist.org**
https://www.inaturalist.org/
Whether you have a PhD or just love the outdoors, iNaturalist and its convenient App will bring you closer to nature and many fellow naturalists.

• **iMapinvasives**
https://www.imapinvasives.org
iMapInvasives is an online, GIS-based data management system used to assist citizen scientists and natural resource professionals working to protect our natural resources from the threat of invasive species.

• **Nature's Notebook** - USA National Phenology Network
https://www.usanpn.org/about
Phenology is the study of cyclic and seasonal natural phenomena, especially in relation to climate and plant and animal life. Examples include the sounds of spring peepers, arrival of hummingbirds, and the flash of fireflies. The USA National Phenology Network consists of a National Coordinating Office (NCO), thousands of volunteer observers and many partners, including research scientists, resource managers, educators, and policy-makers. Anyone who participates in Nature's Notebook or collaborates with NCO staff to advance the science of phenology or to inform decisions is part of the USA-NPN.

• **Project FeederWatch** - Cornell Lab of Ornithology - Cornell University
www.birds.cornell.edu/Page.aspx?pid=1964 November - April season. If you enjoy watching birds at your feeders, consider joining forces with *Project FeederWatch.* More than 15,000 participants count birds at their feeders as often as once per week and send their observations to scientists at the Cornell Lab.

Birding at Clark Preserve Meadow
L to R: Al Gunnison, Matt Coulter, Jim Evans
Elyse Arnow

• **Christmas Bird Count** - National Audubon Society
The annual count is "the nation's longest-running community science bird project." It is a census count of birds in the Western Hemisphere, which is performed annually in the early Northern-hemisphere winter by volunteer birdwatchers. There are three local chapters where you can participate; The Bedford Audubon (www.bedfordaudubon.org), Greenwich Audubon (greenwich.audubon.org) or Saw Mill River Audubon (www.sawmillriveraudubon.org).

Two other Audubon projects that can be done at home include:

• **Great Backyard Bird Count**
www.audubon.org/conservation/about-great-backyard-bird-count
Every February, count for as little as 15 minutes in your own backyard to help expand our understanding of birds.

• **Hummingbirds at Home**
www.audubon.org/content/hummingbirds-home
Hummingbirds at Home is a new citizen science initiative from Audubon that will help scientists understand how climate change, flowering patterns and feeding by people are impacting hummingbirds. On the **Hummingbirds at Home** website you can report on hummingbirds and their feeding behavior at any time of year.

• **Monarch Watch** - University of Kansas
https://www.monarchwatch.org/
Monarch Watch is a nonprofit, cooperative network of students, teachers, volunteers and researchers dedicated to the study of the Monarch butterfly, Danaus plexippus, and its spectacular fall migration. Based at the University of Kansas, Monarch Watch engages in research on monarch migration biology and population dynamics as well as protection of monarch habitats throughout North America.

The following two projects need leadership.

Monitoring Vernal Pools -
A different kind of citizen science project is the monitoring of vernal pools. While these fragile wetland features are poorly understood, they contribute to overall water quality. They can be easily destroyed with the swipe of a bulldozer and are vulnerable to climate change. A local project would serve to protect vernal pools and potentially contribute to the knowledge base.

Typically beneath vernal pools lies either bedrock or a hard clay layer that helps keep water in the pool. Each season causes dramatic changes in the appearance of a vernal pool. The pools collect water during winter and spring rains, changing in volume in response to varying weather patterns. During a single season, pools may fill and dry several times. In years of drought, some pools may not fill at all. The hydrologic role of vernal or woodland pools is a bit of a mystery, but they likely contribute to storage and filtration of surface water, and recharge of aquifers. Although the value of one small wetland or pool may be difficult to discern from a watershed perspective, the collective benefits of many small wetlands to a watershed may be profound.

A resource to guide a team of citizen scientists is *Volunteer Wetland Monitoring: An Introduction and Resource Guide.* https://nepis.epa.gov/Exe/ZyPDF.cgi/2000535D.PDF?Dockey=2000535D.PDF

Native Seed Library
An exciting new trend in the native plant movement is the establishment of a local native plant seed library. Seeds that are known to be of local origins are especially valued. Often located at a public library, users of a native seed library can freely check out seeds, just like books. After planting the seeds and raising the plants to maturity, users collect some of their seeds and restock the library with seeds for others to germinate. A native seed library may exist digitally, enabling participants to contact one another to exchange seeds.

COMMUNITY RESOURCES

The Invasives Project-Pound Ridge volunteers offer to visit your property to identify native and invasive plant species from May to October. The free consultations are provided by Pound Ridge property owners who understand the challenges of managing two acres or more and are grateful for each person interested in joining the cause. Visits are scheduled at your convenience by emailing consult@invasivespoundridge.org.

Mianus River Gorge will provide a free 60 minute consultation on your property. A team of MRG scientists will visit your property to answer your questions or concerns and offer advice on a variety of topics including plant and animal identification, wildlife management, natural history, invasive species, and woodland, field and pond management. Other services are available. For more information call (914) 234-3455 or email info@mianus.org.

Master Forester Owners (MFO) are trained by Cornell Cooperative Extension and at your request, an MFO may arrange for a visit with you at your woodlot. A **woodlot** is a parcel of a woodland or forest capable of small-scale production of forest products (such as wood fuel, sap for maple syrup, sawlogs, and pulpwood) as well as recreational uses like bird watching, bushwalking, and wildflower appreciation. The MFO can help you to identify your goals for your property. Visit www.CornellMFO.info for more information.

The Pound Ridge Library also has an interesting collection of books to support residents in their efforts to create habitats on their property.

PLANT LISTS

The Native Species Planning Guide for New York City and Vicinity:
https://www.nycgovparks.org/sub_about/parks_divisions/nrg/documents/Native_Species_Planting_Guide.pdf

Two native plant lists on the Conservation Board's page (Town website):
Flora of Pound Ridge: Native Plants (includes deer resistant plants)
Wetlands Guide (A Guide to Preserving Pound Ridge Wetlands)
http://www.townofpoundridge.com/conservationboard

• *Bringing Nature Home,* Doug Tallamy's website has lists and information on native woodies and herbaceous plants in addition to the butterflies and moths they attract: http://www.bringingnaturehome.net

• Audubon's native plants for birds by regions: http://www.audubon.org/plantsforbirds

• Fact sheets for native flowers, ferns, shrubs, and trees: https://www.dec.ny.gov/docs/lands_forests_pdf/factnatives.pdf

• Westchester Wilderness Walk/Zofnass Preserve botanical inventory, initiated in 2013 by Scott Mori and a team of botanists from the New York Botanical Gardens (NYBG)[18] can be downloaded and accessed on a notebook for reference in the field. http://sweetgum.nybg.org/science/projects/wlt/

• *Land Use Through Ecology: A Case Study of Pound Ridge, NY* (PRUP Report 1979). Chapter 2, p. 32- 39 describes the species composition characteristic of nine plant communities found in Pound Ridge (Old Field; Successional forest; Oak forest: Mixed hardwood forest; Hemlock and Mixed hardwood forest; Hemlock forest; Conifer plantation; Open-water; Wetlands) and includes a complete species list for most of them.

• *Ecoregional Revegetation Application* (ERA): http://www.nativerevegetation.org/era/

The ERA is an online database of locally adapted and appropriate plant species. It was developed by botanists and ecologists at the Forest Service, Federal Highway Administration, universities and other institutions. The ERA is meant to assist highway planners, land managers and others to select appropriate native plant species for revegetation projects.

This tool can be useful in the discussion of how to address information gaps in plant databases to support emerging planting design technologies

RECOMMENDATIONS FOR HABITAT PROTECTION

The following consolidates many of the recommendations for the protection of habitats in Pound Ridge from the 2010 Comprehensive Plan.

Goal: The Town should protect the environmental quality and ecological integrity of the Town's natural resources. This Plan is based on a strict policy of environmental conservation, using as a basis the environmental data accumulated by the Town over many years.

1. Environmentally important land areas come in many different forms. Scenic vistas of open space, watercourses, natural forestland, historic properties, scenic roadways, natural habitats and the like, all contribute to the Town's character. The Town should request that the Conservation Board, in conjunction with the Pound Ridge Land Conservancy, another land preservation group in Town, compile an inventory of significant environmental areas and features. (2-c. P. A-3)

2. The current minimum front, side and rear setbacks and buffers should be increased in order to protect the Town's semi-rural character, animal habitat and woodland viewsheds, and to enhance privacy between neighbors. Further, the natural environment including geological occurrences, mature tree growth and vegetative under-story should be protected in these setbacks and buffer areas. (10-b. P B-15)

3. The requirement for a septic expansion area equal in size to the actual septic system creates unnecessary site disturbance due to the requirement to clear vegetation from the expansion area. Further, vegetative screening within the setback areas that once provided privacy and preservation of community character is reduced, and homes are therefore more visible. Given the size of currently constructed homes and their associated improvements, the need for adequate buffering can mean the need for larger lots. The Town should explore the feasibility of not requiring the full vegetative clearing of septic system expansion areas in order to preserve woodlands, wildlife habitat and viewsheds. (10-d. P. B-15)

4. The Town should continue to protect the environmental quality and ecological integrity of the Town's natural resources. (1-a. P. C-8)

5. The Town should continue its forward-looking policy of acquiring and preserving open space for purposes including protecting: the quality and quantity of the Town's surface and subsurface water supply, the quality and variety of wildlife habitats in the Town, and the scenic beauty, semi-rural character and aesthetic appeal of the Town. (1-b. P. C-8). This recommendation is reinforced in *Eastern Westchester Biotic Corridor*, Metropolitan Conservation Alliance, Technical Paper Series: No. 4 (Appendix B *Comprehensive Plan,* P. 14).

6. The Town should consider requiring a 'heightened review' of proposed activities on environmentally sensitive lands and in designated Biotic Corridors for all new construction, based upon specific standards. Specifically, such standard should include an analysis of areas in proximity to wetlands, streams and water bodies. The Planning Board would use this information, at its discretion, to establish increased buffers, minimization of impervious surfaces, special lighting requirements and other measures where necessary to protect the integrity of the biotic/aquifer corridors. (g-2. P. C-4)

7. Conservation subdivisions are used, among other things, to:
- preserve important scenic features, including mature forests, streams, gorges, rock outcroppings, scenic vistas, and other existing open spaces
- encourage the preservation of open space in highly visible areas such as along roadsides, ridgelines, entrances, etc. minimize the creation of impervious surfaces (g-3. P. C-15)

8. Pound Ridge should continue to plan for and encourage the preservation of a continuous linked open space network throughout the town. (8-j. P. C-16) To this end, the use of conservation area overlay ordinances are recommended in Eastern Westchester Biotic Corridor (Appendix B Comprehensive Plan) P. 15.

Additional Recommendations To the Town

- **Support a proposal** by Mianus River Gorge (2018) to inventory and rescue native reptiles, amphibians, and plants prior to construction on sites in Pound Ridge.
- **Continue to educate the public** about terrestrial invasive species, particularly those that are not well established (known as early detection/rapid response species) and encourage monitoring water bodies for aquatic invasive species, e.g., water chestnut and hydrilla.
- **Identify and prioritize high value habitats** for additional management efforts.
- **Engage volunteers** in reducing invasive plant species and restoring with native plants in preserves and on town properties.
- **Encourage the use of native plants** in public spaces and by homeowners.
- **Support decisions and actions** that maintain ecosystem function, biodiversity, and connectivity as a strategy for protecting wildlife and habitats in a time of climate change.

Review and incorporate the many recommendations in the Hudsonia report (Part II) into the municipal decision making practices and best management practices.

RECOMMENDATIONS: RESTORING STREAM HABITATS AND CONNECTIVITY

Brook trout *(Salvelinus fontinalis)* are a "New York Species of Greatest Conservation Need" and in decline owing to environmental changes. Fish Atlas data and wild brook trout records on the Cross River and Mill River below Trinity Reservoir support an important habitat area modeled for brook trout that extends up the tributaries of the Cross River into northern Pound Ridge. More information is available in a study by McKenna and Johnson, *Landscape models of brook trout abundance and distribution in lotic habitat with field validation (USGS_PW_70042031.ris).*

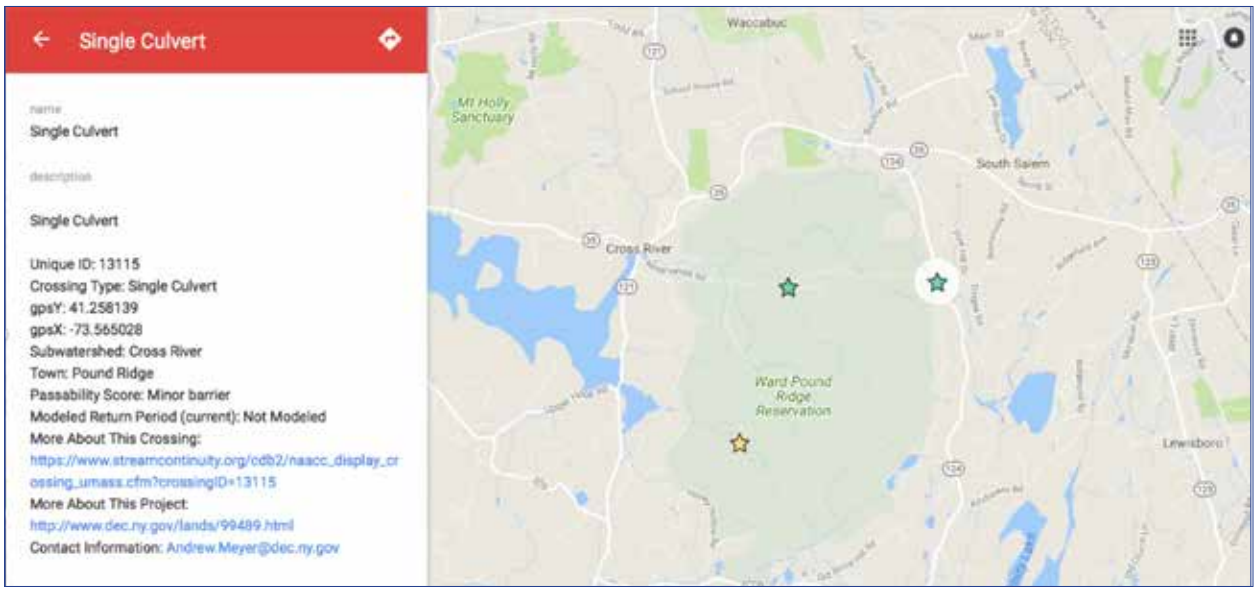
According to the **Fish Atlas Map of New York,** the last record of American eel in Pound Ridge was from the 1950s.[19]

A culvert, on the Lewisboro border off Boutonville Road, has been identified by the Nature Conservancy as a Biologically Important Stream Barrier. The culvert restricts stream access for wild brook trout. If funding were available, restored passage at this culvert should be considered.

Culverts, or the short tunnels that carry a stream under a road, are described in the Water Resources narrative. See also p. 73.

See the Streams map on the Hudson Valley Natural Resource Mapper: http://www.dec.ny.gov/lands/112137.html

A report, *Identification of Biologically Important Barriers in the Hudson River Estuary,* detailing the methods for identifying impediments to stream connectivity is available at https://wri.cals.cornell.edu/hudson-river-estuary/watershed-management/aquatic-connectivity-and-barrier-removal-culvert-dams/



ENDNOTES

1. Levine, E. (ED.) *Bull's Birds of New York State.* Cornell University Press. Ithaca. 1998.

3. Miller, N.A. and M.W. Kemens. 2002. *Eastern Westchester Biotic Corridor.* MCA Technical Paper No. 4, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York.

3. Ibid.

4. Thompson JR, Carpenter DN, Cogbill CV, Foster DR (2013) Four Centuries of Change in Northeastern United States Forests. PLoS ONE 8(9): e72540. https://doi.org/10.1371/journal.pone.0072540

5. History of State Forest Program https://www.dec.ny.gov/lands/4982.html

6. Allport, Susan. *Sermons in Stone: The Stone Walls of New England and New York.* W.W.Norton. 1990.

7. Garden Conservancy Open Days https://www.gardenconservancy.org/open-days

8. Carson, R. Silent Spring. Houghton Mifflin. New York.1962.

9. Johnson, Claudia T. (Lady Bird). *A White House Diary.* University of Texas Press. Austin. 1970.

10. Tallamy, D.W. *Bringing Nature Home: How Native Plants Sustain Wildlife.* Timber Press. 2007. P.9.

11. *Mianus River Gorge: The Early Years* http://www.mianus.org/about-us/early-days/

12. The Nature Conservancy https://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/newyork/places-preserves/eastern-mianus-river-gorge-preserve.xml

13. *Bringing Nature Home: Gardening for Life* http://www.bringingnaturehome.net/gardening-for-life.html

14. Ibid.

15. Kiviat, E. & G. Stevens. *Biodiversity Manual.* Hudsonia Ltd. 2001.

16. In 2017, three mountain lion sightings were reported by a four-person Americorps team in Zofnass Preserve, a resident on High Ridge Road, and through a videotape shared with Pound Ridge Police Department. Local sightings have not been confirmed with physical evidence (tracks, scat, or hair). Any sightings in New York have involved mountain ions (cougars) that are not native to the state. For information about sightings in New York, go to https://www.dec.ny.gov/animals/6974.html
Cougars, do not have a native, self-sustaining population in New York State. The status of the Eastern cougar (*Puma concolor cougar*) is extirpated in New York and extinct according to federal listings. For more information, go to http://www.dec.ny.gov/animals/44564.html

16. Personal correspondence. Chris Nagy. Wildlife scientist, Mianus River Gorge Preserve (Bedford, NY). April 20, 2018.

19. Mori, S. A. & R. F. Naczi. 2015 onward. Plants and Fungi of the Westchester Wilderness Walk/Zofnass Family Preserve. The New York Botanical Garden, Bronx, New York (http://sweetgum.nybg.org/wlt/index.php).

19. Fish Atlas Maps of New York http://www.dec.ny.gov/animals/85760.html

WORKS CITED (Part I)

Allport, Susan. Sermons in Stone: The Stone Walls of New England and New York. W.W.Norton. 1990.

Bringing Nature Home: Gardening for Life http://www.bringingnaturehome.net/gardening-for-life.html

Carson, R. Silent Spring. Houghton Mifflin. New York.1962.

Comprehensive Plan.Town of Pound Ridge, NY. (2010).

History of State Forest Program https://www.dec.ny.gov/lands/4982.html

Johnson, Claudia T. (Lady Bird). A White House Diary. University of Texas Press. Austin. 1970.

Kiviat, E. & G. Stevens. Biodiversity Manual. Hudsonia Ltd. 2001.

Levine, E. (ED.) Bull's Birds of New York State.Cornell University Press. Ithaca. 1998.

McKenna and Johnson. Landscape models of brook trout abundance and distribution in Iotic habitat with field validation. USGS_PW_70042031.ris.

Mianus River Gorge: The Early Years http://www.mianus.org/about-us/early-days/

Mid-Hudson Regional Sustainability Plan (2013), p. 7-15.

http://hudsonvalleyregionalcouncil.org/mid-hudson-regional-sustainability-plan/

Miller, N.A. and M.W. Kemens. 2002. Eastern Westchester Biotic Corridor. MCA Technical Paper No. 4, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York.

Mori, S. A. & R. F. Naczi. 2015 onward. Plants and Fungi of the Westchester Wilderness Walk/Zofnass Family Preserve. The New York Botanical Garden, Bronx, New York (http://sweetgum.nybg.org/wlt/index.php).

Stein, Sara. Noah's Garden. Houghton Mifflin Company. 1993.

Tallamy, D.W. Bringing Nature Home: How Native Plants Sustain Wildlfie. Timber Press. 2007.

The Nature Conservancy https://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/newyork/places-preserves/eastern-mianus-river-gorge-preserve.xml

Thompson JR, Carpenter DN, Cogbill CV, Foster DR (2013) Four Centuries of Change in Northeastern United States Forests. PLoS ONE 8(9): e72540. https://doi.org/10.1371/journal.pone.0072540

Stately trees
Sidney Shelden

PART 2 · Significant Habitats in the Town of Pound Ridge

The Hudsonia Report

SIGNIFICANT HABITATS
IN THE TOWN OF POUND RIDGE, WESTCHESTER COUNTY, NEW YORK

Report to the Town of Pound Ridge, the Hudson River Estuary Program, and the Westchester Community Foundation

By Christopher Graham, Elise Heffernan, and Gretchen Stevens

August 2018

Hudsonia Ltd.
P.O. Box 5000
Annandale, NY 12504

CONTENTS

FIGURES

TABLES

ACKNOWLEDGMENTS

We are extremely grateful to the Hudson River Estuary Program of the New York State Department of Environmental Conservation, the Westchester Community Foundation, the Town of Pound Ridge, the Aquarion Water Company, the Henry Morgenthau Preserve, the Pound Ridge Land Conservancy, the Rockrimmon Country Club, and the Wellspring Monastery, who provided funding for this project, and to the Pound Ridge Land Conservancy for their partnership and support. Carolynn Sears of the Town of Pound Ridge Conservation Board was instrumental in conceiving the project, acquiring funding, and assisting Hudsonia biologists along the way. Jeff Main of Westchester Parks was extremely helpful in allowing us to study the Ward Pound Ridge Reservation. We thank Diane Briganti of the Pound Ridge Assessor's Office, Laura Heady of the Hudson River Estuary Program, and the New York State GIS Clearinghouse for providing GIS data, and the New York Natural Heritage Program for providing data on rare species occurrences. The Pound Ridge web mapper (https://www.axisgis.com/Pound_RidgeNY/) was of great utility for viewing spatial data across the town. Kathleen A. Schmidt, Hudsonia's scientific illustrator, created the drawings that appear throughout this report. Finally, we thank the following landowners and land managers of the Town of Pound Ridge, who graciously allowed us access to their land for field work or provided other valuable information:

Aquarion Water Company
Meredith and Tom Brokaw
Rod Christie (Mianus River Gorge Preserve)
Jeff Main (Ward Pound Ridge Reservation)
Krista Munger (Pound Ridge Land Conservancy)
Sondra Peterson
The Town of Pound Ridge
Kenneth Wang

EXECUTIVE SUMMARY

Hudsonia biologists identified and mapped ecologically significant habitats in twenty-four selected tracts of land throughout the Town of Pound Ridge during the period of June 2017 through July 2018. Through map analysis, aerial photograph interpretation, and field observations we created a large-format map showing the locations and configurations of habitats in those areas. Some of the habitats are rare or declining in the region or support rare species of plants or animals, while others are high quality examples of common habitats or habitat complexes. Among our more interesting finds were: 28 rocky barrens; extensive crest, ledge, talus communities; 61 intermittent woodland pools; 12 fens; a buttonbush pool; many extensive wetland complexes; and extensive areas of contiguous forest, including three larger than 400 acres (ac) (160 hectares [ha]).

In this report we describe each of the mapped habitat types, including their ecological attributes, some of the species of conservation concern they may support, and their sensitivities to human disturbance. We address conservation issues associated with these habitats and provide specific conservation recommendations. We also provide ideas on how to use this report and the habitat map for conservation planning and policy-making, and for site-specific environmental reviews.

The habitat map and report, which contain ecological information unavailable from other sources, can help the Town of Pound Ridge identify the areas of greatest ecological significance, develop conservation goals, and establish conservation policies and practices that will help to protect biodiversity resources while serving the social, cultural, and economic needs of the human community.

INTRODUCTION

Background

Rural landscapes in Westchester County have undergone much change over the last century years as farms, forests, and other undeveloped lands have been converted to residential and other uses. Most of this development has occurred without knowledge of the biological resources that may be lost or harmed by physical development or increased exposure to human activities. The consequences are beautiful residential settings, but also widespread habitat degradation, habitat fragmentation, loss of native biodiversity, and loss of ecosystem services to the human community.

Although many land-use decisions in the region are necessarily made on a site-by-site basis, the long-term viability of biological communities, habitats, and ecosystems requires consideration of whole landscapes. Very little biodiversity information is available for large areas such as entire towns, counties, or watersheds, making it difficult for landowners, developers, municipal planners, and others to incorporate biodiversity protection into day-to-day decision making.

To address this need, Hudsonia Ltd., a nonprofit institute for scientific research and education, initiated a habitat mapping program in 2001. Using the approach set forth in the *Biodiversity Assessment Manual for the Hudson River Estuary Corridor* (Kiviat and Stevens 2001) we identify important biological resources over large geographic areas and inform local communities about effective measures for biodiversity conservation.

Hudsonia has now completed town-wide habitat maps of thirteen Hudson Valley towns and of other large areas in the region. In Westchester County, we have also assisted in habitat mapping projects for the towns of Somers and Bedford. These projects have been funded by a variety of private and public sources. The Pound Ridge project was funded by grants to the Town of Pound Ridge from the Westchester Community Foundation, the NYS Environmental Protection Fund through the Hudson River Estuary Program of the NYS Department of Environmental Conservation, the Town of Pound Ridge, the Aquarion Water Company, the Henry Morgenthau Preserve, the Pound Ridge Land Conservancy, the Rockrimmon Country Club, and the

Wellspring Monastery. We also received endorsement and assistance from the Town of Pound Ridge Conservation Board, the Town Board, and from landowners in the study area.

Biologists Christopher Graham and Elise Heffernan conducted most of the work on this project from June 2017 through July 2018; Gretchen Stevens, director of Hudsonia's Biodiversity Resources Center, participated in all aspects and supervised the project. Through map analysis, aerial photograph interpretation, and field observations, we created a map of ecologically significant habitats in selected areas throughout the Town of Pound Ridge. Some of these habitats are rare or declining in the region, some may support rare species of plants or animals, while others are high quality examples of common habitats or habitat complexes. The goal of this project was to identify and map general habitat types; we did not conduct species-level surveys or map the locations of rare species.

To facilitate intermunicipal and regional planning, we strive for consistency in the ways that we define and identify habitats and present the information for town use, but we also strive to improve our methods and products as the program evolves. Many passages in this report on general habitat descriptions, general conservation and planning concepts, and information applicable to the region as a whole are taken directly from previous Hudsonia reports accompanying habitat maps in Dutchess County (e.g., Stevens and Broadbent 2002, Bell et al. 2005, Tabak et al. 2006, Knab-Vispo et al. 2008, Deppen et al. 2009, Graham et al. 2012, Haeckel et al. 2012) without specific attribution. This report, however, addresses our findings and specific recommendations for the Town of Pound Ridge. We intend for each of these projects to build on the previous ones, and believe that the expanding body of biodiversity information will be a valuable resource for site-specific, town-wide, and region-wide planning and conservation efforts.

We hope that this map and report will help landowners understand how their properties contribute to the larger ecological landscape, and will inspire them to implement habitat protection and enhancement measures voluntarily. We also hope that the Town of Pound Ridge will engage in proactive land-use and conservation planning to ensure that future land

development is planned with a view to long-term protection of the town's considerable biological resources.

What is Biodiversity?

The concept of biodiversity, or biological diversity, encompasses all of life and its processes, including ecosystems, biological communities, populations, species, and genes, as well as their interactions with each other and with the non-biological components of their environment, such as soil, water, air, and sunlight. Protecting native biodiversity is an important component of any effort to maintain healthy, functioning ecosystems that sustain the human community and the living world around us. Healthy ecosystems make the earth habitable by moderating the climate, cycling nutrients, purifying water and air, producing and decomposing organic matter, sequestering carbon, and providing many other essential services. They also serve as the foundation of our natural resource-based economy.

The decline or disappearance of native species can be a symptom of environmental deterioration or collapses in other parts of the ecosystem. While we do not fully understand the roles of all organisms in an ecosystem and cannot fully predict the consequences of the extinction of any particular species, we do know that each organism, including inconspicuous ones such as fungi and insects, plays a unique role in the maintenance of biological communities. Maintaining the full complement of native species in a region allows an ecosystem to withstand stresses and adapt to changing environmental conditions.

What are Ecologically Significant Habitats?

For the purposes of this project, a "habitat" is simply the place where an organism or population lives or where a biological community occurs, and is defined according to both its biological and non-biological components. Individual species will be protected for the long term only if their habitats remain intact. The local or regional disappearance of a habitat can lead to the local or regional extinction of species that depend on that habitat. Habitats that we consider to be "ecologically significant" include:

1. Habitats that are rare or declining in the region.
2. Habitats that support rare species and other species of conservation concern.
3. High-quality examples of common habitats (e.g. those that are especially large, isolated from human activities, old, or lacking harmful invasive species).
4. Complexes of connected habitats that, by virtue of their size, composition, or configuration, have significant biodiversity value.
5. Habitat units that provide landscape connections between other important habitat patches.

Because most wildlife species need to travel among different habitats to satisfy their basic survival needs, landscape patterns can have a profound influence on wildlife populations. The size, connectivity, and juxtaposition of both common and uncommon habitats in the landscape all have important implications for biodiversity. In addition to their importance from a biological standpoint, habitats are also manageable units for planning and conservation over large areas such as whole towns. By illustrating the locations and configurations of ecologically significant habitats throughout the Town of Pound Ridge, the habitat map that accompanies this report provides valuable ecological information that can be incorporated into local land-use planning and decision making.

Study Area

The Town of Pound Ridge is located in eastern Westchester County in southeastern New York. It encompasses approximately 23.1 mi^2 (59.5 km^2) and has a population of roughly 5,100 residents (2010 US Census). The town's landscape largely comprises rolling hills, low, rocky ridges, myriad wetlands, and stream valleys. The town straddles two major watersheds. The northern part of the town (9.4 mi^2 [24.5 km^2]) is in the Croton River watershed, ultimately draining to the Lower Hudson River. The Stone Hill River flows east to west across the northern half of the town, but most of the streams in the northern part of town drain to the Cross River, which flows through the northeastern corner of Pound Ridge. The southern part of town (13.7 mi^2 [35.3 km^2]) drains into the Mianus River and the Mill River, which both ultimately drain into Long Island Sound (Figure 1). The Mianus River forms the southwestern town boundary.

Elevations in Pound Ridge range from 260 feet (ft) (79 meters [m]) above mean sea level along the Mianus River to 860 ft (262 m) at the site of a former fire tower on a rocky crest in Ward Pound Ridge Reservation (WPRR). Most areas with higher elevations (over 650 ft) are in the northern part of town, and predominantly in WPRR.

Pound Ridge is predominantly underlain by gneiss and amphibolite in the Fordham and Bedford Formations, and amphibolite and pelitic schist in the Hartland Formation. Ward Pound Ridge Reservation has a band of Pound Ridge gneiss which curves from the northeast to southwest corners of the reservation. Additionally there are two bands of Inwood marble (and schist) in the town. The southeastern corner of the town is predominantly amphibolite and pelitic schist in the Hartland Formation (Fisher et al. 1970; Figure 2). The surficial material is primarily glacial till, with large areas of exposed bedrock as well, especially in the WPRR. Glacial outwash deposits (sand and gravel) and peat and muck occur in lower-lying areas along the Stone Hill River (Cadwell et al. 1989). West Lane cuts through a small kame—a glacially-deposited mound of sand, gravel, and till.

Primary land uses in Pound Ridge are residential, park and preserve land, and water utility land surrounding drinking water reservoirs. Residential development is fairly evenly distributed south of WPRR, with moderate concentrations around the hamlet of Scotts Corners and around the intersection of Pound Ridge Road and Westchester Avenue. The town has 3671 ac (1486 ha, 24.8%) of open space park and preserve land: Westchester Parks Commission (the owner of WPRR) holds 2826 ac (1144 ha); 366 acres (148 ha) are owned by the Pound Ridge Land Conservancy, 129 acres are held by the Westchester Land Trust; and 85.5 ac (34.5 ha) are in the privately-managed Henry Morgenthau Preserve. Water utility land occupies about 10% of the town (1463 ac [592 ha]) and is distributed throughout, but most is in the southern section. About 310 ac (127 ha) are owned by the Town of Pound Ridge.

Figure 1. Study area in the Town of Pound Ridge, Westchester County, NewYork. The study area consisted of 24 selected tracts of undeveloped land throughout the town, each at least 30 ac (12 ha). Watershed data from the US Geological Survey National Hydrography Dataset. Hudsonia Ltd, 2018.

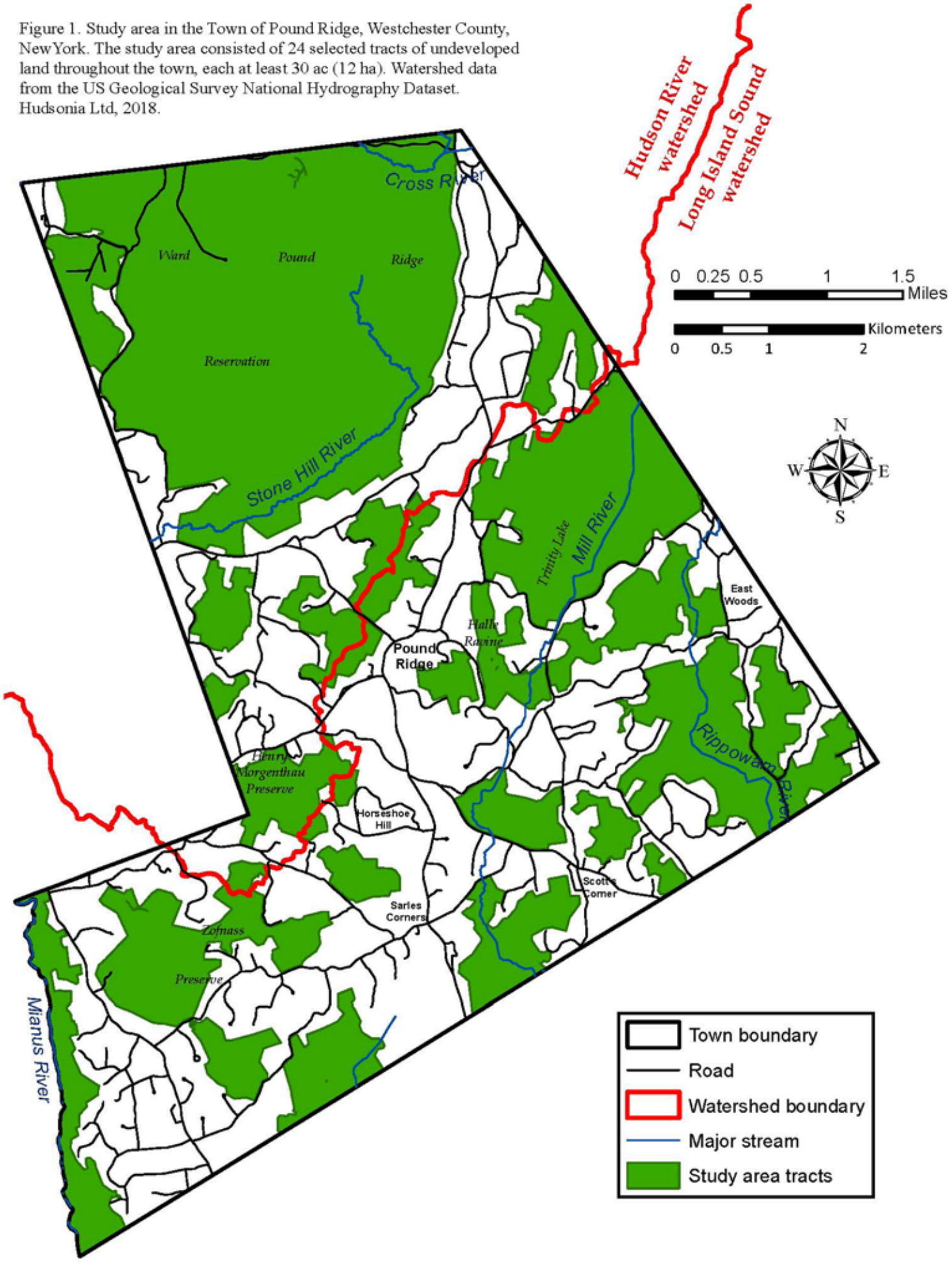
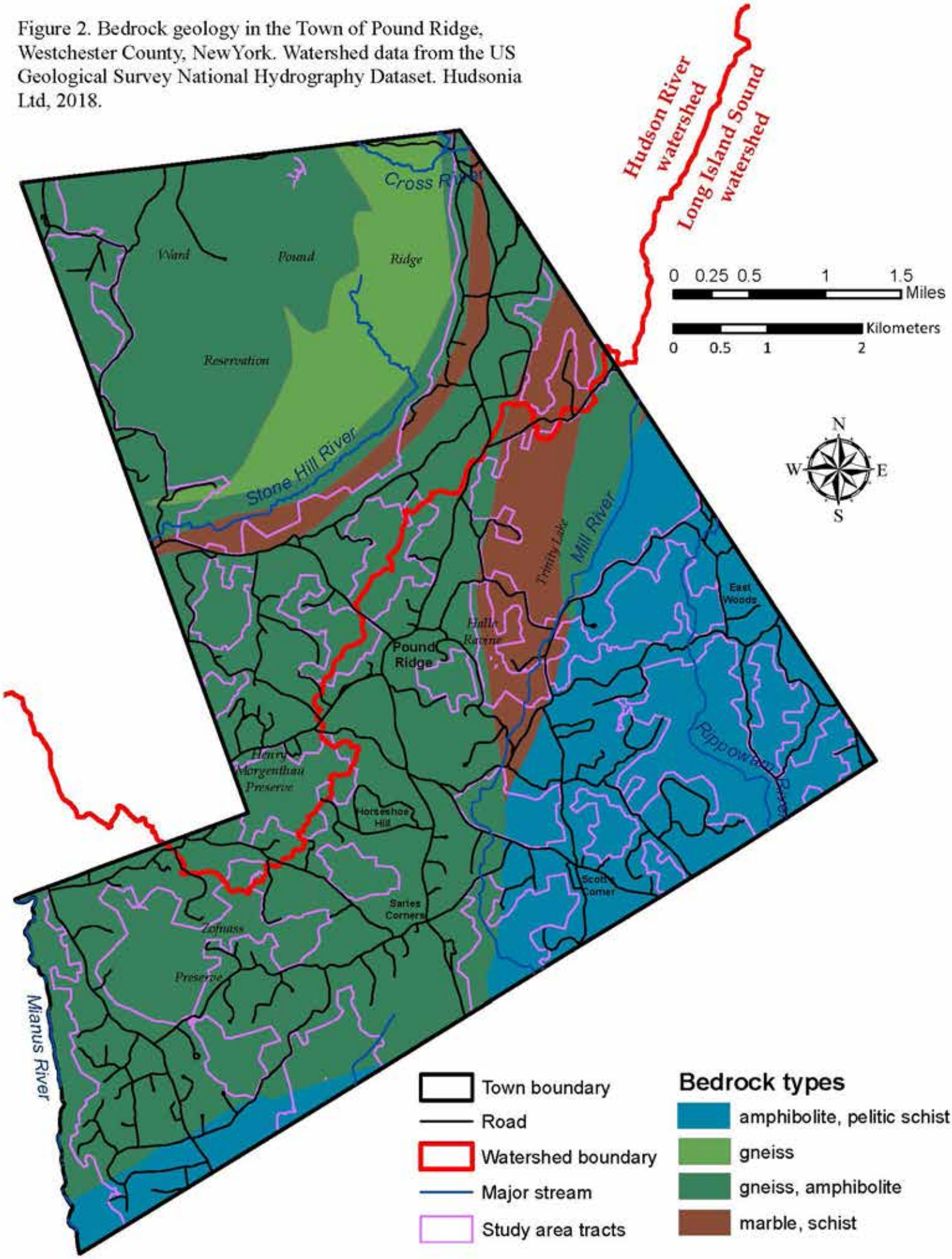


Figure 2. Bedrock geology in the Town of Pound Ridge, Westchester County, NewYork. Watershed data from the US Geological Survey National Hydrography Dataset. Hudsonia Ltd, 2018.



METHODS

Hudsonia employs a combination of laboratory and field methods in the habitat identification and mapping process, as described below.

Gathering Information and Predicting Habitats

During many years of habitat studies in the Hudson Valley, Hudsonia has found that, with careful analysis of map data and aerial photographs, we can accurately predict the occurrence of many habitats that are closely tied to topography, geology, and soils. We use combinations of map features (e.g. slopes, bedrock chemistry, and soil texture, depth, and drainage) and features visible on aerial orthophotos (e.g., exposed bedrock, vegetation cover types) to predict the location and extent of ecologically significant habitats. In addition to biological data provided by the New York Natural Heritage Program, we used the following resources for this project:

- *High-resolution (1 pixel = 6 in [cm]) 4-band digital orthophotos* taken in spring 2009 and 2016 and *true color and color infrared digital orthophotos (1 pixel = 12 in [19 cm])* taken in spring 2013, obtained from the New York State GIS Clearinghouse website. We use these digital aerial photos for on-screen digitizing of habitat boundaries.

- *U.S. Geological Survey topographic maps* (Pound Ridge, NY, and Peach Lake, NY, 7.5 minute quadrangles). Topographic maps illustrate elevation contours, surface water features, and significant cultural features (e.g. roads, railroads, buildings). We use contour lines to predict the occurrence of such habitats as cliffs, wetlands, intermittent streams, and seeps.

- *Bedrock and surficial geology maps* (Lower Hudson Sheets) produced by the New York Geological Survey (Fisher et al. 1970, Cadwell et al. 1989). The bedrock and surficial geologies strongly influence the development of particular soil properties and aspects of groundwater and surface water chemistry, and have important implications for the biotic communities that become established on any site.

- *Soil Survey of Putnam and Westchester County, New York* (Siefried 1994). Specific attributes of soils, such as depth, drainage, texture, and pH, convey a great deal of information about the types of habitats that are likely to occur in an area. Shallow soils, for example, may indicate the locations of crest, ledge, and talus habitats. Poorly and very poorly drained soils usually indicate the location of wetland habitats such as swamps, marshes, and wet meadows. The location of alkaline soils can be used to predict the occurrence of fens and calcareous wet meadows.

- *Geographic Information Systems (GIS) data.* We obtained several of our GIS data layers from the New York State GIS Clearinghouse, including municipal boundaries, roads, hydrological features and 2-ft contour data. National Wetlands Inventory data prepared by the US Fish and Wildlife Service were obtained from their website. We obtained soils data from the Natural Resources Conservation Service (NRCS) website. Tax parcel data came from the Town of Pound Ridge. We used ArcMap 10.5 and 10.6 software (ESRI 2017 and 2018) to examine these data layers and the orthophoto images, and to digitize the habitat boundaries.

Red eft on moss carpet.

Preliminary Habitat Mapping and Field Verification

Due to funding limitations we could not map habitats throughout the whole town. Instead we chose 24 large tracts of undeveloped land for our study area in this project, which covered 52% of the land area of the town (7660 ac [3099 ha]). This amounted to 4003 ac (2205 ha) in the Croton watershed in the northern part of town and 3657 ac (894.4 ha) in the Long Island Sound watershed in the southern part (Figure 3).

We prepared a preliminary map of predicted habitats based on map and aerial orthophoto analysis. We digitized the predicted habitats onscreen over the orthophoto images using ArcMap 10.5 and 10.6 mapping software. With these draft maps in hand we conducted field visits to as many of the mapped habitat units as possible to verify or correct their presence and extent, to assess their quality, and to identify any habitats that could not be identified remotely.

We identified landowners using tax parcel data, and before going to field sites we contacted landowners for permission to visit their land. We prioritized sites for field visits based both on opportunity (i.e., willing landowners and public property) and our need to answer questions about habitat identification or extent that could not be answered remotely. For example, distinctions between wet meadow and calcareous (calcium-rich) wet meadow, and calcareous crest and acidic crest, can only be made in the field. In addition to conducting field work on private land, we viewed habitats from adjacent properties, public roads, and other public access areas. Because the schedule of this project (and non-participating landowners) prevented us from conducting intensive field verification on every parcel in the study area, this prioritization strategy contributed to our efficiency and accuracy in carrying out this work.

We field-checked approximately 51% of the study area. We used remote sensing to map habitats in areas that we did not see in the field, but were able to extrapolate our findings from field observations to adjacent parcels and similar settings throughout the town. We assume that areas of the habitat map that were field-checked are generally more accurate than areas we did not visit.

Defining Habitat Types

Habitats are useful for categorizing places according to apparent ecological function, and are manageable units for scientific inquiry and for land-use planning. For these town-wide habitat mapping projects we classify broad habitat types that are identifiable largely by their vegetation and other visible physical properties. However, habitats exist as part of a continuum of intergrading characteristics, and drawing a line to separate two "habitats" can seem quite arbitrary. Furthermore, some habitat types are intermediates between two other defined habitat types, and some habitat categories can be considered complexes of several habitat types. In order to maintain consistency within and among habitat mapping projects, we have developed certain mapping conventions that we use to classify habitats and depict their boundaries. Some of these conventions are described in Appendix A. All of our mapped habitat boundaries should be considered approximations. Much of the study area was only mapped remotely, and even the field-checked habitat boundaries were sketched without the use of GPS or other land survey equipment.

Each habitat profile in the Results section, below, describes the general ecological attributes of places that are included in that habitat type. Areas outside our study area and developed areas and other areas that we consider non-significant habitats (e.g. structures, paved and gravel roads and driveways, other impervious surfaces, and small lawns, meadows, and woodlots) within our study area are shown as white (no symbol or color) on the habitat map. Areas that have been developed or otherwise altered significantly since 2013 (the orthophoto date) were identified as such only if we observed them in the field or consulted newer aerial photographs, so it is likely that we have underestimated the extent of developed land in the town.

Final Mapping and Presentation of Data

We corrected and refined the preliminary map on the basis of our field observations to produce the final habitat map. We printed the final large-format habitat map at a scale of 1:14,000 using a Hewlett Packard DesignJet 800PS plotter. The GIS database that accompanies the map includes additional information about many of the mapped habitat units, such as notable plant and animal species observed in the field. The habitat map, GIS database, and this report have

been conveyed to the Town of Pound Ridge Conservation Board for use in conservation and land-use planning and decision-making. We request that any maps printed from this database for public viewing be printed at scales no larger than 1:10,000, and that the habitat map data be attributed to Hudsonia Ltd. Although the map was carefully prepared and extensively field-checked, there are inevitable inaccuracies in the final map. Because of this, we request that the following caveat be printed prominently on all maps:

> *"This map is suitable for general land-use planning, but is unsuitable for detailed planning and site design or for jurisdictional determinations. Boundaries of wetlands and other habitats depicted here are approximate."*

rock sandwort

RESULTS

Overview

The large-format Pound Ridge habitat map illustrates the diversity of habitats that occur in the town and the complexity of their configuration in the landscape. A reduction of the completed habitat map is shown in Figure 3. Of the total 7660 ac (3099 ha) in the study area, approximately 98% is undeveloped land (i.e., without structures, paved roads, manicured lawns, etc.). Existing development is dispersed along roads and at the ends of sometimes lengthy driveways throughout the town, so that undeveloped land has been fragmented into discontinuous and irregularly shaped patches. Figure 4 shows blocks of contiguous habitat areas classified by size. Several types of common habitats cover extensive areas within these blocks. For example, approximately 88% of the study area is forested (including both upland forest and swamp habitats) and 14% is wetland. Some of the more unusual habitats we documented are a buttonbush pool, mixed forest swamps, fens, and rocky barrens. In total, we identified 23 different habitat types in the town that we consider to be of ecological importance (Table 1).

The mapped areas represent ecologically significant habitats that have been altered to various degrees by past and present human activities. Most areas of upland forest, for example, have been logged repeatedly or used for agricultural land in the past 250+ years, so they lack the structural complexity of old-growth forests. The hydrology of many wetlands in the town has been extensively altered by filling, draining, and construction of dams, reservoirs, and roads. Purple loosestrife and common reed (introduced invasive species) are common and sometimes dominant plants in marshes and wet meadows and on moist disturbed soils throughout the town. Although we have documented the location and extent of important habitats in the study are, only in a few cases have we provided information on the quality and condition of particular habitat units.

Table 1. Ecologically significant habitats identified by Hudsonia in selected tracts in the Town of Pound Ridge, Westchester County, New York, 2017-18.

Upland Habitats	Wetland Habitats
Upland hardwood forest	Hardwood swamp
Upland conifer forest	Mixed forest swamp
Upland mixed forest	Shrub swamp
Red cedar woodland	Intermittent woodland pool
Crest/ledge/talus	Buttonbush pool
Calcareous crest/ledge/talus	Marsh
Rocky barren	Wet meadow
Upland shrubland	Fen
Upland meadow	Constructed pond
Orchard/plantation	Open water
Cultural	Spring/seep
	Stream

Figure 3. A reduction of the map illustrating ecologically significant habitats in selected tracts in the Town of Pound Ridge, Westchester County, NewYork, as identified and mapped by Hudsonia Ltd in 2017-2018. Hudsonia Ltd, 2018.

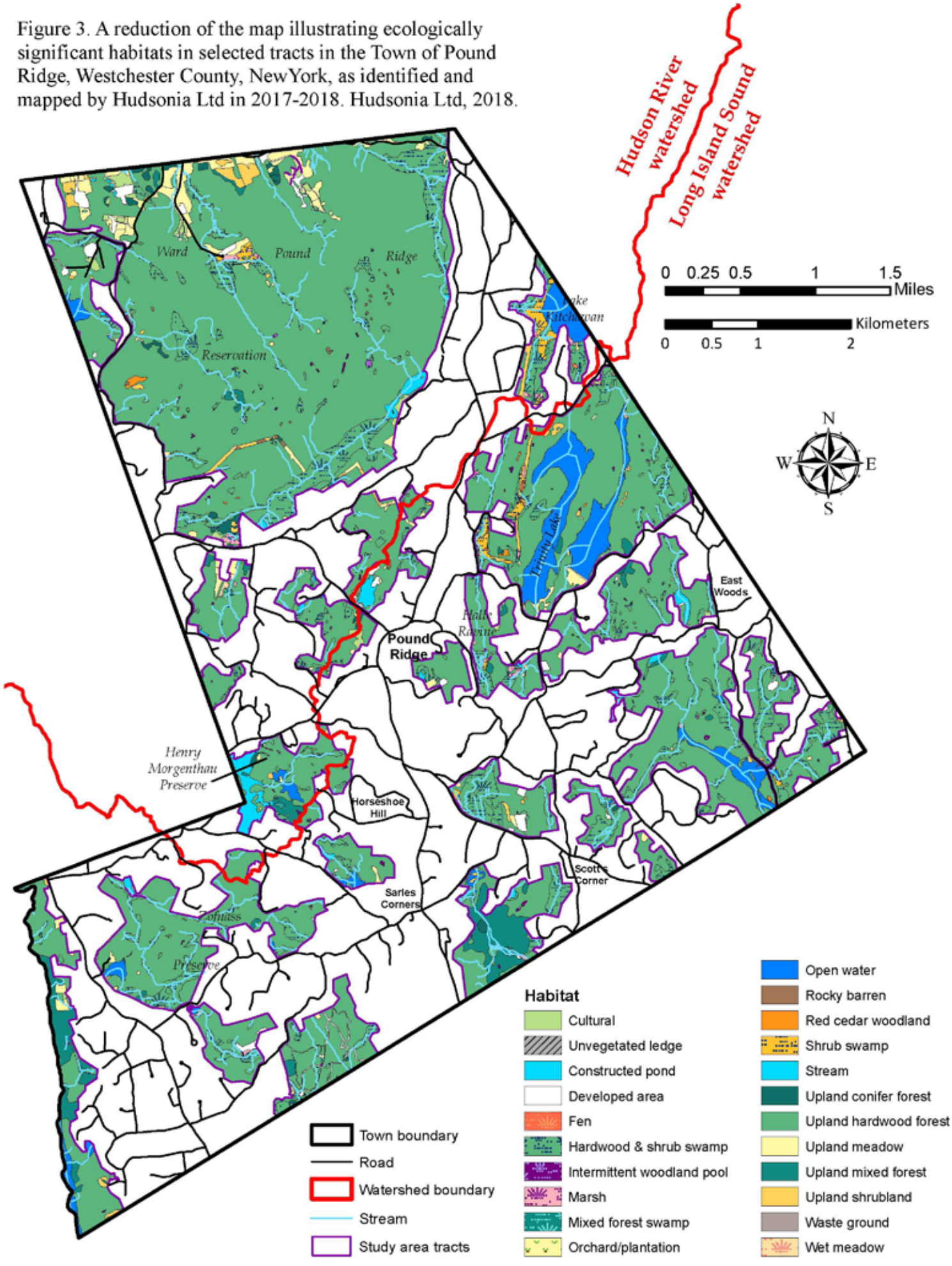
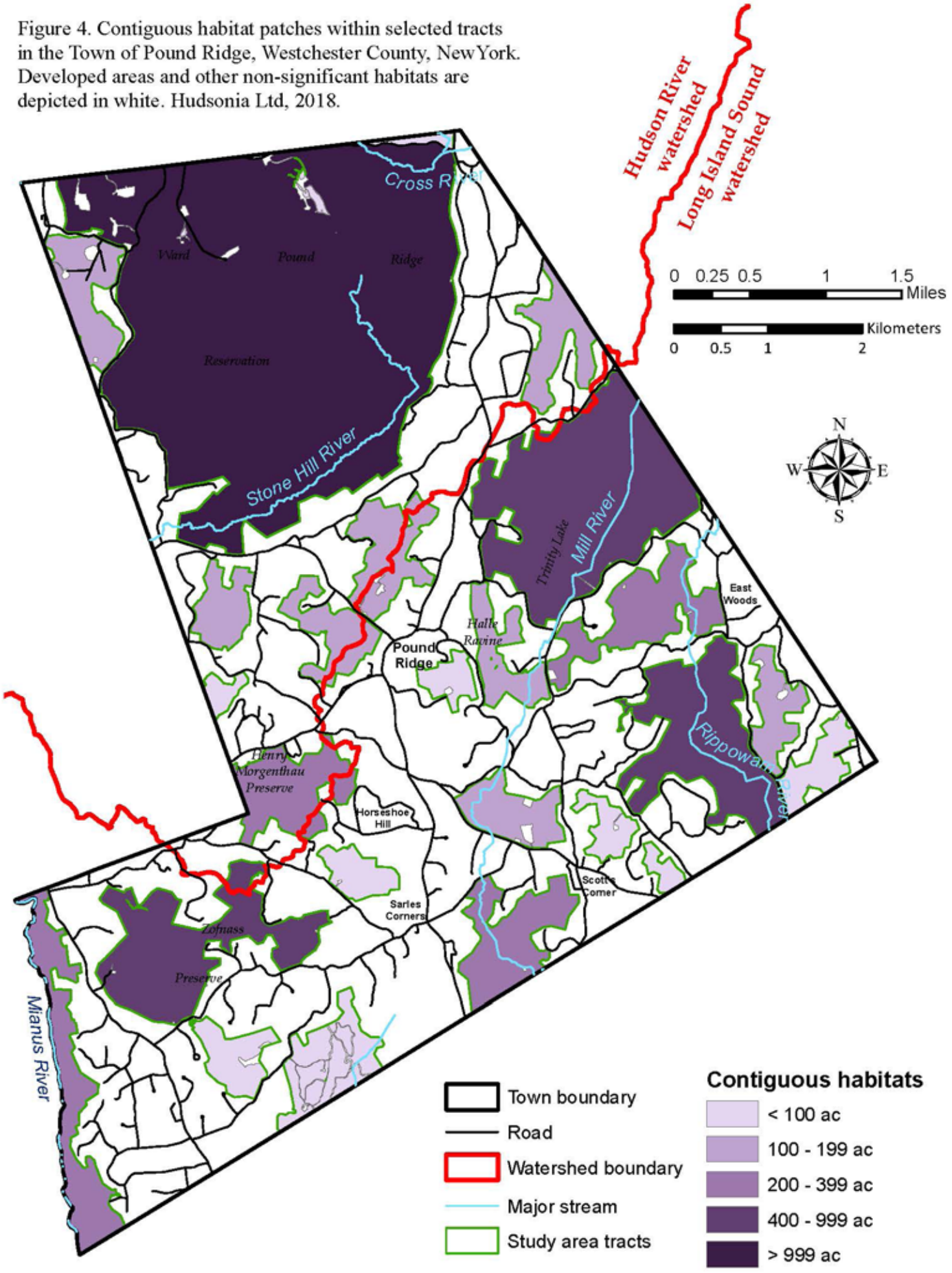


Figure 4. Contiguous habitat patches within selected tracts in the Town of Pound Ridge, Westchester County, NewYork. Developed areas and other non-significant habitats are depicted in white. Hudsonia Ltd, 2018.



HABITAT DESCRIPTIONS

In the following pages we describe some of the ecological attributes of the habitats identified in the town, and discuss some conservation measures that can help to protect these habitats and the species of conservation concern they may support. A large-format map (scale of 1:14,000) accompanying this report depicts the locations of habitats. Figure 3 is a reduced version of the whole-town map. In the narrative below we indicate plant and animal species of conservation concern (those that are listed as such by state agencies or by non-government organizations) by placing an asterisk (*) after the species name. Appendix C provides a longer list of rare species associated with each habitat, including their statewide or regional conservation status. Species in that appendix could occur in their assigned habitat types but are not necessarily present in any particular habitat unit. The letter codes used in Appendix C to describe the conservation status of species are explained in Appendix B. Appendix D gives the common and scientific names of all plants mentioned in this report.

UPLAND HABITATS

UPLAND FORESTS

Ecological Attributes

We classified upland (i.e., non-wetland) forests into three general types for this project: upland hardwood forest, upland conifer forest and upland mixed forest. All three types ranged in age from young stands in which most overstory trees were just 3-6 inches (in) (7-15 centimeters [cm]) in diameter at breast height (dbh), to the most mature stands found in Pound Ridge, in which the dominant canopy trees were 12-18 in (30-46 cm) dbh. Older, more mature forest stands were the most common type found in the study area. We recognize that upland forests are very variable, with each of these three types encompassing many distinct biological communities, but our broad forest types are useful for general planning purposes, and are also the most practical for our remote mapping methods.

Upland Hardwood Forest

Upland hardwood forest is the most common habitat type in the region and is extremely variable in species composition, size and age of trees, vegetation structure, soil drainage and texture, and other habitat factors. The habitat includes many different types of deciduous forest communities, and is used by a large array of common and rare species of plants and animals. Many smaller habitats, such as intermittent woodland pools and crest, ledge, and talus, are frequently embedded within areas of upland hardwood forest.

In mature upland hardwood forests (dominant trees with dbh ≥ 12 in [30 cm]), red oak and sugar maple were by far the most common dominant trees, though black birch, black and chestnut oaks, American beech, pignut hickory, and tulip poplar were also frequent dominants. Younger hardwood forests were frequently dominated by some combination of red oak, sugar maple, red maple, black cherry, black locust, and white ash. Those on shallow, rocky soils of ridges and slopes were frequently dominated by chestnut oak and some combination of black oak, scarlet oak, red oak, pignut hickory, and mockernut hickory. Common understory species included mountain laurel, maple-leaf viburnum, witch-hazel, Japanese barberry, Bell's honeysuckle, lowbush blueberries, and a wide variety of wildflowers, sedges, ferns, and mosses. In addition, while many of the forest edges of Pound Ridge had abundant invasive plant species, the interiors of larger stands, i.e., areas farther from forest edges, were often relatively free of invasive herbs and shrubs.

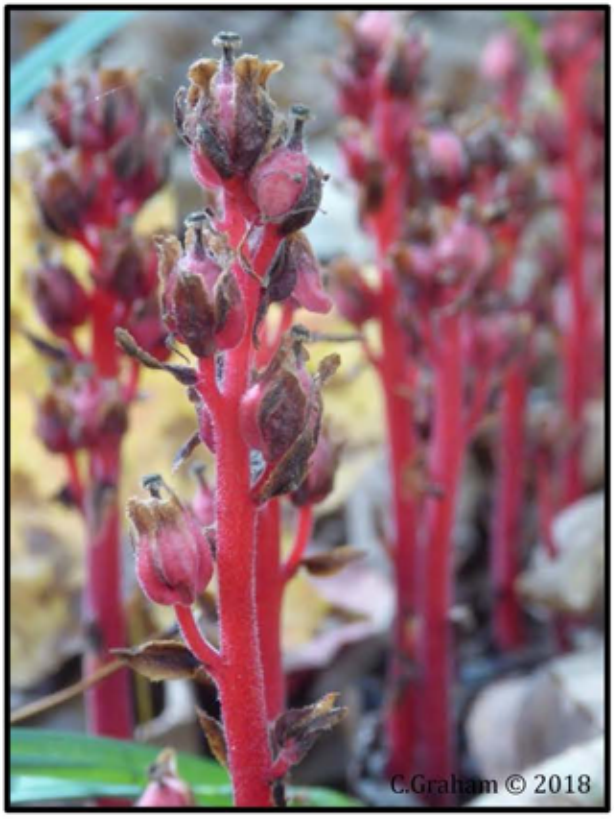
Red oak forest

Upland forests of all kinds provide habitat for a large array of

wildlife, including many species of conservation concern. Eastern box turtle* spends most of its time in upland forests and meadows, finding shelter under logs and organic litter, while spotted turtle* uses upland forests for aestivation (summer dormancy) and travel. Many snake species, such as eastern ratsnake,* northern black racer,* and red-bellied snake, forage widely in upland forests and other habitats. Upland hardwood forests provide important nesting habitat for raptors, including red-shouldered hawk,* Cooper's hawk,* sharp-shinned hawk,* broad-winged hawk, and barred owl, and many species of songbirds, including warblers, vireos, thrushes, and flycatchers. American woodcock* forages and nests in young hardwood forests and shrublands. Acadian flycatcher,* wood thrush,* cerulean warbler,* Kentucky warbler,* and scarlet tanager* are some of the birds that may require large forest-interior areas to nest successfully and maintain populations in the long term. Large mammals such as black bear,* bobcat,* and fisher* also require large expanses of forest. Many small mammals are associated with upland hardwood forests, including eastern chipmunk, southern flying squirrel, and white-footed mouse. Higher densities of small mammals occur in forest areas with abundant logs and other woody debris, and these are favored by snakes such as copperhead, eastern ratsnake, and northern black racer. Hardwood trees larger than 5 in (12.5 cm) dbh—especially those with loose, platy bark such as shagbark hickory, deeply furrowed bark such as black locust, or snags with peeling bark—can be used by big brown, little brown, northern long-eared,* and other bats for summer roosting and nursery colonies.

Animals of conservation concern that use upland forests in Pound Ridge include four-toed salamander,* spotted salamander,* marbled salamander,* eastern box turtle,* eastern worm snake,* eastern hognose snake,* northern black racer,* northern copperhead,* northern goshawk,* Acadian flycatcher,* wood thrush,* scarlet tanager,* black-throated green warbler,* Canada warbler,* cerulean warbler,* Kentucky warbler,* and bobcat* (Miller and Klemens 2002; NYNHP 2018; Anonymous, pers. comm.; Graham, pers. obs.). We observed ambiguous sedge* in a rich, bottomland forest, and black cohosh* in two locations of rich upland soils.

Upland Conifer Forest



Red pinsap

This habitat type comprises both naturally occurring upland forests in which conifers represent more than 75% of canopy cover, and conifer plantations with pole-sized (5-10 in [12-25 cm] dbh) and larger trees. Eastern hemlock, eastern white pine, and eastern red cedar are typical species of naturally occurring conifer stands in the area, and Norway spruce, Scotch pine, and red pine are frequently planted. Eastern red cedar is relatively short-lived and is typically replaced by hardwoods over time, while eastern hemlock forests are long-lived and capable of perpetuating themselves in the absence of significant disturbance or disease.

Conifer stands are used by many species of owls (e.g., barred owl, great horned owl) and other raptors (e.g., Cooper's hawk* and sharp-shinned hawk*) for roosting and sometimes nesting. Red-breasted nuthatch,* purple finch,* and black-throated green warbler* nest in conifer stands. American woodcock* sometimes uses conifer stands for nesting and foraging. Conifer stands also provide important habitat for a variety of mammals, including eastern cottontail, red squirrel, and eastern chipmunk (Bailey and Alexander 1960). Conifer stands provide winter shelter for white-tailed deer and can be especially important for them during periods of deep snow cover. Common rattlebox,* a NYS-Endangered plant, is known from an open, sandy conifer forest in Pound Ridge (NYNHP 2018).

Upland Mixed Forest

We use the term "upland mixed forest" for non-wetland forested areas with both hardwood and conifer species in the overstory, where conifer cover is 25-75% of the canopy. In most cases, the distinction between conifer and mixed forest was made by aerial photograph interpretation. Mixed forests are less densely shaded at ground level and tend to support a higher diversity and greater abundance of understory species than pure conifer stands.

Occurrence in the Town of Pound Ridge

Upland hardwood forests covered a total of 5530 ac (2238 ha, 72%) in our study area, by far the most common habitat type (Figure 3), while upland conifer and upland mixed forests covered much less area. We presume that virtually all forests in the town have been cleared or logged in the past and that no "virgin" stands remain. Forested areas on very steep slopes may have been logged selectively, but not completely cleared. There may be small stands of old-growth forest in the town that we did not observe during field work.

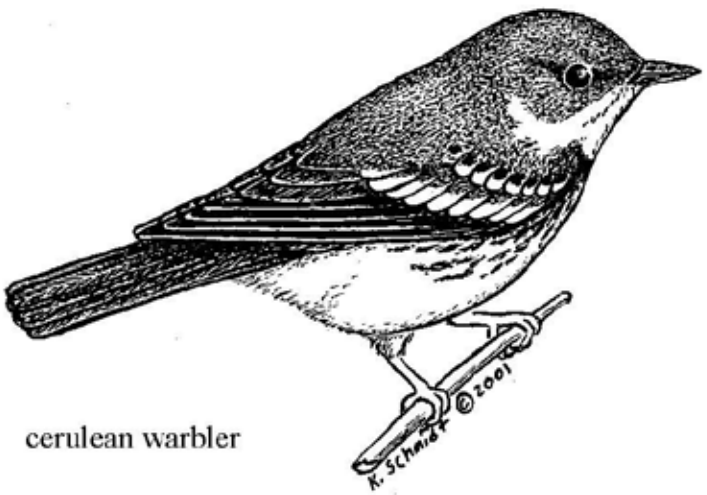
Though most were much smaller, four patches of upland hardwood forest exceeded 400 ac (120 ha), and the largest, at WPRR, was 2165 ac (876 ha). Upland conifer forest and upland mixed forest were scattered around the WPRR. Much of the upland conifer forest along the border with the Town of Lewisboro was recovering from storm damage. Eastern white pine and eastern hemlock occurred in and dominated small stands throughout the study area, while eastern red cedar occurred in only a few patches. While conifer forest accounted for a small fraction of Pound Ridge's land area, and the largest patch was only 7 ac (2.8 ha), mixed forest was much more extensive, totaling 3% of the study area. The largest patches of upland mixed forest were 85 ac (35 ha) at and around the Bye Preserve, and 42 ac (17 ha) along the Mianus Gorge. Both were eastern hemlock-hardwood forests, though in the latter, hemlock was predominant in the understory rather than in the canopy.

Sensitivities/Impacts

Forests of all kinds are important habitats for wildlife. Extensive forested areas that are unfragmented by roads, driveways, trails, utility corridors, residential lots, or meadows are especially important for certain organisms, but are increasingly rare in the region. Fragmenting

features pose many threats to wildlife and the forest itself. Paved and unpaved roads act as barriers that many species will not cross or cannot safely cross (Forman and Deblinger 2000). Mortality from vehicles can significantly reduce the population densities of amphibians (Fahrig et al. 1995), and many animals will not breed near traffic noise (Trombulak and Frissell 2000). Long driveways intruding deep into forests cause significant fragmentation of core forest areas. Development along existing roads is far less disruptive, though it may still block important wildlife travel corridors between forested patches. Roadways, including driveways, can provide access to interior forest areas for nest predators (such as raccoon and opossum) and the brown-headed cowbird (a nest parasite), which reduce the reproductive success of many forest interior birds. Where dirt roads or trails cut through forest, vehicle, horse, and pedestrian traffic can harm tree roots and cause soil erosion. Runoff from roads and driveways can pollute nearby areas with road salt, heavy metals, and sediments (Trombulak and Frissell 2000). Forests are also susceptible to invasion by shade-tolerant non-native herbs and shrubs, which may easily be dispersed along roads and trails and by logging machinery, ATVs, and other vehicles.

In addition to fragmentation, forest habitats can be degraded in many other ways. Clearing the forest understory destroys habitat for birds such as wood thrush,* which nests in dense understory vegetation, and black-and-white warbler* and ovenbird,* which nest on the forest floor. Removal of mature and especially large trees eliminates habitat for lichens, fungi, and bryophytes, as well as the many kinds of animals that use cavities and that forage in and around large and decaying trees. Selective logging can also damage the understory and cause soil erosion, compaction, and rutting, and sedimentation of streams. Soil compaction and removal of dead and downed wood and debris eliminates habitat for mosses, lichens, fungi, birds, amphibians, reptiles, small mammals, and insects. Human habitation near fire-prone forests has led to the suppression of naturally occurring wildfires, which can be important for some forest species and the forest ecosystem as a whole.



cerulean warbler

Introduced forest pests are also threatening forest health in the Hudson Valley. Of note is the hemlock woolly adelgid (HWA), a non-native aphid-like insect that has infested many eastern hemlock stands from Georgia to New England and has caused widespread loss of hemlock in the Hudson Valley. The adelgid typically kills trees within 10 years and has the potential to cause the near extirpation of hemlock forests in the region (McClure 1991). Also of note is the emerald ash borer (EAB), a non-native tree borer that infests ash species and has been found in 30 of New York's 62 counties (NYSDEC 2018), including Westchester County. While the adults do little damage to the tree, the larvae feed on the phloem and cambium; a heavy infestation will effectively girdle a tree, killing it within 2-4 years. Early detection of the emerald ash borer is difficult, and outbreaks are almost impossible to contain once identified. White and green ash (*Fraxinus americana* and *F. pensylvanica*) are common trees throughout Pound Ridge, and black ash (*Fraxinus nigra*) also occurs there. White ash is frequently found in upland forests and as a street tree, and green ash is common in floodplains and hardwood swamps. The Conservation Priorities and Planning section of this report gives recommendations for protecting and fostering the habitat values of large forests, and Figure 7 illustrates locations of contiguous forest blocks in the study area tracts of Pound Ridge.

RED CEDAR WOODLAND

Ecological Attributes

"Red cedar woodlands" have an overstory of widely-spaced eastern red cedar trees and grassy meadow remnants among them. Red cedar is one of the first woody plants to colonize oldfields on mildly acidic to alkaline soils in this region, and red cedar woodlands are often transitional between upland meadow and young forest habitats. The seeds of red cedar are bird-dispersed, and the seedlings are successful at becoming established in the hot, dry conditions of old pastures (Holthuijzen and Sharik 1984). The cedars tend to develop particularly dense stands in areas with calcareous (calcium rich) soils. Other, less common trees of this habitat include gray birch, red maple, quaking aspen, and red oak. The understory vegetation is similar to that of upland meadows. Kentucky bluegrass and other hayfield and pasture grasses are often dominant in the understory, particularly in more open stands; little bluestem is often dominant on poorer soils. Red cedars can persist in these stands for many years even after a hardwood

forest grows up around them. Beyond a certain density of red cedars, when few open grassy spaces remain, we classified stands as upland conifer or upland mixed forest.

Rare plants of red cedar woodlands on calcareous soils in the region include Carolina whitlow-grass,* yellow wild flax,* and Bicknell's sedge.* We found whorled milkweed* and butterflyweed* (a milkweed) in one red cedar woodland. The olive hairstreak* (butterfly) uses red cedar as a larval host. Open red cedar woodlands with exposed gravelly or sandy soils may be important nesting habitat for several reptile species of conservation concern, including wood turtle,* spotted turtle,* eastern box turtle,* and eastern hognose snake.* These animals may travel considerable distances overland from their primary wetland, stream, or forest habitats to reach the nesting grounds. Eastern hognose snake* may also use these habitats for basking, foraging, and over-wintering. The berry-like cones of red cedar are a food source for eastern bluebird,* cedar waxwing, and other birds. Many songbirds, including field sparrow,* eastern towhee,* and brown thrasher,* also use red cedar for nesting and roosting. Insectivorous birds such as black-capped chickadee and golden-crowned kinglet forage in red cedar.

Red cedar woodland

Occurrence in the Town of Pound Ridge

We found nine red cedar woodlands in the study area; the largest was a 3.5 ac-(1.4-ha) woodland atop Joe's Hill in WPRR, surrounding a rocky barren. Another 1-ac (0.4-ha) red

cedar woodland was situated on marble bedrock in the Isaacson Preserve. Red cedar woodlands were mostly on shallow soils and rocky slopes.

Sensitivities/Impacts

Red cedar woodlands on abandoned agricultural lands are often considered prime development sites, and thus are particularly vulnerable to direct habitat loss or degradation. Woodlands on steep slopes with fine sandy soils may be especially susceptible to erosion from ATV traffic, driveway construction, and other human uses. Use of heavy equipment may harm or destroy the nests of turtles, snakes, and ground-nesting birds. Human disturbances may also facilitate the invasion of non-native forbs and shrubs that tend to diminish habitat quality by forming dense stands that discourage or displace native plant species. Wherever possible, measures should be taken to prevent the direct loss or degradation of these habitats and to maintain unfragmented connections with nearby wetlands, forests, and other important habitats. Red cedar woodlands are typically a transitional habitat, and will ordinarily develop into young forest with the cedars gradually overtopped by deciduous trees.

CREST/LEDGE/TALUS

Ecological Attributes

Rocky crest, ledge, and talus habitats often (but not always) occur together, so they are described and mapped together for this project. Crest and ledge habitats occur where soils are very shallow and bedrock is partially exposed at the ground surface, either at the summit of a hill or knoll (crest) or elsewhere (ledge). These habitats are usually embedded within other habitat types, most commonly upland forest. They can occur at any elevation, but may be most familiar on hillsides and hilltops in the region. Talus is the term for the fields of large rock fragments that often accumulate below steep ledges and cliffs. We also include large glacial erratics (glacially-deposited boulders) in this habitat type. Some crest, ledge, and talus habitats support well-developed forests, while others have only sparse, patchy, and stunted vegetation. Crest, ledge, and talus habitats often appear to be harsh and inhospitable, but they can support an extraordinary diversity of uncommon and rare plants and animals. Some species, such as wall-rue,* smooth cliffbrake,* purple cliffbrake,* and northern slimy salamander* are found only in and near rocky places in the region. The communities and species that occur at any

particular location are determined by many factors, including bedrock type, outcrop size, aspect, exposure, slope, elevation, biotic influences, and kinds and intensity of human disturbance.

A typical rocky forest in Pound Ridge.

Because distinct communities develop in calcareous and non-calcareous environments, we distinguished calcareous bedrock exposures wherever possible. Calcareous crests often have trees such as eastern red cedar, northern hackberry,* American basswood, and butternut; shrubs such as bladdernut, American prickly-ash, and Japanese barberry; and herbs such as wild columbine, ebony spleenwort, maidenhair spleenwort, maidenhair fern, and fragile fern. They can support numerous rare plant species, such as walking fern,* yellow harlequin,* and Carolina whitlow-grass.* Non-calcareous crests often have trees such as red oak, chestnut oak, eastern hemlock, and occasionally pitch pine; shrubs such as lowbush blueberries, chokeberries, and scrub oak; and herbs such as Pennsylvania sedge, little bluestem, common hairgrass, bristly sarsaparilla, and rock polypody. Rare plants of non-calcareous crests include mountain spleenwort,* clustered sedge,* and slender knotweed.*

Rocky areas in the Pound Ridge study area were frequently associated with chestnut oak, red oak, black birch, and mountain laurel. Other common plants of such places included lowbush blueberries, black huckleberry, rock polypody, marginal wood fern, Pennsylvania sedge, Swan's sedge, and poverty grass. Calcicoles (calcium-associated plants) of calcareous crest,

ledge, and talus included wild columbine, bloodroot, black cohosh,* wild ginger, maidenhair fern, and ebony and maidenhair spleenworts.

Northern hairstreak* (butterfly) occurs with oak species which are host plants for its larvae, and olive hairstreak* occurs on crests with its host eastern red cedar. Rocky habitats with larger fissures, cavities, and exposed ledges may provide shelter, den, and basking habitat for eastern hognose snake,* northern copperhead,* and other snakes of conservation concern. Northern slimy salamander* occurs in non-calcareous wooded ledge and talus areas. Breeding birds of crest habitats include worm-eating warbler* and cerulean warbler.* Bobcat* and fisher* use crests and ledges for travel, hunting, and cover. Bobcats use ledge and talus habitats for denning. Southern red-backed vole* is found in some rocky areas, and eastern small-footed bat* roosts in talus habitat. Eastern ratsnake,* eastern hognose snake,* northern black racer,* northern copperhead,* worm-eating warbler,* cerulean warbler,* and bobcat* are all known from Pound Ridge (Miller and Klemens 2002).

We mapped as "calcareous crest, ledge, and talus" those areas that we identified as such in the field and nearby areas with similar physiography. We mapped as simply "crest, ledge, and talus" those areas that we confirmed as non-calcareous in the field, as well as all other ledgy areas that we did not visit or visited too late in the season for indicator species. Thus, the "crest, ledge, and talus" designation serves as a catch-all for non-calcareous outcrops and talus plus other such rocky habitats of unknown chemistry. For areas that we could not visit in the field, we mapped predicted coverage of crest, ledge, and talus based on the coincidence of shallow soils (as mapped in Siefried 1994) and steep slopes.

Occurrence in the Town of Pound Ridge

Crest, ledge, and talus habitats occurred throughout the town, mostly on hills, ridges, and steep slopes (Figure 8). Extensive non-calcareous crest, ledge, and talus occurred in WPRR (especially the southern and eastern slopes), in and around the Zofnass Preserve, and around the northern ends of Trinity Lake and Mill River Reservoir. Altogether, we mapped 1,740 ac (705 ha) of known or predicted crest, ledge, and talus habitat. A few, small calcareous (marble)

outcrops were located south of Lake Kitchawan, in the Isaacson Preserve, and off the south end of the Halle Ravine.

Sensitivities/Impacts

Crest, ledge, and talus habitats often occur in locations that are valued by humans for recreational uses, scenic vistas, house sites, and communication towers. Construction of trails, roads, and houses destroys crest, ledge, and talus habitats directly, and causes fragmentation of these habitats and the forested areas of which they are often a part. Rare plants of crests are vulnerable to trampling and collecting; rare snakes are susceptible to road mortality, intentional killing, and collecting; and rare breeding birds of crests are easily disturbed by human activities nearby. The shallow soils of these habitats are susceptible to erosion from construction and logging activities and from foot and ATV traffic. The Conservation Priorities and Planning section of this report gives recommendations for preserving the habitat values of these rocky habitats.

ROCKY BARREN

Ecological Attributes

A subset of rocky crest habitat (see above), rocky barrens occur on knoll tops, hilltops, and steep slopes with exposed bedrock and shallow, often acidic soils. The vegetation may be predominantly grassy or woody or a combination thereof, but extensive exposed bedrock is the unifying features. The exposed bedrock can be of various types, but many of the barrens habitats in Pound Ridge are on gneiss. The soils are extremely shallow, excessively well-drained, very nutrient poor, and susceptible to drought. Some of these ecosystems may be maintained by episodic fire events, which limit colonization by species that are not fire-adapted, help certain plant species such as pitch pine regenerate, return nutrients to the soil, and prevent the overgrowth of trees that can shade out typical barren species (which require full sunlight). Because these barrens are usually located in exposed areas with shallow soils, woody plants are susceptible to breakage from wind and winter storms to which crests are fully exposed (Thompson and Sarro 2008); this exposure contributes to the sparse tree growth and shrubby, stunted character of barrens vegetation. Due to the open canopy, exposed rock, and dry soils, rocky barrens tend to have a much warmer microclimate in summer than the

surrounding forested habitat, especially in the spring and fall, and a colder microclimate in winter.

A grass-dominated rocky barren.

Although these habitats seem inhospitable (in part because of exposure to extreme temperatures and short growing seasons [Thompson and Sarro 2008]), their plants and animals are adapted to harsh conditions. Dominant trees include pitch pine, chestnut oak, red oak, and scarlet oak; the shrub layer may include scrub oak, eastern red cedar, blueberries, black huckleberry, deerberry, and sweetfern. Common herbs include Pennsylvania sedge, poverty grass, common hairgrass, little bluestem, and bracken. Lichens and mosses are often abundant. Our definition of these habitats corresponds to Edinger et al.'s (2014) "pitch pine-oak forest," "pitch pine-oak-heath rocky summit," "red cedar rocky summit," and "rocky summit grassland." There may be a continuous canopy of pitch pine or pitch pine and oak with a scrub oak understory; the shrub layer (largely scrub oak and/or heath shrubs) may dominate, with only scattered pines or eastern red cedars; or the vegetation may be predominantly grassy with scattered shrubs and trees.). Common species in Pound Ridge's rocky barrens were chestnut oak, scarlet oak, and pitch pine, with lowbush blueberries, black huckleberry, poverty grass, and panic grasses common in the understory. Mosses and lichens also were often abundant.

Rare plants of rocky barrens include clustered sedge,* mountain spleenwort,* and dwarf shadbush.* Rare butterflies that use scrub oak, little bluestem, lowbush blueberry, or pitch pine as their primary food plant tend to concentrate in rocky barrens, including Edward's hairstreak,* cobweb skipper,* and Leonard's skipper.* Woody barrens also provide habitat for several rare oak-dependent moths. Deep rock fissures can provide crucial shelter for northern copperhead* and other snakes of conservation concern, and the exposed ledges provide basking and breeding habitat in the spring and early summer. Birds of these habitats include common yellowthroat, prairie warbler,* field sparrow,* eastern towhee,* and whip-poor-will.* Northern copperhead,* eastern ratsnake,* and northern black racer* are all found in Pound Ridge (Miller and Klemens 2002) and may use rocky barrens.

Occurrence in the Town of Pound Ridge

A total of 28 rocky barrens were found in our study area (Figure 8), most of these in WPRR. They were scattered throughout the reservation, but many were concentrated in the southern and southeastern parts thereof. The largest area was 0.7 ac (0.3 ha) and could be characterized as a pitch pine-oak forest (Edinger et al. 2014); most of the areas were between 0.1 and 0.3 ac (0.04 – 0.12 ha). These barrens may be a remnant of historically larger habitats once maintained by fire and now persisting because shallow soils inhibit establishment of taller tree species that would shade out the barren species. Because these communities are difficult to find remotely, we expect there are additional small, rocky barrens in the areas of exposed bedrock that we did not field-check.

Sensitivities/Impacts

The most immediate threat to these fragile habitats is human foot traffic; barrens near trails are often visited for scenic views and for picnicking and camping. Trampling, soil compaction, and soil erosion can damage or eliminate rare plants, discourage use by rare animals, and encourage invasions of non-native plants. Barrens on hilltops can also be disturbed or destroyed by the construction and maintenance of communication towers. Construction of roads and buildings in the areas between rocky barrens and other exposed crests can fragment important migration corridors for snakes and butterflies, thereby isolating neighboring populations and reducing

their long-term viability. Because snakes tend to congregate on rocky barrens and other exposed crests at certain times of the year, the snakes are highly vulnerable to being killed or harassed, or collected by poachers. Barrens tend to be disturbance-maintained ecosystems, but wildfire suppression eliminates this important disturbance regime. The scarcity of fires enables other, less specialized forest species to colonize these areas. The Conservation Priorities and Planning section of this report gives recommendations for protecting and fostering the habitat values of barrens habitats.

UPLAND SHRUBLAND

Ecological Attributes

We use the term "upland shrubland" for shrub-dominated upland (non-wetland) habitats in which shrub cover is 20% or more. In most cases these are lands in transition between meadow and young forest, but they also occur along utility corridors maintained by cutting or herbicides, and in areas of recent forest clearing. Land use (both historical and current) and soil characteristics are important factors influencing the species composition of shrub communities. Shrublands often host native shrubs such as meadowsweet, gray dogwood, northern blackberry, and raspberries, as well as scattered seedlings and saplings of eastern red cedar, hawthorns, eastern white pine, gray birch, red maple, quaking aspen, and oaks. Among the shrubs are native and non-native grasses and forbs. Other shrublands, however, are dominated by non-native, invasive species such as Japanese barberry, Bell's honeysuckles, oriental bittersweet, mile-a-minute vine and multiflora rose. Occasionally, large, open-grown trees (e.g. sugar maple, red oak, white oak, sycamore) left as shade for livestock or ornament may be present. Many non-native, invasive plants tend to thrive in places with a history of recent agricultural use (up to 40-80 years ago), fine soil texture (Lundgren et al. 2004, Johnson et al. 2006). Recently-logged areas, if left unmanaged, usually have a shrubland phase with abundant tree saplings and northern blackberry before transitioning to young forest.

Rare butterflies such as Aphrodite fritillary,* dusted skipper,* Leonard's skipper,* and cobweb skipper* may occur in shrublands where their larval host plants are present (the fritillary uses violets and the skippers use native grasses such as little bluestem). Upland shrublands and other non-forested upland habitats may be used by turtles for nesting, aestivating (e.g. painted turtle,

wood turtle,* spotted turtle,* and eastern box turtle*) or foraging (eastern box turtle*). Many bird species of conservation concern nest in upland shrublands and adjacent upland meadow habitats, including brown thrasher,* blue-winged warbler,* golden-winged warbler,* prairie warbler,* yellow-breasted chat,* field sparrow,* and eastern towhee. Many shrubland birds (including blue-winged warbler) do not seem to be area-sensitive in shrubland patches larger than about 1 ha, and they will nest in small to medium-sized shrublands within forest openings, particularly those with low vegetation, few trees, and dense shrub cover (Askins et al. 2007). Nevertheless, most of these birds avoid forest edges (Schlossberg & King 2008) so extensive upland shrublands (>12.5 ac [5 ha]) and those that form large complexes with meadow habitats may be particularly important (Shake et al. 2012). Several species of hawks and falcons use upland shrublands and adjacent meadows for hunting small mammals such as meadow vole, white-footed mouse, eastern cottontail, and New England cottontail.* The last species, once common in the Northeast but now of conservation concern, seems to do best in large shrublands with dense shrub thickets. The Hudson Valley east of the Hudson River and western Connecticut are believed to be important parts of the remaining range of this species; we do not know if it is extant in Pound Ridge.

Occurrence in the Town of Pound Ridge

Upland shrublands were sparsely distributed throughout the study area (Figure 3), and ranged from less than 0.1 ac to 9 ac (< 0.04 – 3.6 ha). The largest patches were in former oldfields and in utility corridors, with smaller shrublands occurring in forest blow-downs and canopy gaps. Common species included Bell's honeysuckle, multiflora rose, gray dogwood, Japanese barberry, eastern red cedar, goldenrods, and grasses.

Sensitivities/Impacts

Shrublands and meadows are closely related habitats. Having a diversity of ages and structures in these habitats may promote overall biological diversity, and can be achieved by rotational mowing and/or brush-hogging. To reduce the impacts of these management activities on birds, mowing should be timed to coincide with the post-fledging season for most birds (e.g. October and later), and only take place every few years, if possible. Prescribed or spontaneous fires can also maintain shrublands and grasslands. Soil compaction and erosion caused by ATVs, other

vehicles, and equipment can reduce the habitat value for invertebrates, small mammals, nesting birds, and nesting turtles. If shrublands are left undisturbed, most will eventually become forests, which are also valuable habitats.

UPLAND MEADOW

Ecological Attributes

This broad category includes abandoned fields and other upland areas dominated by herbaceous (non-woody) vegetation. Upland meadows are typically dominated by grasses and forbs and have less than 20% shrub cover. The ecological values of these habitats can differ widely according to the types of vegetation present and the disturbance histories (e.g., tilling, mowing, grazing, pesticide applications). Undisturbed meadows often develop diverse plant communities of grasses, forbs, and shrubs and can support a large array of wildlife, including invertebrates, some frog species, reptiles, mammals, and birds. Meadows with thin, nutrient-poor soils often support a higher abundance and diversity of native, warm-season grasses and other native plants. It is for both present and potential ecological values that we consider all types of meadow habitat to be ecologically significant.

Common rattlebox* and stiff-leaved goldenrod* are known from upland meadows in Pound Ridge (NYNHP 2018), and Hudsonia biologists observed Bush's sedge* in an oldfield within the study area. Several species of rare butterflies, such as Aphrodite fritillary,* meadow fritillary, * dusted skipper,* Leonard's skipper,* swarthy skipper,* and striped hairstreak use upland meadows that support their particular host plants. Northern oak hairstreak* has been found in upland meadow of Pound Ridge (NYNHP 2018). Upland meadows can also be used for nesting by wood turtle,* spotted turtle,* box turtle,* painted turtle, and snapping turtle. Grassland-breeding birds such as grasshopper sparrow,* savannah sparrow,* eastern meadowlark,* and bobolink* use extensive meadow habitats for nesting and/or foraging. Wild turkeys forage on invertebrates and seeds in upland and wet meadows. Upland meadows often have large populations of small mammals (e.g., meadow vole) and can be important hunting grounds for raptors, foxes, and eastern coyote.

Occurrence in the Town of Pound Ridge

There were 182 ac (74 ha, 2%) of upland meadow in the study area. The largest patches were 21 and 12 ac (8.5 and 4.8 ha) along the northern boundary of WPRR; however, this meadow complex extended into the Lewisboro section of the reservation and therefore has a far greater total size. Many other small meadows occurred around developed areas, where they were an alternative to mowed lawns.

Sensitivities/Impacts

Upland meadow patch

Principal causes of the loss of high-quality meadow habitat in the Northeast are the intensification of agriculture, regrowth of shrubland and forest after abandonment of agriculture, and residential development. The dramatic decline of grassland-breeding birds in the Northeast has been attributed to the loss of large patches of suitable meadow habitat; many of these birds need large meadows that are not divided by fences or hedgerows, which can harbor predators (Wiens 1969). Mowing of upland meadows during the nesting season can cause extensive mortality of eggs, nestlings, and fledglings. Another threat to upland meadow habitats is the soil compaction and erosion caused by ATVs, other vehicles, and equipment, which can reduce the habitat value for invertebrates, small mammals, nesting birds, and nesting turtles. Destruction of vegetation can affect rare plants and reduce viable habitat for butterflies. Horse pastures potentially have open-space, scenic, and

biodiversity values, but those that are grazed intensively have little current value for native biodiversity.

Good management of small meadows can be critical for invertebrates and small mammals. Different groups of butterflies depend on different meadow habitats (oldfields/ hayfields; stream margins; wet meadows/pond margins; dry, shallow-soiled fields; Vispo & Knab-Vispo 2012), and different species have variously timed life cycles. Perhaps the best management strategy for butterfly conservation is to mow fields only in halves or portions which cut across topography. For example, if the field has wet and dry parts, cut half the wet and half the dry in any one year, rather than all the wet this year, and all the dry next year (Conrad Vispo, personal communication). Mow strategically to ensure that early-, mid-, and late-flowering forbs are available to serve insects with different active periods. Nectar from October flowers, for example, will support late-flying native bees and butterflies when many other food sources have gone to seed.

ORCHARD/PLANTATION

This habitat type includes actively maintained or recently abandoned fruit orchards, tree farms, and plant nurseries. Conifer plantations with larger, older trees were mapped as "upland conifer forest," and those that had been partially harvested and colonized by shrubs were mapped as "upland shrubland." Fruit orchards with old trees may provide breeding habitat for eastern bluebird* and can be valuable to other cavity-using birds, bats, and other animals. These habitats have some of the vegetation structure and ecological values of upland meadows and upland shrublands, and will ordinarily develop into young forests if they remain undisturbed after abandonment. The habitat values of active orchards or plantations is often compromised by frequent mowing, application of pesticides, and other human activities; we considered this an ecologically significant habitat type more for its future ecological values after abandonment than its current values. We found only one orchard/plantation (abandoned)—a spruce plantation of 1.8 ac (0.7 ha) in WPRR.

CULTURAL

We define "cultural" habitats as areas that are significantly altered and intensively managed (e.g., mowed) but are not otherwise developed with pavement or structures. Large lawns, golf courses, and athletic fields are typical examples. We consider them to be ecologically significant when they are large and adjacent to other ecologically significant habitats (i.e., when they are not entirely surrounded by developed areas). We identified this as a significant habitat type more for its potential ecological values than its current values, which are reduced by frequent mowing, application of fertilizers and pesticides, or other types of management and intensive human uses. Nonetheless, eastern screech-owl* and barn owl* are known to nest, forage, and roost in cultural areas. American kestrel,* spring migrating songbirds, and bats may forage in these habitats, and wood duck* and American kestrel* may nest here, as may several species of turtle. Large individual ornamental or fruit trees can provide habitat for cavity-nesting birds such as eastern bluebird,* roosting bats, and many other animals, and for mosses, liverworts, and lichens, potentially including rare species. Of the different types of places mapped as "cultural," cemeteries are particularly well suited to provide habitat to a variety of species, since mature trees are often present, noise levels are minimal, and vehicular traffic is infrequent and slow. Many cultural areas have "open space" values for the human community (e.g., recreational or scenic), and some provide important services such as buffering less disturbed habitats from human activities and linking patches of undeveloped habitat. However, because cultural areas are already significantly altered, their habitat values are greatly diminished compared to those of relatively undisturbed habitats. Cultural habitats in our study area included playing fields, riding rings, large lawns, and manicured borders of ponds. They ranged from smaller than 0.1 to 6 ac (< 0.04 - 2.5 ha).

Anise millipedes in turkey tail mushrooms

WETLAND HABITATS

SWAMPS

Ecological Attributes

A "swamp" is a wetland dominated by woody vegetation (trees or shrubs). We mapped three general types of swamp habitat in the town: hardwood swamp, mixed forest swamp, and shrub swamp.

Hardwood Swamp

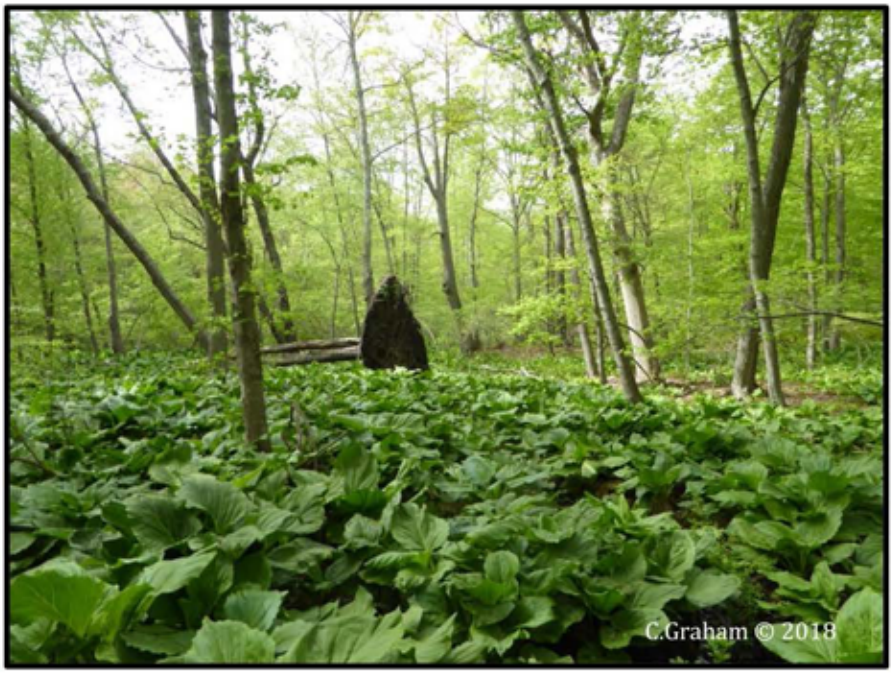
Hardwood swamps in Pound Ridge were typically dominated by red maple, and had other tree species such as green ash, American elm, slippery elm, and yellow birch. One large hardwood swamp south of Lake Kitchawan was dominated by black ash, indicating calcareous soils. Many hardwood swamps contained abundant shrubs, including highbush blueberry, coast pepperbush, winterberry holly, glossy buckthorn, multiflora rose, and spicebush. Common herbaceous species included tussock sedge, skunk-cabbage, orange jewelweed, yellow iris, false nettle, and sensitive, cinnamon, royal fern, and marsh ferns. Hardwood swamps are sometimes difficult to distinguish from shrub swamps on aerial photos, and might therefore be over-estimated in areas that were not field checked.

Mixed Forest Swamp

Mixed forest swamps have a canopy composed of 25-75% conifers. Eastern hemlock was the typical conifer species of these wetlands. This habitat has characteristics intermediate between those of hardwood and conifer swamps, and shares many of the ecological values of those habitats.

Shrub Swamp

A shrub swamp is a subset of hardwood swamp where shrubs instead of trees are dominant. If trees are present, they are widely spaced. Typical shrubs included glossy buckthorn (which dominated several large shrub swamps in areas of marble bedrock), winterberry holly, highbush blueberry, coast pepperbush, silky dogwood, alders, northern arrowwood, and spicebush.



A hardwood swamp carpeted with skunk cabbage

Swamps are important to a wide variety of birds, mammals, amphibians, reptiles, and invertebrates, especially when the swamp is contiguous with other wetland types or embedded within large areas of upland forest. Swamp cottonwood* is a very rare tree of deeply-flooding hardwood swamps and is known from only a handful of sites in the Hudson Valley. Purple milkweed* is known from one shrub swamp in Pound Ridge (NYNHP 2018). Hardwood and shrub swamps along the floodplains of clear, low-gradient streams can be an important component of wood turtle* habitat. Other turtles such as spotted turtle* and box turtle* frequently use swamps for summer foraging, drought refuge, overwintering, and travel corridors. Pools within swamps are used by several pool-breeding amphibian species, and are the primary breeding habitat of blue-spotted salamander.* Four-toed salamander,* believed to be regionally rare or scarce, uses swamps with rocks or abundant, moss-covered, downed wood or woody hummocks. Eastern ribbon snake* forages for frogs in swamps. Red-shouldered hawk,* barred owl, great blue heron,* wood duck,* American black duck,* red-headed woodpecker,* Canada warbler,* and white-eyed vireo* nest in hardwood swamps.

Among hardwood and shrub swamps that we mapped, we noted a particular type worth distinguishing (denoted with a star on the habitat map): pool-like swamp. *Pool-like swamps* have hydrological properties—pool areas that dry up during the summer and are isolated from other wetlands and streams—similar to intermittent woodland pools, but also have the trees and shrubs characteristic of swamps. Because of their impermanent water and their isolation from streams and other wetlands, these swamps may have ecological roles similar to those of

intermittent woodland pools. See the section on intermittent woodland pools (below) for additional ecological attributes and occurrence information.

Occurrence in the Town of Pound Ridge

Swamps occurred in a variety of settings: on seepy slopes, along streams, in depressions, and as part of large wetland complexes. Swamps ranged from smaller than 0.1 to over 113 ac (< 0.04 - 45.7 ha), and were often contiguous with other wetland habitats such as marsh, wet meadow, and open water (Figure 11). We mapped a total of 975 ac (390 ha) of swamp, accounting for 13% of the study area. Hardwood swamps covered 918 ac (372 ha), or about 12% of the study area, while mixed forest swamps (12 ac [5 ha]) and shrub swamps (50 ac [20 ha]) accounted for far less land area. The two largest swamps were along the Stone Hill River (116 ac [47 ha]) and along the Cross River (77 ac [31 ha]). We classified 46 of these swamps as pool-like swamps, many of them scattered throughout WPRR.

Sensitivities/Impacts

While some swamps may be protected by federal or state laws, that protection is usually incomplete or inadequate, and most swamps are still threatened by a variety of land uses. Small swamps embedded in upland forest are sometimes overlooked in environmental reviews, but can have extremely high biodiversity values, and play similar ecological roles to those of intermittent woodland pools (see below). Many of the larger swamps are located in low-elevation areas where human land uses are also concentrated. They can easily be damaged by alterations to the quality or quantity of surface water runoff, or by disruptions of groundwater sources that feed them. Swamps that are surrounded by agricultural land are subject to runoff contaminated with agricultural chemicals, and those near roads and other developed areas often receive sediment- and toxin-laden runoff. Polluted runoff and groundwater can degrade a swamp's water quality, affecting the ecological condition (and thus habitat value) of the swamp and its associated streams. Maintaining flow patterns and water volumes in swamps is important to the plants and animals of these habitats. Connectivity between swamp habitats and nearby upland and wetland habitats is essential for amphibians that breed in swamps and for other resident and transient wildlife of swamps. Direct disturbance, such as logging, can damage soil structure, plant communities, and microhabitats, and provide access for invasive

plants. Ponds for ornamental or other purposes are sometimes excavated or impounded in swamps, but the lost habitat values of the pre-existing swamp usually far outweigh any habitat values gained in the new, artificial pond environment. The Conservation Priorities and Planning section of this report provides recommendations for preserving the habitat values of swamps within larger wetland complexes. Recommendations for preserving the habitat values of pool-like swamps are given in the Conservation Priorities and Planning section on intermittent woodland pools, and Figure 9 shows their conservation zones.

Song sparrow in its shrub swamp habitat

INTERMITTENT WOODLAND POOL

Ecological Attributes

An intermittent woodland pool is a small wetland, partially or entirely surrounded by forest, typically with no surface water inlet or outlet (or an ephemeral one), and with standing water during fall, winter, and spring that dries up by mid- to late summer during a normal year. This habitat is a subset of the widely recognized "vernal pool" habitat (which may occur in forested or open settings). Despite the small size of intermittent woodland pools, those that hold water through early summer can support amphibian diversity equal to or higher than that of much larger wetlands (Semlitsch and Bodie 1998, Semlitsch 2000). Seasonal drying and lack of a stream connection ensure that these pools do not support fish, which are major predators on amphibian eggs and larvae. The surrounding forest supplies the pool with organic detritus, which is the base of the pool's food web. The forest is also essential habitat for adult pool-breeding amphibians during the non-breeding season.

Common plant species of intermittent woodland pools in Pound Ridge included black gum, red maple, high-bush blueberry, winterberry holly, marsh fern, and tussock sedge, mostly around pool edges.

Pool-like swamps have hydrological properties similar to intermittent woodland pools, in addition to woody vegetation characteristic of swamps. Because of their isolation from streams and other wetlands, these swamps may have ecological roles similar to those of intermittent woodland pools—i.e. they may provide seasonal water with fewer aquatic predators, breeding habitat for pool-breeding amphibians, and refuge for turtles.

Intermittent woodland pools (and pool-like swamps) provide critical breeding and nursery habitat for wood frog,* Jefferson salamander,* marbled salamander,* and spotted salamander* and are also used by other amphibians such as spring peeper, blue-spotted salamander* and four-toed salamander.* Reptiles such as spotted turtle* and eastern ribbon snake* use intermittent woodland pools for foraging, rehydrating, and resting. Wood duck,* mallard, and American black duck* use intermittent woodland pools for foraging, nesting, and brood-

An intermittent woodland pool, nearly dry in summertime

rearing, and a variety of other waterfowl and wading birds use these pools for foraging. During the breeding season, birds may be more abundant and diverse around intermittent woodland pools than in upland forest (McKinney & Paton 2009). The invertebrate communities of these pools can be rich, providing abundant food for songbirds such as yellow warbler, common yellowthroat, and northern waterthrush.* Springtime physa* is a regionally rare snail associated with intermittent woodland pools. Large and small mammals use these pools for foraging and as water sources. Featherfoil* and false hop sedge* seem to specialize in this habitat. Indeed, we found false hop sedge* in two intermittent woodland pools in Pound Ridge, and featherfoil was previously known from a woodland pool in the town (NYNHP 2018).

Occurrence in the Town of Pound Ridge

Figure 9 illustrates locations of intermittent woodland pools and their conservation zones in the Pound Ridge study area. We found 61 intermittent woodland pools scattered across the study area; the largest was 0.5 ac (0.2 ha). Many of these woodland pools are connected by undeveloped forest habitat, which increases the habitat value of the network of pools. Some intermittent woodland pools were part of larger hardwood swamps, but we mapped these only when the entire swamp was isolated from streams or larger water bodies. Because pools were small and often difficult to identify on aerial photographs, we expect there are additional such habitats that we did not map.

Sensitivities/Impacts

We consider intermittent woodland pools to be one of the most imperiled habitats in the region. Although they are widely distributed, the pools are small (often less than 0.1 ac [0.04 ha]) and their ecological importance is often undervalued. They are frequently drained or filled by landowners and developers, used as dumping grounds, treated for mosquito control, and sometimes converted into ornamental ponds. They are often overlooked in environmental reviews of proposed developments, and even when the pools themselves are spared in a development plan, the surrounding forest, so essential to the ecological functions of the pools, is frequently destroyed. Intermittent woodland pools are often excluded from federal and state wetland protection due to their small size, intermittent surface water, and isolation from streams or larger waterbodies. However, it is these very characteristics of size, intermittency,

and isolation that make woodland pools uniquely suited to species that do not reproduce or compete as successfully in larger wetland systems. The Conservation Priorities section of this report provides recommendations for protecting the habitat values of intermittent woodland pools (as well as pool-like swamps).

BUTTONBUSH POOL

Ecological Attributes

Buttonbush pools are seasonally or permanently flooded shrubby pools normally dominated by buttonbush, though buttonbush may appear and disappear over the years in a given location. Other shrubs such as highbush blueberry, swamp azalea, and willows may also be abundant. In some cases, an open water moat entirely or partly surrounds a shrub thicket in the middle of the pool, which may include small trees such as red maple or green ash. Conversely, the shrub stands may occupy the outer portions of the area with open water in the middle. These pools are typically isolated from streams, though some may have a small intermittent inlet and/or outlet. Standing water is normally present in winter and spring but often disappears by late summer or remains only in isolated puddles. Buttonbush pools are a kind of shrub swamp, and can also be considered a kind of intermittent woodland pool, providing many of the same habitat values for aquatic and terrestrial wildlife.

Occurrence in the Town of Pound Ridge

We documented only one buttonbush pool in the study area, covering 1.1 ac (0.4 ha). The pool was west of the northernmost end of the Stone Hill River (Figure 9). Because these pools are often difficult to identify on aerial photographs, there may be others in the study area that we did not map.

Sensitivities/Impacts

Buttonbush pools may be particularly sensitive to changes in hydrology. Groundwater extraction or changes in infiltration in the vicinity could alter the pool's hydroperiod and water depth, and alteration of surface water entering or leaving the pool could drastically change its character. These pools are also sensitive to changes in water chemistry; runoff from roads, agricultural fields, lawns, and construction sites all negatively affect water quality.

Development and habitat fragmentation in the surrounding landscape threaten the habitat connections between these pools and other wetland and upland habitats that are essential to pool-breeding amphibians, and other wildlife. Like intermittent woodland pools, buttonbush pools are occasionally excavated for ornamental ponds and they are often partly drained by means of ditches. The intermittent woodland pools section of Conservation Priorities and Planning, below, provides recommendations for protecting the habitat values of buttonbush pools.

MARSH

Ecological Attributes

A marsh is a wetland that has standing water for most or all of the growing season and is dominated by herbaceous (non-woody) vegetation. Marshes often occur at the fringes of deeper water bodies (e.g., lakes and ponds), or in close association with other wetland habitats such as wet meadows or swamps. The edges of marshes, where standing water is less permanent, often grade into wet meadows. Cattails, tussock sedge, common reed, arrow arum, broad-leaved arrowhead, water-plantain, and purple loosestrife are some typical emergent marsh plants in this region. Some marshes are dominated by floating-leaved plants such as pond-lilies, water-shield, and duckweeds. Many of the marshes we observed in the field were dominated by common reed or cattails.

Female common yellowthroat, a warbler of marshes and swamps.

Several rare plant species are known from marshes in the region, and the diverse plant communities of some marshes provide habitat for butterflies such as the Baltimore,* monarch,* and northern pearly eye. Marshes are also important habitats for reptiles and amphibians, including northern water snake, eastern painted turtle, snapping turtle, spotted turtle,* green

frog, pickerel frog, and spring peeper. Numerous bird species, including marsh wren,* common moorhen,* American bittern,* least bittern,* great blue heron,* Virginia rail,* king rail,* sora,* American black duck,* and wood duck* use marshes for nesting or as nursery habitat. Pied-billed grebe* also uses this habitat where it occurs adjacent to open water areas. Many raptors, wading birds, and mammals use marshes for foraging.

Occurrence in the Town of Pound Ridge

We mapped 22 ac (8.8 ha) of marsh in the study area (Figure 11), much of it occurring as part of larger wetland complexes. Marshes ranged in size from 0.1 to 3.1 ac (0.04 to 1.3 ha); the largest was in the center of Ward Pound Ridge Reservation, just south of Michigan Road. The southern end of Thalheim Preserve also has an extensive wetland complex with many patches of marsh.

Sensitivities/Impacts

In addition to direct disturbances such as filling or draining, marshes are subject to stresses from offsite (upgradient) sources. Alteration of surface water runoff patterns or groundwater flows can lead to dramatic changes in the plant and animal communities of marshes. Polluted stormwater runoff from roads, parking lots, lawns, and other surfaces in developed landscapes carries sediments, nutrients, de-icing compounds, and other contaminants into the wetland. Nutrient and sediment inputs and human or beaver alteration of water levels can also alter the plant community and facilitate invasion by non-native plants such as purple loosestrife and common reed. Purple loosestrife and common reed have displaced many native wetland graminoids in the marsh habitats of our region in recent decades and are dominant in numerous marshes in the town. Noise and direct disturbance from human activities can discourage breeding activities of marsh birds. Because many animal species of marshes depend equally on surrounding upland habitats for their life history needs, protection of the ecological functions of marshes must go hand-in-hand with protection of the surrounding habitats. The Conservation Priorities and Planning section of this report provides recommendations for preserving the habitat values of marshes within larger wetland complexes.

WET MEADOW

Ecological Attributes

A wet meadow is a wetland dominated by herbaceous (non-woody) vegetation, and which retains little or no standing water during most of the growing season. The period of inundation or soil saturation is longer than that of an upland meadow, but shorter than that of a marsh. Some wet meadows are dominated by purple loosestrife, common reed, or reed canary grass, while others have a diverse mixture of wetland grasses, sedges, forbs, and scattered shrubs. Mannagrasses, woolgrass, reed canary grass, soft rush, spotted Joe-Pye-weed, common jewelweed, sensitive fern, and marsh fern are some typical native plants of wet meadows.

Wet meadows with diverse plant communities may have rich invertebrate faunas. Blue flag and certain sedges and grasses of wet meadows are larval food plants for regionally-rare butterflies. Eastern ribbon snake,* which is known from Pound Ridge (Miller and Klemens 2002), may use calcium-rich wet meadow. Wet meadows provide foraging habitat for songbirds, wading birds, raptors, reptiles, and mammals. Wet meadows that are part of extensive meadow areas (both upland and wetland) may be especially important to species of grassland-breeding birds.

Occurrence in the Town of Pound Ridge

We mapped 8.5 ac (3.4 ha) of wet meadow in our study area (Figure 11), the largest being nearly 2 ac (0.8 ha).

Sensitivities/Impacts

Some wet meadows are able to withstand light mowing or light grazing by livestock, but heavy grazing or frequent mowing can destroy the soil structure, eliminate sensitive plant species, and invite non-native weeds. Mowing and grazing when soils are dry, e.g., in late summer, is less damaging to the soils and the plant community, and postponing mowing until late August or September will help to protect late-nesting birds. Wet meadows that are part of larger complexes of meadow and shrubland habitats are prime sites for development or agricultural uses, and are often drained, filled, or excavated. Because many wet meadows are omitted from state, federal, and site-specific wetland maps, they are frequently overlooked in environmental reviews of development proposals. See the Conservation Priorities and Planning section of this

report for recommendations on preserving the habitat values of wet meadows within larger wetland complexes.

FEN

Ecological Attributes

A fen is a low-stature shrub- and herb-dominated wetland that is fed by calcareous groundwater seepage. Fens almost always occur in areas influenced by carbonate bedrock (e.g., limestone or marble), and are identified by their low, often sparse vegetation and their distinctive plant community. Tussocky vegetation and small seepage rivulets are often present, and some fens have substantial areas of bare mineral soil or organic muck. Fens in Pound Ridge were dominated by a mix of shrubby cinquefoil, woolly-fruited sedge, and hard-stemmed bulrush. Most of the fens had been invaded by glossy buckthorn and common reed—both non-native—which were often abundant. Other common species were marsh fern, lakeside sedge, inland sedge, bottle-shaped sedge, and skunk cabbage. The fens contained numerous regionally rare plants, including leatherleaf,* large cranberry, round-leaved sundew,* pitcher plant,* grass pink,* buckbean,* grass-of-parnassus,* and alder-leaved buckthorn.* One fen also contained brown bog sedge,* and a few had hidden spikemoss.*

Fens are a rare habitat type because of the limited distribution of carbonate bedrock, calcareous soils, and calcareous groundwater seepage, and the historic alteration of wetlands. Fens support many species of conservation concern, including rare plants, invertebrates, reptiles, and breeding birds. More than 12 state-listed rare plants are found almost exclusively in fen habitats, including handsome sedge,* Schweinitz's sedge,* bog valerian,* scarlet Indian paintbrush,* spreading globeflower,* and swamp birch.* Rare butterflies such as Dion skipper* and black dash,* as well as rare dragonflies, such as forcipate emerald* and Kennedy's emerald,* are largely restricted to fen habitats. Other uncommon invertebrates, including phantom cranefly,* can also be found in fens. Fens comprise the core habitat for the endangered bog turtle* in southeastern New York, though this species may have been extirpated from Westchester County. Fens are also used by other reptiles of conservation concern such as the spotted turtle* and eastern ribbon snake,* both known from Pound Ridge (Miller and Klemens 2002).

Occurrence in the Town of Pound Ridge

We mapped twelve fens in the study area (Figure 10), all over or near a band of Inwood marble (see Figure 2). The fens were all relatively small. The two largest fens that we found, at 0.6 ac (0.4 ha) and 0.4 ac (0.2 ha), were in a much larger wetland complex west of Trinity Lake. We also mapped three fens within a larger, calcareous swamp complex south of Lake Kitchawan, and several in the Isaacson Preserve.

Fen dominated by hard-stemmed bulrush, shrubby cinquefoil, marsh fern

Because fens are difficult to identify by remote sensing, there may be other unmapped fens in areas we did not visit. Unmapped fens are most likely to occur in low-elevation areas over Inwood marble, including edges or interiors of wet meadows, swamps, marshes, or calcareous wet meadows, upper edges of stream floodplains, or at the bases of ridges.

Sensitivities/Impacts

Fens are highly vulnerable to degradation from direct disturbance and from activities in nearby upland areas. Nutrient and salt pollution from septic systems, fertilizers, or road runoff, disruption of groundwater flow by new wells or excavation nearby, sedimentation from agricultural or construction activity, or direct physical disturbance can lead to changes in the character of the habitat, including a decline in overall plant diversity and invasion by non-native species and tall shrubs (Aerts and Berendse 1988, Panno et al. 1999, Richburg et al.

2001, Drexler and Bedford 2002). Such changes can render the habitat unsuitable for bog turtle* and other fen animals and plants that require the particular structural, chemical, or hydrological environment of an intact fen. The Conservation Priorities and Planning section of this report provides recommendations for preserving the habitat values of fens.

SPRINGS & SEEPS

Ecological Attributes

Springs and seeps are places where groundwater discharges to the ground surface, either at a single point (a spring) or diffusely (a seep). Although springs often discharge into ponds, streams, or wetlands such as fens and swamps, we generally mapped only springs and seeps that discharged conspicuously into upland locations. Springs and seeps originating from deep groundwater sources flow more or less continuously, and emerge at a fairly constant temperature, creating an environment that is cooler in summer and warmer in winter than the surroundings. For this reason, seeps and springs sometimes support aquatic or wetland species that are ordinarily found at more northern or southern latitudes. The habitats created at springs and seeps are determined in part by the hydroperiod and the chemistry of the soils and bedrock through which the groundwater flows before discharging. Springs and seeps are water sources

Seep in upland hardwood forest

for many streams, and they help maintain the cool water temperature of streams, which is an important habitat characteristic for certain rare and declining fishes, amphibians, and other aquatic organisms. Springs and seeps also serve as water sources for animals during droughts and in winters when other water sources are frozen.

Very little is known about the ecology of seeps in the Northeast. Golden saxifrage is a plant more-or-less restricted to springs and groundwater-fed wetlands and streams. Herbaceous plant diversity may be higher in seeps than in surrounding upland forest (Morley & Calhoun 2009). A few rare invertebrates are restricted to springs in the region, and the Piedmont groundwater amphipod* could occur in the area (Smith 1988). Gray petaltail* and tiger spiketail* are two rare dragonflies found in seeps. Springs emanating from calcareous bedrock or calcium-rich surficial deposits sometimes support an abundant and diverse snail fauna. Northern dusky salamander* uses springs and cool streams.

Occurrence in the Town of Pound Ridge

We mapped 25 springs and 21 ac (8 ha) of seepage. Many of the mapped springs and seeps occurred in clusters or loose groupings associated with the same physiographic feature; e.g., a particular hillside or stream valley. They were also usually associated with streams or wetlands. Seeps contained typical wetland vegetation or a mixture of wetland and upland plants. Because the occurrence of springs and seeps is difficult to predict by remote sensing, we mapped only those we saw in the field and those that had a distinct signature on one of our map sources. We expect there are many more springs and seeps in the town that we did not map. More detailed surveys for these habitats should be conducted as needed on a site-by-site basis.

Sensitivities/Impacts

Springs are easily disrupted by disturbance to up-gradient land or groundwater, altered patterns of surface water infiltration, or pollution of infiltrating waters. Some springs have been modified for water supply, with constructed or excavated basins and sometimes spring houses. Pumping of groundwater for human or livestock water supply can deplete water available to nearby springs and seeps.

OPEN WATER

Ecological Attributes

"Open water" habitats include naturally formed ponds and lakes, large pools lacking floating or emergent vegetation within marshes and swamps, and unvegetated ponds that may have originally been constructed by humans but have since reverted to a more natural state (e.g., surrounded by unmanaged vegetation). Open water areas can be important habitat for many common species, including invertebrates, fishes, frogs, turtles, waterfowl, muskrat, beaver, and bats. Open water areas sometimes support submerged aquatic vegetation that can provide important habitat for aquatic invertebrates and fish. Dusky dancer* (a damselfly) is known from a large open water body in Pound Ridge (NYNHP 2018). Spotted turtle* uses ponds and lakes during both drought and non-drought periods, and wood turtle* may overwinter and mate in open water areas. Wood duck,* American black duck,* pied-billed grebe,*osprey,* and bald eagle may use open water areas as foraging habitat. These can be important stopover sites for migrating waterfowl. Bats, American mink, and river otter* also forage at open water habitats.

Occurrence in the Town of Pound Ridge

We mapped 344 ac (139 ha) of open water, or 5% of the study area. Most of the large water-supply reservoirs in town were mapped as open water, because their shorelines had little or no development. Water bodies ranged in size from well under one acre to the 117-ac (47-ha) Trinity Lake. Other large open water areas included the Mill River Reservoir (71 ac [29 ha]), the Siscowit Reservoir (42 ac [17 ha]), and Lake Kitchawan (42 ac [17 ha]), which extends into neighboring Lewisboro.

Sensitivities/Impacts

The habitat values of natural open water areas are often greater than those of constructed ponds, since the areas are less intensively managed, less disturbed by human activities, and surrounded by undeveloped land. Open water habitats are vulnerable to human impacts such as shoreline development, aquatic weed control, use of motorized watercraft, and runoff from roads, lawns, and agricultural areas. Aquatic weed control, which may include harvesting, herbicide application, or introduction of grass carp, is an especially important concern in open water habitats, and the potential negative impacts should be assessed carefully before any such

activities are undertaken (Heady and Kiviat 2000, Kiviat 2009). Because open water areas are often within larger wetland and stream complexes, any disturbance to the habitat may have far-reaching effects on the surrounding landscape. To protect water quality and habitat values, broad zones of undisturbed vegetation and soils should be maintained around ponds and lakes. If part of a pond or lake must be kept open (unvegetated) for ornamental, recreational, or other reasons, it is best to avoid dredging and to allow other parts of the pond to develop abundant vegetation. This can be accomplished by harvesting aquatic vegetation only where necessary to create open lanes or pools for boating, fishing, or swimming.

Female spangled skimmer, a dragonfly of ponds and lakes.

CONSTRUCTED POND

Ecological Attributes

Constructed ponds are water bodies that have been excavated or dammed by humans, either in existing wetlands or streambeds, or in upland terrain. Many of these ponds are created for fire protection, fishing, watering livestock, irrigation, swimming, boating, and aesthetics. Some were excavated incidental to mining operations. If constructed ponds are not intensively managed by humans, they can be important habitats for many of the common and rare species that are associated with naturally formed open water habitats (see below). We have mapped constructed ponds and reservoirs that have long been unmanaged and are now surrounded by intact habitats as "open water" or "marsh," depending on the vegetation structure.

Occurrence in the Town of Pound Ridge

More than half of the water bodies in the study area were constructed ponds, though these occupied a much smaller area, 97 ac (39 ha), than the areas mapped as open water. The largest

constructed pond was Blue Heron Lake, at 37 ac (15 ha). Most constructed ponds were ornamental ponds or former agricultural ponds. Ornamental ponds were usually located within landscaped areas in close proximity to residences. Because of the potential value of constructed ponds as drought refuges and foraging areas for turtles, waterfowl, wading birds, and other wildlife, we mapped constructed ponds within developed areas as well as those surrounded by intact habitats. Constructed ponds with substantial cover of emergent vegetation (e.g. cattail, purple loosestrife, common reed) were mapped as marsh.

Sensitivities/Impacts

The habitat values of constructed ponds vary depending on the landscape context and the extent of human disturbance. In general, the habitat value is higher when the ponds have undeveloped, unmanaged shorelines, are relatively undisturbed by human activities, have more vascular plant vegetation, and are embedded within an area of intact habitat. Because many constructed ponds are not buffered by sufficient natural vegetation and undisturbed soils, they are vulnerable to the adverse impacts of agricultural runoff, septic leachate, and pesticide or fertilizer runoff from lawns and gardens. We expect that many of the ponds maintained for ornamental purposes are treated with herbicides and perhaps other pesticides, or contain introduced fish such as grass carp and non-native game and forage fishes. Since constructed ponds can serve as habitat for a variety of common and rare species, these impacts should be minimized whenever possible.

Although ponds are sometimes constructed for the purpose of enhancing wildlife habitat, the habitat values of constructed ponds (and especially intensively managed ornamental ponds) do not ordinarily justify altering streams or destroying natural wetland or upland habitats to create them. In most cases, the loss of ecological functions of the pre-existing natural habitats far outweighs any habitat value gained in the artificially created environments.

STREAMS

Ecological Attributes

Perennial streams flow continuously throughout years with normal precipitation, but some may dry up during droughts. They provide essential water sources for wildlife throughout the

year, and are critical habitat for many plant, vertebrate, and invertebrate species. We loosely define "riparian corridor" as the zone along a perennial stream that includes the stream banks, the floodplain, and adjacent steep slopes. These corridors can support a variety of wetland and non-wetland forests, meadows, and shrublands, and are integral to the stream ecosystem.

We did not map actual riparian corridors but instead mapped "conservation zones" of a set width on either side of streams (Figure 12). These zones represent a minimum area along the stream that is needed for effective protection of stream water quality, habitat quality, and wildlife (see Streams & Riparian Corridors in the Priority Habitats section). Our mapped zones do not necessarily cover the whole riparian corridor for any stream, however, which varies in width depending on factors such as local topography, soil characteristics, and land uses in the watershed, and in some cases the size of the stream.

Rare plants of riparian areas in the region include cattail sedge,* Davis' sedge,* winged monkeyflower,* and goldenseal.* The fish and aquatic invertebrate communities of perennial streams may be diverse, especially in clean-water streams with unsilted bottoms. Tiger spiketail* and arrowhead spiketail,* both dragonflies, are both known from streams in Pound Ridge (NYNHP 2018). Brook trout* is a native species that requires clear, cool streams for successful spawning and other life needs. Wild brook trout, while confined largely to small headwater streams in the region due to

Forested perennial stream

degraded water quality and competition from brown trout (a non-native species), is present in a few streams in the WPRR. Wood turtle* uses perennial streams with deep pools and recumbent logs, undercut banks, or muskrat or beaver burrows, and is known from Pound Ridge (Miller and Klemens 2002). Perennial streams and their riparian zones, including sand and gravel bars, provide nesting or foraging habitat for many species of birds, such as spotted sandpiper, belted kingfisher, tree swallow, bank swallow, winter wren,* Louisiana waterthrush,* great blue heron,* and green heron. Red-shouldered hawk* and cerulean warbler* nest in areas with extensive riparian forests, especially those with mature trees. Bats use perennial stream corridors for foraging. Muskrat, beaver, mink, and river otter* are some of the mammals that regularly use riparian corridors.

Intermittent streams may flow for a few days or for many months during the year, but ordinarily dry up at some time during years of normal precipitation. They are the headwaters of most perennial streams, and are significant water sources for lakes, ponds, and wetlands of all kinds. The condition of these streams therefore influences the water quantity and quality of those larger water bodies and wetlands. Intermittent streams provide microhabitats not present in perennial streams, supply aquatic organisms and organic drift to downstream reaches, and can be important local water sources for wildlife (Meyer et al. 2007). Their loss or degradation in a portion of the landscape can affect the presence and behavior of wildlife populations over a large area (Lowe and Likens 2005). Plants such as winged monkeyflower* and may-apple* are sometimes associated with intermittent streams. Although intermittent streams have been little studied by biologists, they have been found to support rich aquatic invertebrate communities, including regionally rare mollusks (Gremaud 1977) and dragonflies. Both perennial and intermittent streams provide breeding, larval, and adult habitat for northern dusky salamander* and northern two-lined salamander. The forests and, sometimes, meadows adjacent to streams provide foraging habitats for adults and juveniles of these species.

Occurrence in the Town of Pound Ridge

Figure 12 shows the streams throughout the Pound Ridge study area. The largest streams in the study area are the Cross River, Mill River, Stone Hill River, and Mianus River. While the Cross River flows across the study area only briefly in the northeastern part of town, the Mill River

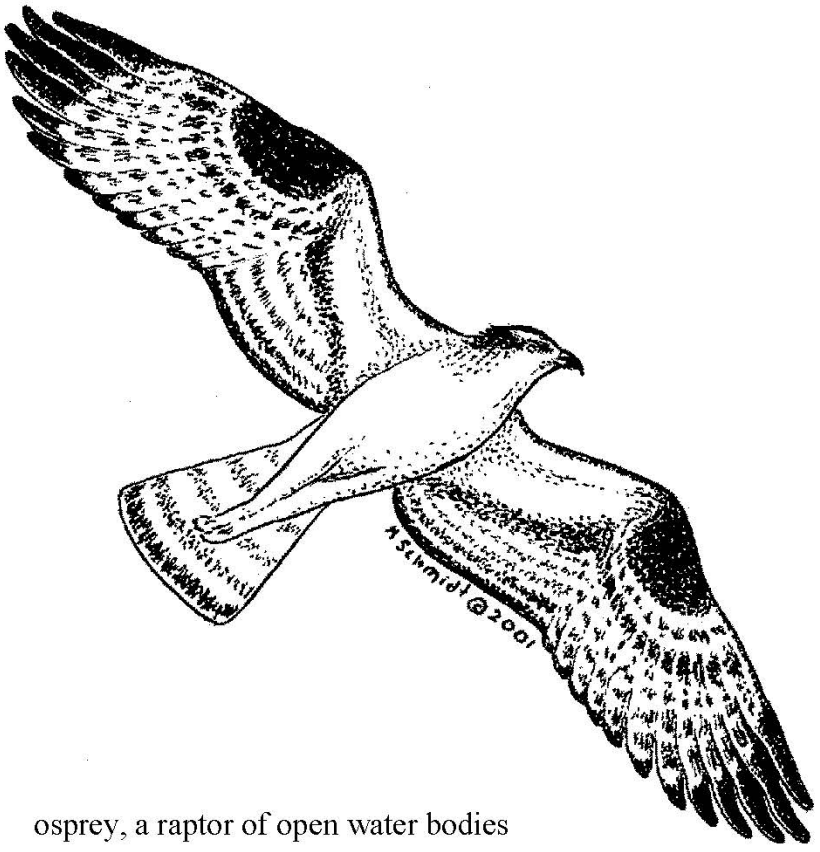
(6.3 km [3.9 mi]) and Stone Hill River (5.2 km [3.2 mi]) both have significant lengths in the study area. The Mianus River flows along the southwestern boundary of the study area and the town, through the Mianus Gorge, for about 4 km (2.5 mi). Other named streams include the Rippowam River, the Waccabuc River, and the East Branch Mianus River. Numerous perennial and intermittent tributaries flow into these larger streams. The combined length of perennial streams mapped in the study area was 32 km (20 mi). Intermittent streams were myriad, with a combined length of 81 km (50 mi).

Sensitivities/Impacts

Removal of trees or other shade-producing vegetation along a stream can lead to elevated water temperatures that adversely affect aquatic invertebrate and fish communities. Clearing of vegetation in and near floodplains can reduce the important exchange of nutrients and organic materials between the stream and the floodplain, and reduce the amount and quality of organic detritus available to support the aquatic food web. It can also diminish the floodplain's capacity for floodwater attenuation, leading to increased flooding downstream, scouring and bank erosion, and sedimentation of downstream reaches. Any alteration of flooding regimes, stream water volumes, timing of runoff, and water quality can profoundly affect these habitats and the species that use them. Hardening of the stream banks with concrete, riprap, gabions, or other materials reduces the biological and physical interactions between the stream and floodplain, and tends to be harmful to both stream and floodplain habitats. Removal of snags (fallen trees or logs) from the streambed degrades habitat for fishes, turtles, snakes, birds, muskrats, and their food organisms.

The habitat quality of a stream is affected not only by direct disturbance to the stream or its floodplain, but also by land uses throughout the watershed. (A watershed, or catchment, is the entire land area that drains into a given water body). Watershed urbanization (including roads and residential, industrial, and commercial development) has been linked to deterioration in stream water quality (Parsons and Lovett 1993). Activities in the watershed that cause soil erosion, changes in surface water runoff, reduced groundwater infiltration, or contamination of surface water or groundwater are likely to affect stream habitats adversely. For example, an increase in impervious surfaces (roads, parking lots, roofs) may elevate runoff volumes, leading

to erosion of stream banks and siltation of stream bottoms or incision (deep erosion of streambeds), degrading the habitat for invertebrates, fish, and other animals. Road runoff often carries contaminants such as petroleum hydrocarbons, heavy metals, road salt, sand, and silt into streams. Applications of fertilizers and pesticides to agricultural fields, golf courses, lawns, and gardens in or near the riparian zone can degrade the water quality and alter the biological communities of streams. Construction, logging, soil mining, clearing for vistas, creating lawns, and other disruptive activities in and near riparian zones can hamper riparian functions and adversely affect the species that depend on streams, riparian zones, and nearby upland habitats. The Conservation Priorities and Planning section of this report provides recommendations for protecting the habitat values of streams and riparian corridors.



osprey, a raptor of open water bodies

CONSERVATION PRIORITIES AND PLANNING

Most local land-use decisions in the Hudson Valley are made on a site-by-site basis, without the benefit of good ecological information about the site or the surrounding lands. The loss of biological resources from any single development site may seem trivial, but the cumulative losses from thousands of site-by-site decisions are substantial. Regional impacts include the disappearance of certain habitats from whole segments of the landscape, the fragmentation and degradation of many other habitats, the local extinction of species, the depletion of overall biodiversity, and the impairment of ecosystem function and services.

Because biological communities, habitats, and ecosystems cross property and municipal boundaries, the best approach to biodiversity conservation is from the perspective of whole landscapes. The Pound Ridge habitat map facilitates this approach by illustrating the location and configuration of significant habitats on large tracts of land throughout the town. The map, together with the information provided in this report, can be applied directly to land-use and conservation planning and decision making at multiple scales. In the following pages, we outline recommendations for: 1) developing general strategies for biodiversity conservation; 2) using the map to identify priorities for town-wide conservation, land-use planning, and habitat enhancement; and 3) using the map as a resource for reviewing site-specific land-use proposals

General Guidelines for Biodiversity Conservation

We hope that the Pound Ridge habitat map and this report will help landowners understand how their land fits into the larger ecological landscape, and will inspire them to voluntarily adopt habitat protection measures. We also hope that the town will engage in proactive land-use and conservation planning to ensure that future development is planned with a view to long-term protection of the valuable biological resources that still exist within the town.

A variety of regulatory and non-regulatory means can be employed by a municipality to achieve its conservation goals, including volunteer conservation efforts by individual land-owners, master planning, zoning ordinances, tax incentives, land stewardship incentives, permit conditions, land acquisition, conservation easements, and public education. Several publications of the Metropolitan Conservation Alliance, the Pace University Land-use Law

Center, and the Environmental Law Institute describe some of the tools and techniques available to municipalities for conservation planning. For example, *Conservation Thresholds for Land-Use Planners* (Environmental Law Institute 2003) synthesizes information from the scientific literature to provide guidance to land-use planners interested in establishing regulatory setbacks from sensitive habitats. A publication from the Metropolitan Conservation Alliance (2002) offers a model local ordinance to delineate a conservation overlay district that can be integrated into a comprehensive plan and local zoning ordinance. The *Local Open Space Planning Guide* (NYSDEC and NYSDOS 2004) describes how to take advantage of laws, programs, technical assistance, and funding resources available to pursue open space conservation, and provides contact information for relevant organizations. A publication from Cornell and the New York State Department of Environmental Conservation (NYSDEC), *Conserving Natural Areas and Wildlife in Your Community* (Strong 2008), describes the tools and resources available to municipalities to help protect their important natural assets.

In addition to regulations and incentives designed to protect specific types of habitat, the town can also apply some general practices on a town-wide basis to foster biodiversity conservation. The examples listed below are adapted from the *Biodiversity Assessment Manual* (Kiviat and Stevens 2001). We encourage the Town of Pound Ridge to apply these measures to town-wide planning and to every new land-use proposal that comes before the town, and to distribute this list to applicants who are considering new land-use projects.

- **Protect large, contiguous, undeveloped tracts** wherever possible.
- **Plan landscapes with interconnected networks of undeveloped habitats** (preserve and restore links between natural habitats on adjacent properties). When considering protection for a particular species or group of species, design the networks according to the particular needs of the species of concern.
- **Preserve natural disturbance processes** such as fires, floods, seasonal water level changes, landslides, and wind exposures wherever possible.
- **Restore and maintain broad buffer zones** of natural vegetation along streams, shores of water bodies and wetlands, and around the perimeters of other sensitive habitats.

- **Direct human uses toward the least sensitive areas**, and minimize alteration of natural features, including vegetation, soils, bedrock, and waterways.
- **Encourage development of altered land instead of unaltered land.** Promote redevelopment of brownfields and previously altered sites, "infill" development, and re-use of existing structures wherever possible (with exceptions for such areas that support rare species that would be harmed by development).
- **Preserve farmland soils and farmland potential** wherever possible by avoiding development on Prime Farmland Soils or Farmland Soils of Statewide Importance, and avoiding fragmentation of active or potential farmland.
- **Encourage and provide incentives for developers to consider environmental concerns early in the planning process**, and to incorporate biodiversity conservation principles into their choice of development sites, their site design, and their construction practices.
- **Concentrate development near existing population centers and along existing roads**; discourage construction of new roads in undeveloped areas. **Promote clustered and pedestrian-centered development** wherever possible to maximize extent of unaltered land and minimize expanded vehicle use.
- **Minimize areas of lawn and impervious surfaces** (roads, parking lots, sidewalks, driveways, roof surfaces) and design stormwater management to maintain pre-construction volumes and seasonal patterns of onsite runoff retention and infiltration. These measures will foster groundwater recharge, protect offsite surface water quality, and moderate downstream flood flows. Retrofit existing infrastructure to achieve these goals wherever possible.
- **Restore degraded habitats wherever possible**, but do not use restoration projects as a license to destroy existing habitats. Base any habitat restoration on sound scientific principles and research in order to maximize the likelihood of having the intended positive impacts on biodiversity and ecosystems. Any restoration plan should include monitoring of the restored habitat to assess the outcomes and regular maintenance to protect restored features from degradation.

- **Modify urban areas to provide more habitat elements** (for example, rain gardens and tree-lined streets). Use public education and incentives to encourage private landowners to improve the habitat quality of their yards.
- **Promote the establishment of conservation agreements** on parcels of greatest apparent ecological value.

Using the Habitat Map for Townwide Conservation Planning

The Pound Ridge habitat map illustrates the sizes of habitat units, the degree of connectivity between habitats, and the juxtaposition of habitats in the landscape, all of which have important implications for regional biodiversity. Habitat fragmentation is among the primary threats to biodiversity worldwide (Davies et al. 2001) and in the Hudson Valley. While some species and habitats may be adequately protected in small patches, many wide-ranging species, such as black bear,* barred owl, and red-shouldered hawk,* require large, unbroken blocks of habitat. Many species, such as wood turtle* and Jefferson salamander,* need to travel among different habitats to satisfy their basic needs for food, water, cover, nesting and nursery areas, and population dispersal. Landscapes that are fragmented by roads, utility corridors, and development limit animal movements and interactions, disrupting patterns of dispersal, reproduction, competition, and predation. Habitat patches surrounded by human development function as islands, and species unable to move between habitats are vulnerable to genetic isolation and possible extinction over the long term. Landscapes with interconnected networks of unfragmented habitat, on the other hand, are more likely to support a broad diversity of native species and the ecological processes and disturbance regimes that maintain those species. Corridors and habitat connectivity allow for the movement of organisms as they adapt to changing conditions, so will become even more important in the face of global climate change. Careful siting and design of new development can help to protect the remaining large habitat patches (Figure 4) and maintain broad corridors between them.

The habitat map can also be used to identify high priority habitats for conservation, including those that are rare or support rare species, or that seem particularly important to regional biodiversity. For instance, the buttonbush pool and nearby wetland and upland habitats may support the spotted turtle, which needs a complex of habitats to fulfill its seasonal needs for

foraging, nesting, basking, aestivating, rehydrating, and overwintering. Figures 7-12 illustrate the areas we have identified as "priority habitats" and their "conservation zones." These places are especially valuable if they are located within larger areas of intact and connected habitat (Figure 4).

The habitat map and this report are practical tools that can help the town select areas for protection and identify sites for new development where the ecological impacts will be minimized. The map can also be used with the habitat maps of adjacent towns for conservation planning across town boundaries.

Reviewing Site-Specific Land Use Proposals

In addition to townwide land-use and conservation planning, the habitat map and report can be used for reviewing site-specific development proposals, providing ecological information about both the proposed development site and the surrounding areas that might be affected. We recommend that landowners and reviewers considering a new land-use proposal take the following steps to evaluate the impact of the proposed change on the habitats present on and near the site:

1. Consult the large-format habitat map to see if the new project lies within one of the large tracts of land where ecologically significant habitats have been mapped, or if the site is within an important connecting area between those large tracts.
2. If the former, consult the large-format habitat map to see which ecologically significant habitats, if any, are located on and near the site in question.
3. Read the descriptions of those habitats in this report; note the discussion of habitat sensitivities.
4. Consult Figures 7-12 to see if any of the "Priority Habitats" or their conservation zones occur on or near the site. Note the conservation issues and recommendations for each.
5. Consider whether the proposed development project can be designed or modified to ensure that the habitats of greatest ecological concern and their conservation zones, as well as the ecological connections between them, are maintained intact. Examples of design modifications include but are not limited to:

- Locating human activity areas as far as possible from the most sensitive habitats.
- Minimizing intrusions into large forested or meadow habitats.
- Minimizing intrusions into forested areas that are within 750 ft (230 m) of an intermittent woodland pool.
- Avoiding disturbances that would disrupt the quantity or quality of groundwater available to onsite or offsite streams or wetlands fed by groundwater.
- Channeling stormwater runoff from paved areas or fertilized turf through oil-water separators and into detention basins or "rain gardens" instead of directly into ditches, streams, ponds, or wetlands.
- Locating developed features such that broad corridors of undeveloped land are maintained between important habitats on and off the site.

6. If the site is located between two or more of the large tracts, consider how the new project could be designed to maximize the habitat connectivity or maintain habitat "stepping-stones" between the two tracts.

Because the habitat map has not been 100% field-verified we emphasize that, at the site-specific scale, it should be used strictly as a general guide for land-use planning and decision making. Site visits by qualified professionals should be an integral part of the review process for any proposed land-use change.

LANDSCAPE-SCALE CONSERVATION

Habitat loss and fragmentation are significant threats to wildlife populations, especially for those species that need to move between habitats to fulfill their life history needs. In the age of a rapidly changing climate, migration and dispersal needs will be even greater (Debinski and Holt 2002, Walther et al 2002, Howard and Schlesinger 2013). Many models have predicted that species will need to move to higher latitudes or higher elevations, or seek out *in situ* microclimate refugia (Walther et al 2002, Howard and Sclesinger 2013, Morelli et al 2016) as former habitats become unsuitable. These movements are increasingly hazardous in the urbanizing and fragmented landscapes of southeastern New York.

One approach to landscape conservation in these fragmented landscapes is a network of conservation areas in a hub-and-spoke configuration, in which a large area, a "hub", that provides continuous habitat for plants and animals is connected by spokes, or corridors (Brown and Harris 2005). If the hub area is large and unfragmented and has diverse habitats, the target species should be able to succeed in these areas over multiple generations (Brown and Harris 2005). The connecting areas between hubs are usually highly constrained by developed land. While the term "corridor" conjures an image of a linear, narrow landscape feature, the broader the corridor is, the more likely it will be used successfully by a wide array of wildlife species (Ricketts 2002, Brown and Harris 2005). Narrow corridors have a large edge-to-interior ratio, which influences the interior conditions (moisture, light, noise) and wildlife use.

The hub-and-spoke models are frequently subsidized by "stepping stone" areas, which are smaller and can be used as temporary refugia between hubs (Saura et al. 2014). While the hub-and-spoke models have some limitations, the goal is to create a network of large habitat areas within a fragmented landscape that is still permeable to wildlife (Ricketts 2002, Brown and Harris 2005, Howard and Sclesinger 2013, Saura et al 2014).

The hub-and-spoke model can be implemented at multiple scales to achieve connected landscapes. Within the Hudson Valley, five large habitat areas have been identified for wildlife conservation and migration (Hudson Highlands, Shawangunk Range, Catskill Mountains, Taconic Mountains, Rensselaer Plateau) (Howard and Schlesinger 2013). The closest large

area, the Hudson Highlands, can be connected to Pound Ridge via the Eastern Westchester Biotic Corridor (EWBC), a regionally important area of 22,000 acres through the towns of Pound Ridge, Lewisboro and North Salem, delineated by the Metropolitan Conservation Alliance (Miller and Klemens 2002) (Figure 5). The EWBC was extended to include habitat areas in the Town of Bedford, based on field surveys by MCA (LaBruna and Klemens 2007). Additionally, ecologically significant habitats across Bedford have been mapped by the Bedford Conservation Board (Figure 6). Much of Pound Ridge is within the Biotic Corridor (Figure 5), and the central hub is the Ward Pound Ridge Reservation. The WPRR, straddling the boundary between Pound Ridge and Lewisboro, is designated by NYS DEC as a Significant Biodiversity Area (Penhollow et al. 2006) and, at 4,700 acres, is the largest continuous habitat within the EWBC.

The goal of the EWBC project was to establish a regional, multi-town approach to the conservation of wildlife and habitats. The four towns were selected because they contain an impressive diversity of wildlife and habitats, because they are under development pressures which threaten those natural resources, and because there is a growing awareness within the towns of a need to address these issues. (Miller and Klemens 2002)

The EWBC was identified by surveying "focal species" throughout the original, tri-town area. Focal species are those that respond very noticeably to land development, habitat loss, and habitat fragmentation. The analysis considered two broad categories of focal species:

> Category I (Specialists): Species that experience population declines as a result of urbanization. These tend to be wildlife with very specific habitat requirements, such as neotropical migratory songbirds or pool-breeding amphibians. These species often disappear from human-settled landscapes.
> Category II (Generalists): Species that experience population increases in response to urbanization. These tend to be habitat generalists, such as bullfrog, blue jay, and gray squirrel.

The MCA used existing data from the New York Natural Heritage Program and from the Ward Pound Ridge Reservation and conducted additional field surveys to discover the relative proportion of Category I and Category II species in different parts of the three towns, and assess the relative importance of individual sites for conservation. Those sites with solid populations of Category I species are likely to have higher quality, less-degraded habitats than those with higher proportions of Category II species, and may therefore be more worthy of conservation efforts. Directing new development to the more-degraded areas will help preserve the ecological integrity of the more intact sites, and will help to maintain the rich biological diversity of these towns and the region.

MCA analyzed species distribution and habitat requirements, and habitat distribution throughout the study area, and delineated the Eastern Westchester Biotic Corridor to encompass the areas where Category I species were most concentrated and where an array of key intact habitats still persists. Methods were replicated for the Bedford addendum (LaBruna and Klemens 2007). The EWBC is a broad swath that necessarily includes developed areas, but can help to focus conservation attention on the remaining areas of intact habitat.

The EWBC assessment reported many species of conservation concern in Pound Ridge including river otter,* bobcat*, northern dusky salamander,* eastern ribbon snake,* bog turtle,* bobolink,* and American woodcock,* (see Miller and Klemens 2002 Table 1 for full species list). While WPPR stood out as both a hub and biodiversity hotspot, Trinity Lake was identified as having the highest bird diversity throughout the three towns, and was particularly important for migrating warblers. The EWBC report stresses the importance of maintaining the "spokes" of conserved land radiating from the biodiversity hubs so that the landscape remains permeable to wildlife and the hubs do not become isolated habitat areas. Landscape permeability in Pound Ridge was found to be relatively high for Westchester County due to the high proportion of forest and the relatively low population density.

Landscape-scale conservation is the big-picture goal for many conservation efforts; however, most decisions are made on a local scale. Therefore when towns like Pound Ridge, Lewisboro,

and North Salem actively focus local efforts on conservation, it is important that ecologically significant habitat protection be prioritized.

PRIORITY HABITATS IN POUND RIDGE

While large areas of the town have been developed for residential use, large areas of high-quality habitat yet remain, which are not only important locally but also contribute greatly to regional biodiversity. The WPRR by itself has been designated one of the NYS DEC Significant Biodiversity Areas (Penhollow et al. 2006), which are selected areas of the Hudson Valley that stand out for their intact biological communities, the presence of rare or declining species, or an array of regionally important habitats. The majority of our study area, 75% (5,750 ac [2,330 ha]), also falls within the Eastern Westchester Biotic Corridor, a concept designed by Miller and Klemens (2002) to build upon the 4,700-ac (1,900 ha) core habitat of the WPRR. The corridor spans the towns of North Salem, Lewisboro, Pound Ridge, and Bedford, and encompasses an extensive array of intact habitats, wildlife, and plants (see *Landscape-Scale Conservation*, above). Despite falling outside the EWBC, the remaining, southwestern 25% of our study area nevertheless constitutes an important area for local and regional biodiversity, given its large tracts of intact forest, numerous woodland pools and pool complexes, and such special places as the Henry Morgenthau Preserve, the Zofnass Preserve, and the Mianus River Gorge.

Animals of conservation concern known to occur in Pound Ridge include marbled salamander,* northern dusky salamander,* Fowler's toad,* spotted turtle,* wood turtle,* eastern box turtle,* eastern worm snake,* eastern ribbon snake,* eastern hognose snake,* northern copperhead,* American woodcock,* northern goshawk,* brown thrasher,* wood thrush,* worm-eating warbler, * Canada warbler,* cerulean warbler, * and scarlet tanager* (Miller and Klemens 2002; Anonymous pers. comm.).

By employing a proactive approach to land-use and conservation planning, the Town of Pound Ridge has the opportunity to protect the integrity of remaining biological resources for the long term. With limited funds, time, and attention to devote to conservation purposes, however, municipal agencies must decide how best to direct those resources to maximize conservation

Figure 5. Study area tracts in Pound Ridge as they relate to the Eastern Westchester Biotic Corridor (Miller and Klemens 2002) and corridor extension. Hudsonia Ltd, 2018.

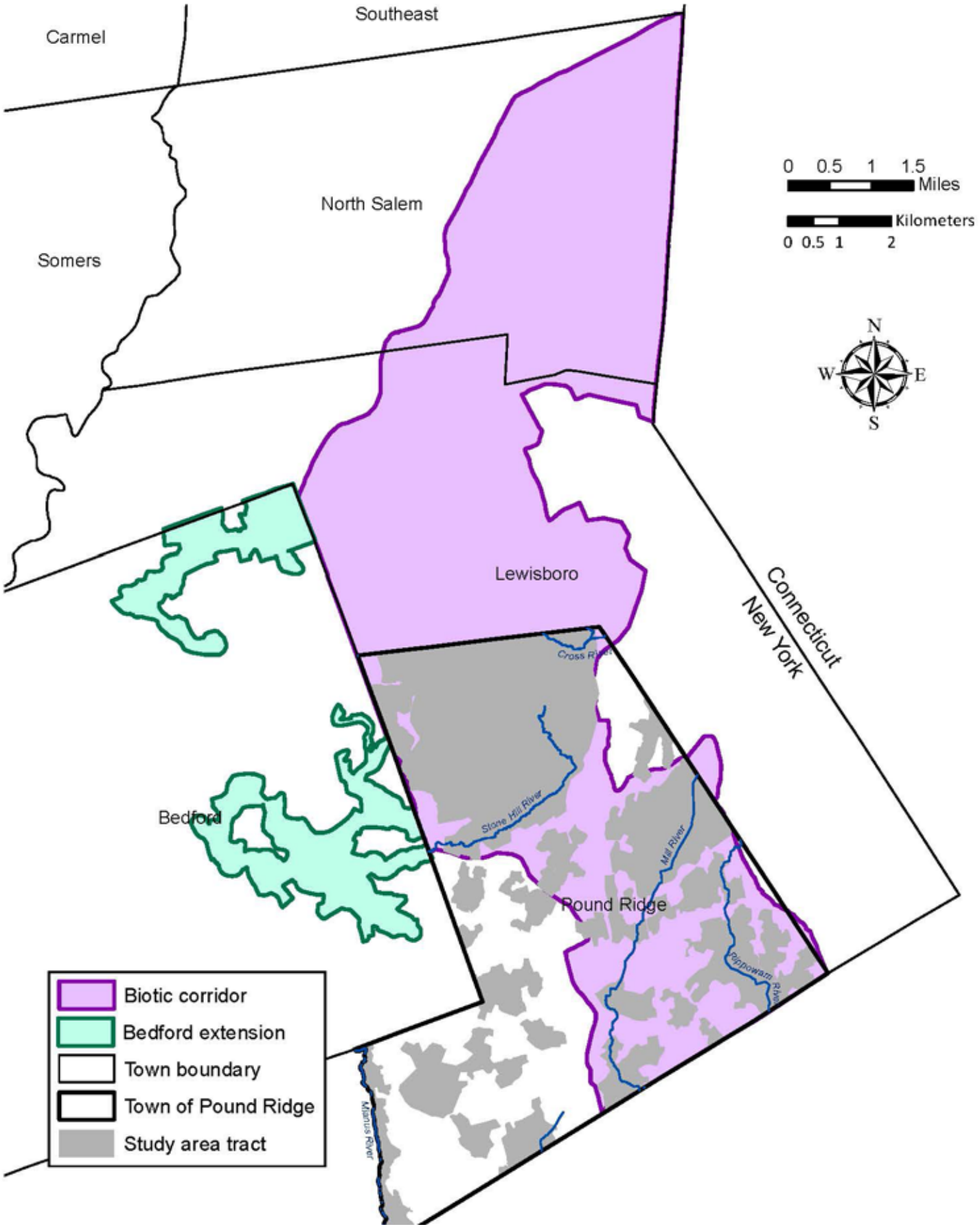
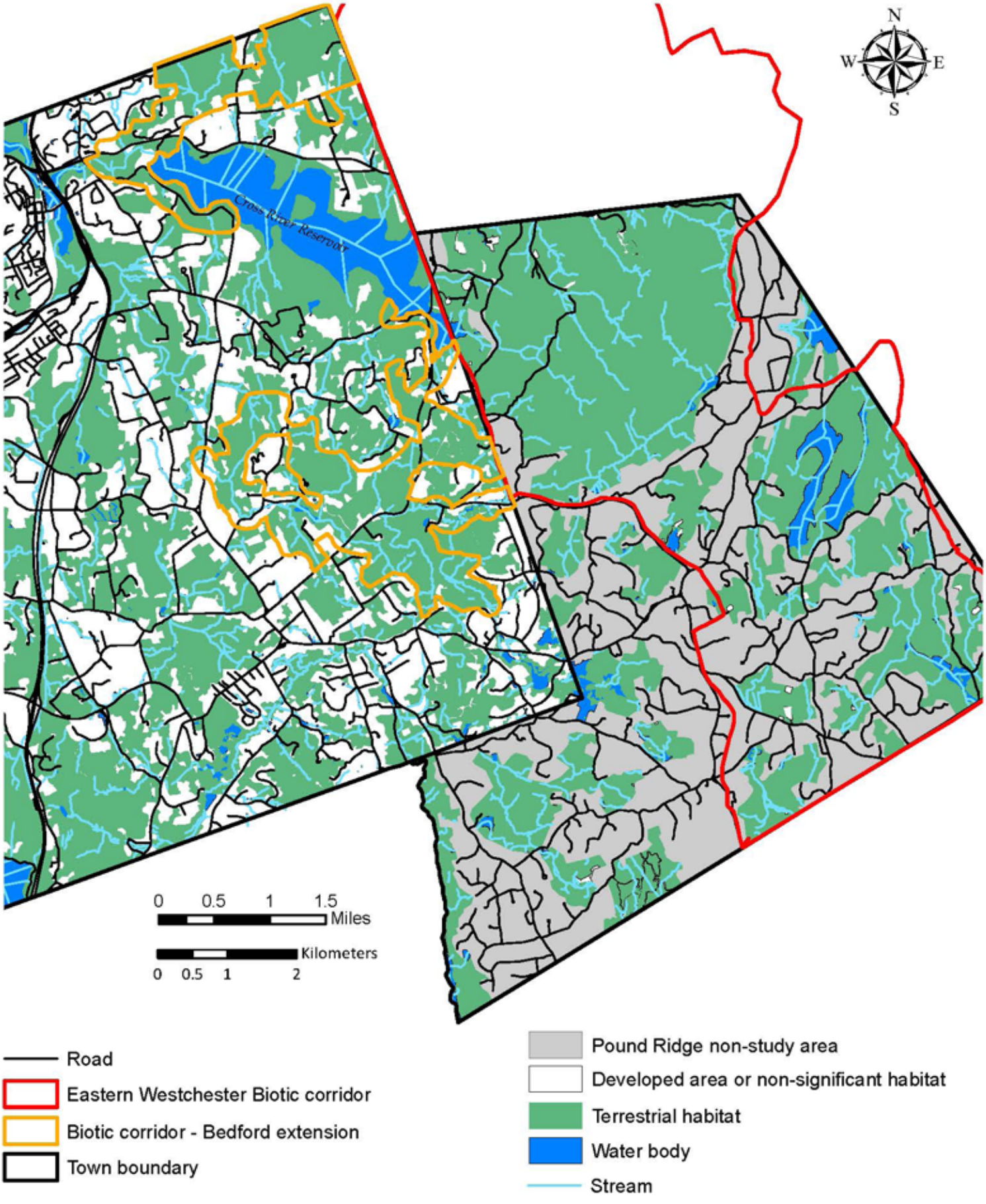


Figure 6. Simplified habitats in the Towns of Pound Ridge and Bedford, Westchester County, NewYork, as identified and mapped by Hudsonia and the Bedford CAC. Note that all significant habitats are mapped in Bedford, while in Pound Ridge only selected large habitat blocks (the study area) are mapped. The Eastern Westchester Biotic Corridor is also shown. Hudsonia Ltd, 2018.



results. While it may be impossible to protect all significant habitats, there are reasonable ways to prioritize conservation efforts using the best available scientific information. Important considerations in prioritizing such efforts include preserving sensitive habitat types, high quality habitat units, and a variety of habitats well-connected and well-distributed over the landscape. Below we highlight some habitat types that we consider "priority habitats" for conservation in the town. It must be understood, however, that we believe all the habitat areas depicted on the large-format habitat map are ecologically significant and worthy of conservation attention. The list of priority habitats below is a subset of those with more urgent conservation needs.

We used the requirements of a selected group of species to help identify some of the areas where conservation efforts might yield the greatest return for biological diversity. For each of the "priority habitat" types, we chose a species or group of species that have large home ranges, specialized habitat needs, or acute sensitivity to disturbance (see Table 2). Many are rare or declining in the region or statewide. Each of these species or groups requires a particular habitat type for a crucial stage in its life cycle (e.g., hibernation, breeding), and those "core habitats" typically form the hub of the animal's habitat complex. In many cases, the focal species also requires additional habitat types for other life history needs, and these habitats are typically located within a certain distance of the core habitat. This distance defines the extent of the species' habitat complex and, therefore, the minimum area that needs to be protected or managed in order to protect the local population and conserve the species. We call this the "conservation zone" and discuss the size of this zone in the "Conservation Issues" and "Recommendations" subsections for each priority habitat description. (The conservation zone distances are measured from the outer periphery of the core habitat, not from its center.) We used findings in scientific literature to estimate the priority conservation zone for the species of concern (Table 2). If the habitats of the highly sensitive species of concern are protected, many other rare and common species that occur in the same habitats will also be protected.

Table 2. Priority habitats, species of concern, and associated priority conservation zones identified by Hudsonia in the Town of Pound Ridge, Westchester County, New York, 2018.

Priority Habitat	Associated Species or Group of Concern	Priority Conservation Zone	Rationale	References
Large forest	Forest interior-breeding birds	Unfragmented patches of at least 130-200 ac (53-80 ha)	Required for high probability of supporting breeding hermit and wood thrush in a 60% forested landscape.	Rosenberg et al. 2003
Rocky barren and extensive crest/ledge/talus	Northern copperhead,* eastern ratsnake,* northern black racer*	Extensive crest/ledge/talus, and 3,300 ft (1,000 m) zone around barrens habitats	Includes habitat essential for denning, nesting, basking, foraging, and dispersal.	Fitch 1960, Todd 2000, Blouin-Demers and Weatherhead 2002
Intermittent woodland pool	Pool-breeding amphibians	750 ft (230 m) from pool.	Area of non-breeding season habitat considered critical for sustaining populations.	Madison 1997, Semlitsch 1998, Calhoun and Klemens 2002, Veysey et al. 2011
Fen	Rare plants*	entire watershed of the fen and connected wetlands	Land uses within the watershed affect the quality and quantity of surface water and groundwater feeding fen, which affect plant populations.	(none available)
Wetland complex	Spotted turtle*	Minimum upland zone of 400 ft (120 m) beyond outermost wetlands in a complex.	Corresponds to maximum reported distance of nests from the nearest wetland.	Joyal et al. 2001
Perennial stream	Wood turtle*	820 ft (250 m) from stream.	Encompasses most of the critical habitat, including hibernacula, nesting areas, spring basking sites, foraging habitat, and overland travel corridors.	Carroll and Ehrenfeld 1978, Harding and Bloomer 1979, Buech et al. 1997, Foscarini and Brooks 1997, Tingley et al. 2009

LARGE FORESTS

Target Areas

Rich bottomland forest with abundant forest herbs

In general, forested areas (including both upland forest and swamp) with the highest conservation value include large forest tracts, mature and relatively undisturbed forests, and those with a lower proportion of edge to interior habitat. Smaller forests that provide connections between other forests, such as corridors or patches that could be used as "stepping stones," are also valuable in a landscape context. The largest forest areas are illustrated in Figure 7. The largest forest by far, at 2,800 ac (1,130 ha), was in the WPRR in northern Pound Ridge. Two forest patches totaled between 400 and 500 ac (160 and 200 ha): one surrounding the Zofnass Preserve in southwestern Pound Ridge, and another in the Eastwoods area around the Siscowit Reservoir. Two other patches, around Trinity Lake and Mill River Reservoir, were separated only by Mill River Reservoir, and were in fact contiguous with each other to the north, in the Town of Lewisboro. If combined, these two forest patches (343 ac and 189 ac [139 ha and 76 ha]), which are separated in some places by as little as 30 m (98 ft) across Mill River Reservoir, would form one forest block of 532 ac (215 ha). Three other forest patches fell between 200 and 250 ac (101 ha), a critical threshold for several forest-breeding birds of our region (Rosenberg et al. 2003; see below). One of these contained the Bye Preserve and a high-quality hardwood-hemlock ravine east thereof; another was a long, narrow band of forest that lay along the Mianus River in the Mianus Gorge, and conneced with more contiguous forest to the

west in the Town of North Castle, and to the north in the Town of Bedford. Finally, eight other forest patches scattered about town were between 100 and 200 ac (40 – 81 ha).

Conservation Issues for Selected Focal Species

Loss of forest and fragmentation of remaining forest are the two most serious threats facing forest-adapted organisms. The decline of extensive forests has been implicated in the declines of numerous "area-sensitive" species, which require many hundreds or thousands of acres of contiguous forest to sustain local populations. These include large mammals such as black bear* and bobcat* (Godin 1977, Merritt 1987), some raptors (Bednarz and Dinsmore 1982, Billings 1990, Crocoll 1994), and many migratory songbirds (Robbins 1979, 1980; Ambuel and Temple 1983, Wilcove 1985, Hill and Hagan 1991, Lampila et al. 2005). In addition to reduced total area, fragmented forest has a larger proportion of edge habitat. Temperature, humidity, and light are altered near forest edges, and edge environments favor a set of disturbance-adapted species, including many nest predators and a nest parasite (brown-headed cowbird) of forest-breeding birds (Murcia 1995). Large forests, particularly those that are more round and less linear, support forest species that are highly sensitive to disturbance and predation along forest edges. For example, a study of forest breeding birds in mid-Atlantic states found that black-and-white warbler,* cerulean warbler,* worm-eating warbler,* and Louisiana waterthrush* were rarely found in forests smaller than 247 ac (100 ha). The study suggested that the minimum forest area these birds require for sustainable breeding ranges from 370 ac (150 ha) for worm-eating warbler* to 2,470 ac (1,000 ha) for black-throated blue warbler. (Robbins et al. 1989). For wood thrush,* only forest patches larger than 200 ac (80 ha) are considered highly suitable for breeding populations in our region (Rosenberg et al. 2003). Although bird area requirements vary regionally and locally (Rosenberg et al. 1999, 2000), these area figures demonstrate the need to preserve large forests for these birds, some of which we observed during our field work in Pound Ridge (e.g., red-shouldered hawk,* Louisiana waterthrush,* wood thrush*). Large forests with rocky crests also provide habitat for several reptiles of conservation concern such as northern copperhead,* eastern ratsnake,* and northern black racer* (see section on crest/ledge/talus and rocky barren, below).

Eastern box turtle, a NYS Species of Special Concern

Forest fragmentation can also inhibit or prevent animals from moving across the landscape, and can result in losses of genetic diversity and local extinctions in populations from isolated forest patches. For example, some species of frogs and salamanders are unable to disperse effectively through non-forested habitat due to desiccation and predation (Rothermel and Semlitsch 2002). Road mortality of migrating amphibians and reptiles can result in reduced population densities (Fahrig et al. 1995) or changes in sex ratios in local populations (Marchand and Litvaitis 2004).

Another threat to forests in our region is the spread of invasive insect species. One example is the hemlock woolly adelgid, an aphid-like insect that has caused widespread mortality of hemlock forests in the Hudson Valley. While we did not observe signs of stand-wide decline in most locations, most hemlock forests of this latitude are expected to be severely impacted in the near future. Other potential threats include the emerald ash borer and the Asian long-horned beetle. The emerald ash borer can infest all native ash species and can kill a tree in two to four years. It has been found in Westchester County (NYSDEC 2018). The Asian long-horned beetle threatens native maple, birch, and willow trees and has the potential to greatly affect the forestry, maple syrup, and nursery industries (NISIC 2018). It is known from New York City and Long Island (NYSDEC 2017). Transporting of untreated firewood is now limited by law to less than 50 mi from its origin to limit the spread of these pests in New York (NYSDEC 2009).

In addition to their tremendous values for wildlife, forests are perhaps the most effective type of land cover for sustaining clean and abundant surface water (in streams, lakes, ponds, and

wetlands) and groundwater. Forests with intact canopy, understory, ground vegetation, and floors (i.e., organic duff and soils) are extremely effective at promoting infiltration of precipitation (Bormann et al. 1969, Likens et al. 1970, Bormann et al. 1974, Wilder and Kiviat 2008), and may be the best insurance for maintaining groundwater quality and quantity, and for maintaining flow volumes, temperatures, water quality, and habitat quality in streams.

Recommendations

We recommend that the remaining blocks of large forest within the Town of Pound Ridge be considered priority areas for conservation and that efforts be taken to fully protect these habitats wherever possible. If new development in these large forested areas cannot be avoided, concentrating it near forest edges and near existing roads and other development will help to preserve as much unfragmented forest area as possible. Locating new roads or driveways near forest edges instead of the forest interiors will avoid dividing the habitat into smaller isolated patches. Some general guidelines for forest conservation include the following:

1. **Protect large, contiguous forested areas** wherever possible, and avoid development and logging in forest interiors.

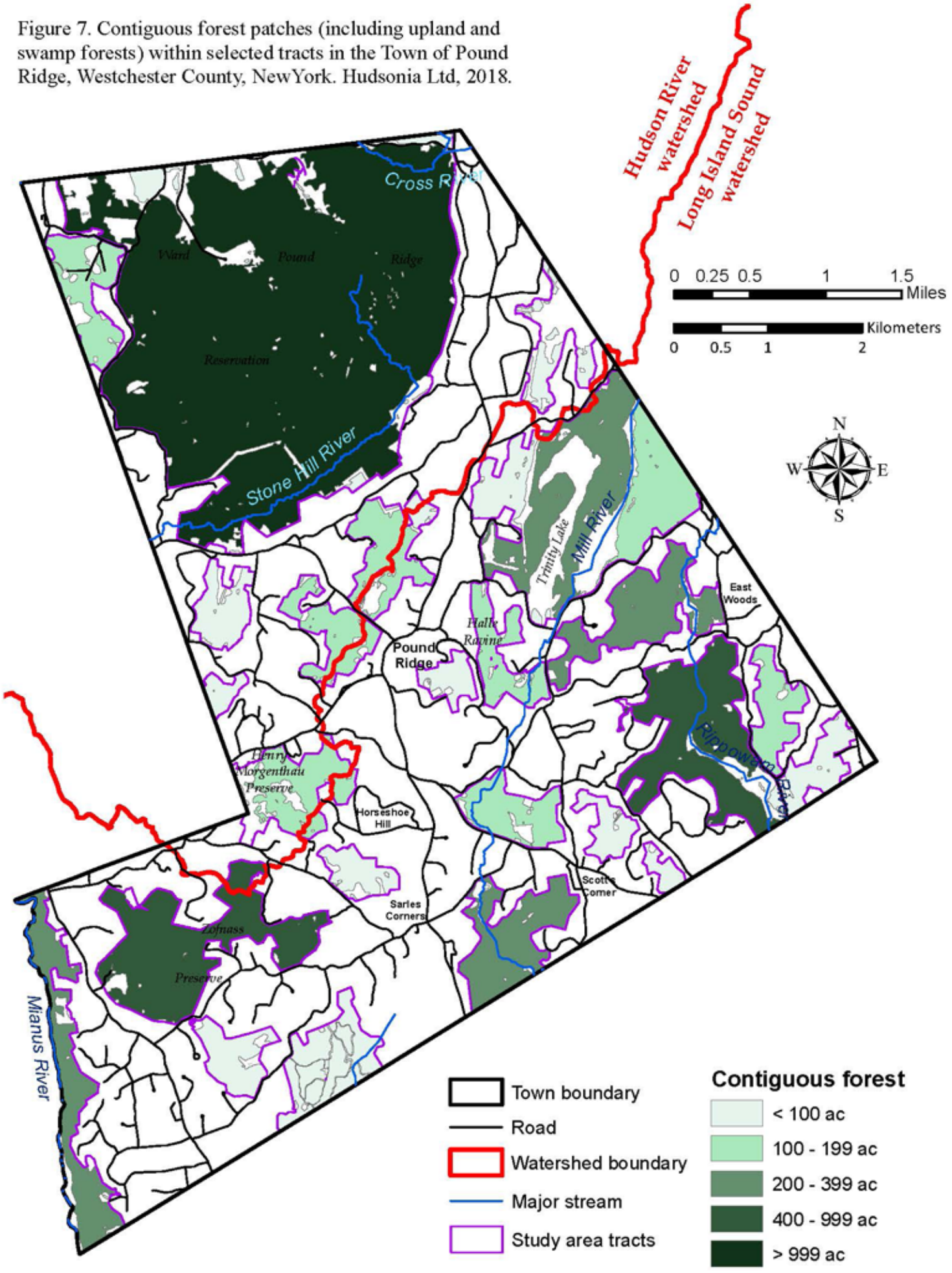
2. **Protect patches of forest types that are less common in the town regardless of their size**. These include mature forests (and old-growth, if any is present), natural conifer stands, forests with an unusual tree species composition, or forests that have smaller, unusual habitats (such as calcareous crest, ledge, or talus) embedded in them.

3. **Maintain or restore broad corridors of intact habitat between large forested areas.** For example, a forested riparian corridor or a series of smaller forest patches may provide connections between larger forest areas. Forest patches on opposite sides of a road may provide a "bridge" across the road for forest-dwelling animals.

4. **Maintain the forest canopy and understory vegetation intact**.

5. **Maintain standing dead wood, downed wood, and organic debris, and prevent disturbance or compaction of the forest floor**. Consult with an invasive species expert if you think you have an infestation of an invasive insect species, as treatment procedures vary by species.

Figure 7. Contiguous forest patches (including upland and swamp forests) within selected tracts in the Town of Pound Ridge, Westchester County, NewYork. Hudsonia Ltd, 2018.



CREST/LEDGE/TALUS and ROCKY BARREN

Target Areas

We identified and mapped crest, ledge, and talus habitats throughout the study area. There were particular concentrations in the WPRR (especially along the southern and western ridge, including the eponymous Pound Ridge escarpment) and in and around the Zofnass Preserve in southwestern Pound Ridge. We observed calcareous crest and ledge, specifically marble, in a few locations west and southwest of Trinity Lake. Overall, we mapped approximately 1,740 ac (700 ha) of known and potential crest, ledge, and talus habitat, or 23% of the study area. Within those areas we also mapped 27 rocky barrens, all but two of which were in the WPRR. All were less than 1 ac [0.4 ha]. Two concentrations of rocky barrens occurred on the south and western rims of WPRR: one of 6 barrens within 1.5 km (1 mi) of each other, and one of 15 barrens within 1.5 km (1 mi) of each other.

Conservation Issues for Selected Focal Species

Some rare and vulnerable snakes depend on rocky habitats, including the exposed outcrops of crest/ledge and rocky barrens. Snakes such as northern copperhead,* eastern ratsnake,* and northern black racer* den in crest, ledge, and talus habitats and range far into the surrounding landscape to forage in forests and meadows. Copperheads, for instance, will travel on average 0.4 mi (0.7 km) from their dens and have been known to travel up to 0.7 mi (1.2 km) (Fitch 1960). Eastern ratsnakes and northern black racers travel similar distances from their den sites (Blouin-Demers and Weatherhead 2002; Todd 2000). Northern copperhead and other snakes are vulnerable to loss or disturbance of habitat, collection for live trade, and malicious killing (Klemens 1993). Perhaps one of the greatest threats to the sensitive animals associated with crest/ledge/talus and rocky barrens (including far-ranging rare reptiles) is the fragmentation of large rocky forested areas and associated habitat complexes. The construction of houses, roads, and other structures in these habitats can isolate populations by preventing successful migration, dispersal, and genetic exchange. This, in turn, can limit the ability of these populations to adapt to changing climatic or other environmental conditions and make them more prone to local extinction.

Eastern ratsnake, a snake of rocky forests and barrens

Rocky barrens are uncommon in the Hudson Valley but are best represented in the high-elevation areas of the Catskills, Shawangunks, Taconics, and Hudson Highlands. They are disturbance-maintained ecosystems (ice, fire, wind, ice), but human suppression of wildfires has eliminated one of the disturbances that historically maintained them. The plant communities of some rocky barrens, such as oak-heath barrens, are especially adapted to episodic fires. Without fire events, other forest species can colonize these areas, and eventually barren specialists may be out-competed by the more typical species of rocky upland hardwood forests.

Recommendations

To help protect crest, ledge, and talus habitats, we recommend the following measures:

1. **Avoid direct alteration of crest, ledge, and talus habitats** wherever possible, and concentrate any unavoidable development in a manner that maximizes the amount and contiguity of undisturbed rocky habitat. Minimize the extent of new roads through undeveloped land with extensive crest, ledge, and talus. Take special measures to restrict the potential movement of snakes into developed areas, thereby minimizing the likelihood of human-snake encounters (which are often fatal for the snake) and road mortality.

2. **Maintain broad corridors** between crest, ledge, and talus habitats**.** Intervening areas between habitats provide travel corridors for species that migrate among different habitats for breeding, foraging, and dispersal.

3. **Protect large forested areas around crest, ledge, and talus habitats.**

4. **Consider the impacts of habitat disturbance** to crest, ledge, and talus when reviewing all applications for mined lands permits and other development proposals, keeping in mind that rare snakes typically travel long distances from their den sites.

5. **Educate construction workers and residents** about snake conservation and whom to contact to safely relocate snakes encountered on a construction site or in a residential yard.

Particular measures for conservation of rocky barrens and their associated rare species include:

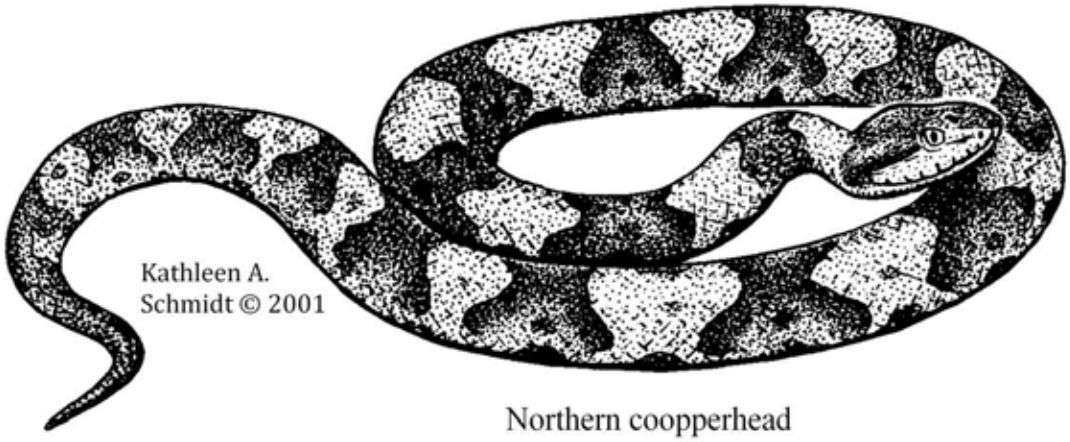
1. **Protect rocky barrens and associated crest, ledge, and talus habitats.** Avoid direct alterations including, but not limited to, the construction of communication towers; mining; house, road, and driveway construction; and high intensity human recreation. Protecting these habitats protects denning and basking areas for rare snakes and the habitat's specially adapted plants.

2. **Protect critical adjoining habitats within 100 ft (30 m) of the barrens** (and larger contiguous areas wherever possible)**.** Basking reptiles and other organisms that are sensitive to human disturbances use these barrens, but the paucity of similar habitat types on the landscape limits the ability of some organisms to avoid human activity. Disturbances in or near a rocky barren can force out sensitive species and provide an avenue for the establishment of invasive plants. Because these habitats have shallow soils, they are particularly sensitive to trampling or ATV use that can wear away soils and damage plant root systems. For these reasons we recommend that habitats within at least 100 ft (30 m) of a rocky barren be considered critical components of the barren habitat. Avoid new development of any kind, including roads and high-use hiking trails, within this 100-ft zone. Protecting larger areas of contiguous habitat surrounding rocky barrens will not only protect potential foraging habitats and travel corridors for rare species, but may also help support the ecological and natural disturbance processes (e.g. fire) that help sustain the rocky barren habitats.

3. **Maintain broad corridors between rocky barrens and nearby crest, ledge, and talus habitats** to provide travel routes for species that migrate among different rocky habitats for breeding, foraging, and dispersal.

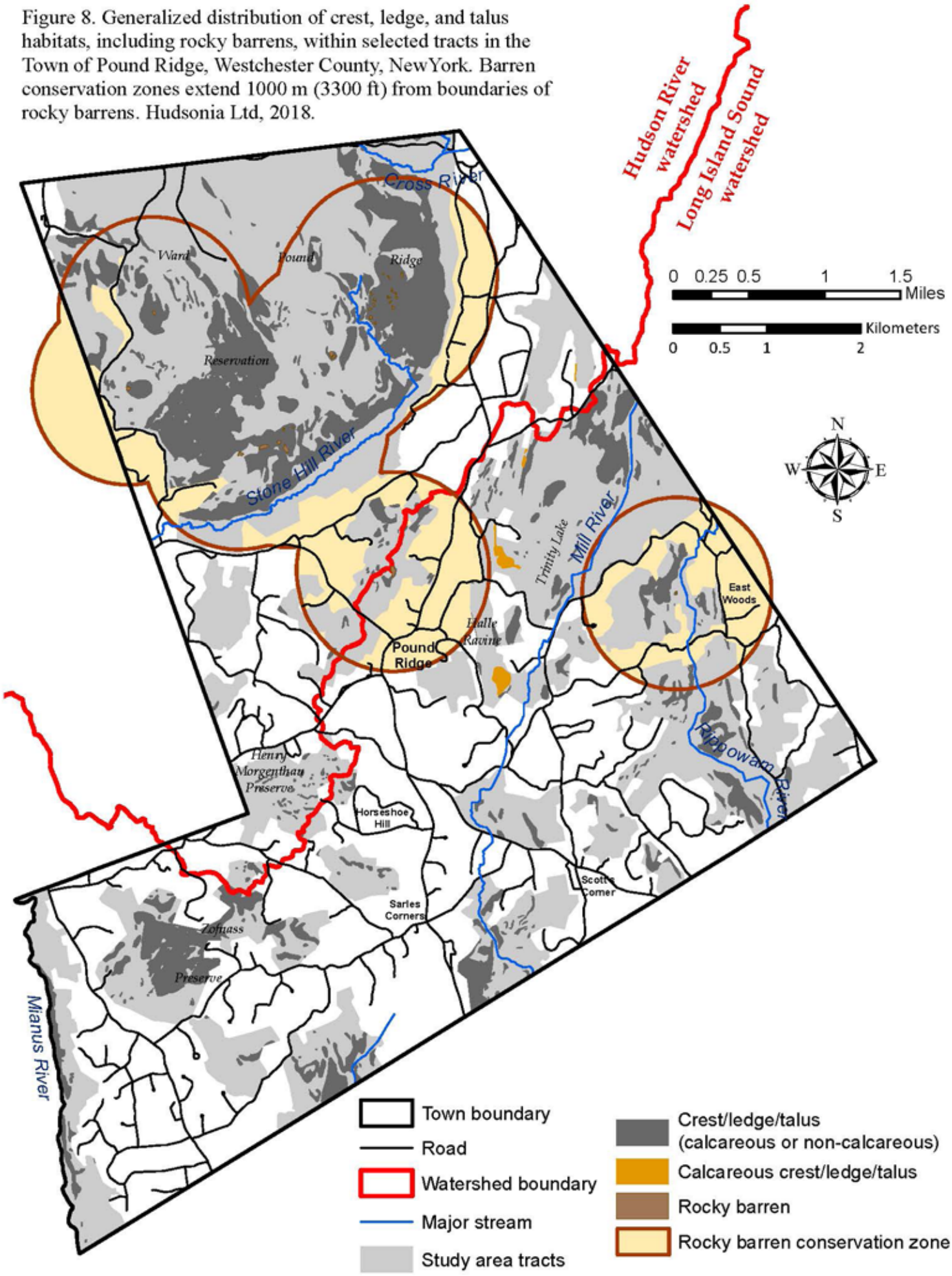
4. **Protect critical adjoining habitats (ledges, forests, meadows) within 3,300 ft (1,000 m) of the rocky barrens.** Habitats within this zone should be considered critical components of the barren habitat "complex" that may be used for foraging and travel by northern copperhead and other snakes of conservation concern. As much as

possible, avoid new development of any kind, including roads and driveways within this 0.6-mi zone. If development cannot be avoided, it should be concentrated in a manner that maximizes the amount and contiguity of undisturbed habitat. Protecting large areas of contiguous habitat surrounding the barrens will not only protect potential foraging habitats and travel corridors, but may also help support the ecological and natural disturbance processes (e.g., fire) that help sustain the barrens habitats.



Northern coopperhead

Figure 8. Generalized distribution of crest, ledge, and talus habitats, including rocky barrens, within selected tracts in the Town of Pound Ridge, Westchester County, NewYork. Barren conservation zones extend 1000 m (3300 ft) from boundaries of rocky barrens. Hudsonia Ltd, 2018.



INTERMITTENT WOODLAND POOLS & POOL-LIKE SWAMPS

Target Areas

Our study area in Pound Ridge was rife with intermittent woodland pools and pool-like swamps, which we consider together here. Overall, we identified and mapped 61 intermittent woodland pools in the study area tracts (Figure 9), and there are likely to be others that we missed. We also mapped 45 pool-like swamps with presumed ecological functions similar to those of intermittent woodland pools. Buttonbush pools are another wetland that share some characteristics of intermittent woodland pools, namely intermittent standing water and hydrological isolation (see "Buttonbush Pool" habitat description), and so we include the only mapped buttonbush pool here. We refer to the combined set of intermittent woodland pools, pool-like swamps, and buttonbush pool as *woodland pools*.

Pool-like swamp. Note shrubs and trees emergent from pooled water.

While each woodland pool may be important to preserve, groups or networks of pools (which are found throughout the town) and their surrounding forests are particularly valuable from a habitat perspective. Groups of pools can support amphibian and reptile metapopulations—groups of small populations that are able to exchange individuals and recolonize sites where populations have recently disappeared. We define a pool complex as groupings in which each pool is within the conservation zone (750 ft (230 m)) (see below) of one or more other pools. Five such complexes consisted of five or more pools embedded in unfragmented habitat (mostly forest); one of these, in the WPRR, contained an incredible 35 woodland pools, and two others contained nine pools each.

Conservation Issues for Selected Focal Species

Because they lack fish and certain other predators, intermittent woodland pools provide crucial breeding and nursery habitat for several amphibian species that cannot successfully reproduce in other wetlands, including several of the mole salamanders (Jefferson salamander,* marbled salamander,* spotted salamander*) and wood frog.* We use these as the focal species for conservation planning for intermittent woodland pools. Except for their relatively brief breeding season and egg and larval stages, these species are terrestrial and require the deep shade, thick leaf litter, uncompacted soil, and coarse woody debris of the surrounding upland forest for foraging and shelter. The upland forested area within a 750 ft (230 m) radius of the intermittent woodland pool is considered necessary to support populations of amphibians that breed in intermittent woodland pools (Calhoun and Klemens 2002). Disturbance of vegetation or soils within this area—including the direct loss of pool and forest habitats, alteration of the pool hydroperiod, and degradation of pool water quality or forest floor habitat quality—can have significant adverse effects on amphibians.

Wood frog, an obligate pool breeder

Pool-breeding amphibians are especially vulnerable to upland habitat fragmentation because of their annual movement patterns. Each year adults migrate to the intermittent woodland pools to breed, and then adults and (later) juveniles disperse from the pool to terrestrial habitats. Jefferson salamanders are known to migrate seasonally up to 2,050 ft (625 m) from their breeding pools into surrounding forests (Semlitsch 1998). A wood frog adult may travel as far as 3,835 ft (1,169 m) from a breeding pool (Calhoun and Klemens 2002). Both salamanders and frogs are vulnerable to vehicle mortality where roads or driveways cross their travel routes. Roads, especially dense networks of roads or heavily-traveled roads, have been associated with reduced amphibian populations (Fahrig et al. 1995, Lehtinen et al. 1999, Findlay and Bourdages 2000). A New Hampshire study found that road density within 1,000 m was the best predictor of egg mass abundance (a proxy for population size) for wood frog and spotted (Veysey et al. 2011). Open fields and clearcuts are another barrier to forest-dwelling amphibians. Juveniles have trouble crossing open fields due to a high risk of desiccation and predation in those exposed environments (Rothermel and Semlitsch 2002).

Populations of these amphibian species depend not only on a single woodland pool, but on a forested landscape dotted with such wetlands among which individual animals can disperse (Semlitsch 2000). A network of pools is essential to amphibians for several reasons. Each pool is different from the next in vegetation structure, plant community, and hydroperiod, so each may provide habitat for a different subset of pool-associated species at different times. Also, different pools provide better or worse habitat each year, due to their internal characteristics and those of their watersheds, and year-to-year variations in precipitation and air temperatures. To preserve the full assemblage of species in the landscape, a variety of pools and upland forest connections between pools must be present to connect local populations (Semlitsch and Bodie 1998). Nearby pools can also serve to "rescue" a population: if the population at one pool is extirpated, individuals from another pool can recolonize the site. This rescue effect is needed to maintain the metapopulation over the long term (Semlitsch and Bodie 1998). Thus, protecting the salamander and frog species associated with intermittent woodland pools requires protecting not only their core breeding habitat (i.e., an intermittent woodland pool), but also their key foraging and wintering habitats in the surrounding upland forests, and the forested migration corridors between individual pools and pool complexes (Gibbons 2003).

Recommendations

To help protect pool-breeding amphibians and the habitat complexes they require, we recommend the following protective measures be applied to all intermittent woodland pools, buttonbush pools, and pool-like swamps (adapted from Calhoun and Klemens 2002):

1. **Protect the intermittent woodland pool depression**. Intermittent woodland pools are often overlooked during environmental reviews of proposed development projects and are frequently drained, filled, or dumped in. We recommend that intermittent woodland pools be permanently protected from development and disturbance of any kind including the construction of houses, roads, lawns, and permanent ponds within the pool depression. This zone of protection should include the pool basin up to the spring high water mark and all associated vegetation. The soil in and surrounding the pool should not be compacted in any manner and the vegetation, woody debris, leaf litter, and stumps or root crowns within the pool should not be removed.

2. **Avoid channeling runoff from roads and developed areas** (including overflow from stormwater ponds) into intermittent woodland pools. Such runoff carries substances harmful to amphibians (such as road salt and nitrate) to the pools, and alters pool water volumes (see below).

3. **Protect all upland forest within 100 ft (30 m) of the intermittent woodland pool**. During the spring and early summer this zone provides important shelter for high densities of adult and recently metamorphosed salamanders and frogs. The forest in this zone also helps shade the pool, maintains pool water quality, and provides important leaf litter and woody debris to the pool ecosystem. This organic debris constitutes the base of the pool food web and provides attachment sites for amphibian egg masses.

4. **Maintain critical terrestrial habitat within 750 ft (230 m) of the pool**. The upland forests within 750 ft (230 m) or more of a woodland pool are critical foraging and shelter habitats for pool-breeding amphibians during the non-breeding season. Roads, development, logging, ATV use, and other activities within this terrestrial habitat can crush many amphibians and destroy the forest floor microhabitats that provide them with shelter and invertebrate food. Development within this zone can also prevent dispersal and genetic exchange between neighboring pools, thereby making local extinction more likely. A minimum of 75% of this zone should remain in contiguous (unfragmented) forest with an undisturbed forest floor. Wherever possible, forested connections between individual pools should be identified and maintained to provide overland dispersal corridors.

We also recommend the following for all development activity proposed within the critical terrestrial habitat zone (750 ft [230 m]) of an intermittent woodland pool:

1. **Avoid or minimize the potential adverse affects of roads to the greatest extent possible**. Pool-breeding salamanders and frogs are especially susceptible to road mortality from vehicular traffic, predation, and desiccation. Curbs and other structures associated with roads frequently intercept and funnel migrating amphibians into stormwater drains where they may be killed. To minimize these potential adverse impacts:
    - Locate no new roads and driveways with projected traffic volumes in excess of 5-10 vehicles per hour within 750 ft (230 m) of the pool.
    - Regardless of traffic volumes, limit the total length of roads and driveways within 750 ft of a woodland pool to the greatest extent possible and tightly cluster any new development to minimize forest fragmentation. .
    - Use gently sloping curbs or no-curb alternatives to reduce barriers to amphibian movement.
    - Use oversized square box culverts (2 ft wide by 3 ft high [0.6 m x 0.9 m]), spaced at 20-ft (6-m) intervals, near wetlands and known amphibian migration routes to facilitate amphibian movements under roads. Use special outward-facing "curbing" along the adjacent roadway to deflect amphibians into the box culverts.

2. **Maintain woodland pool water quality and quantity at pre-disturbance levels**. Development within a woodland pool's watershed can degrade pool water quality by increasing sediments, nutrients, and other pollutants. Even slight increases in sediments or pollution can stress and kill amphibian eggs and larvae, and may have adverse long-term affects on the adults. Activities such as groundwater extraction (e.g. from wells) or the redirection of natural surface water flows can reduce the pool hydroperiod below the threshold required for successful egg and larval development. Increasing impervious surfaces or channeling stormwater runoff toward pools can increase pool hydroperiod, which can also adversely affect the ability of amphibians to reproduce successfully. Protective measures include the following:
    - Do not use intermittent woodland pools for stormwater detention, either temporarily or permanently.
    - Aggressively treat stormwater throughout the development site, using methods that allow for the maximum infiltration and filtration of runoff, including grassy swales, filter strips, "rain gardens," and oil-water separators in paved parking lots. Direct all stormwater away from nearby woodland pools.

- Avoid or minimize the use of pesticides and fertilizers within the woodland pool's watershed. If mosquito control is necessary, limit it to the application of bacterial larvicides, which appear at this time to have lesser negative impacts on non-target pool biota than other methods. Avoid using de-icing salts such as sodium chloride where they will pollute surface runoff into amphibian breeding pools. These salts cannot be removed from water or soils by means of treatment methods currently in use.
- Maintain both surface water runoff and groundwater inputs to intermittent woodland pools at pre-construction levels. Carefully design stormwater management systems in the pool's watershed to avoid changes (either increases or decreases) in seasonal pool depths, volumes, and hydroperiods.
- Minimize impervious surfaces including roads, parking lots, and buildings to reduce runoff problems and resulting stormwater management needs.

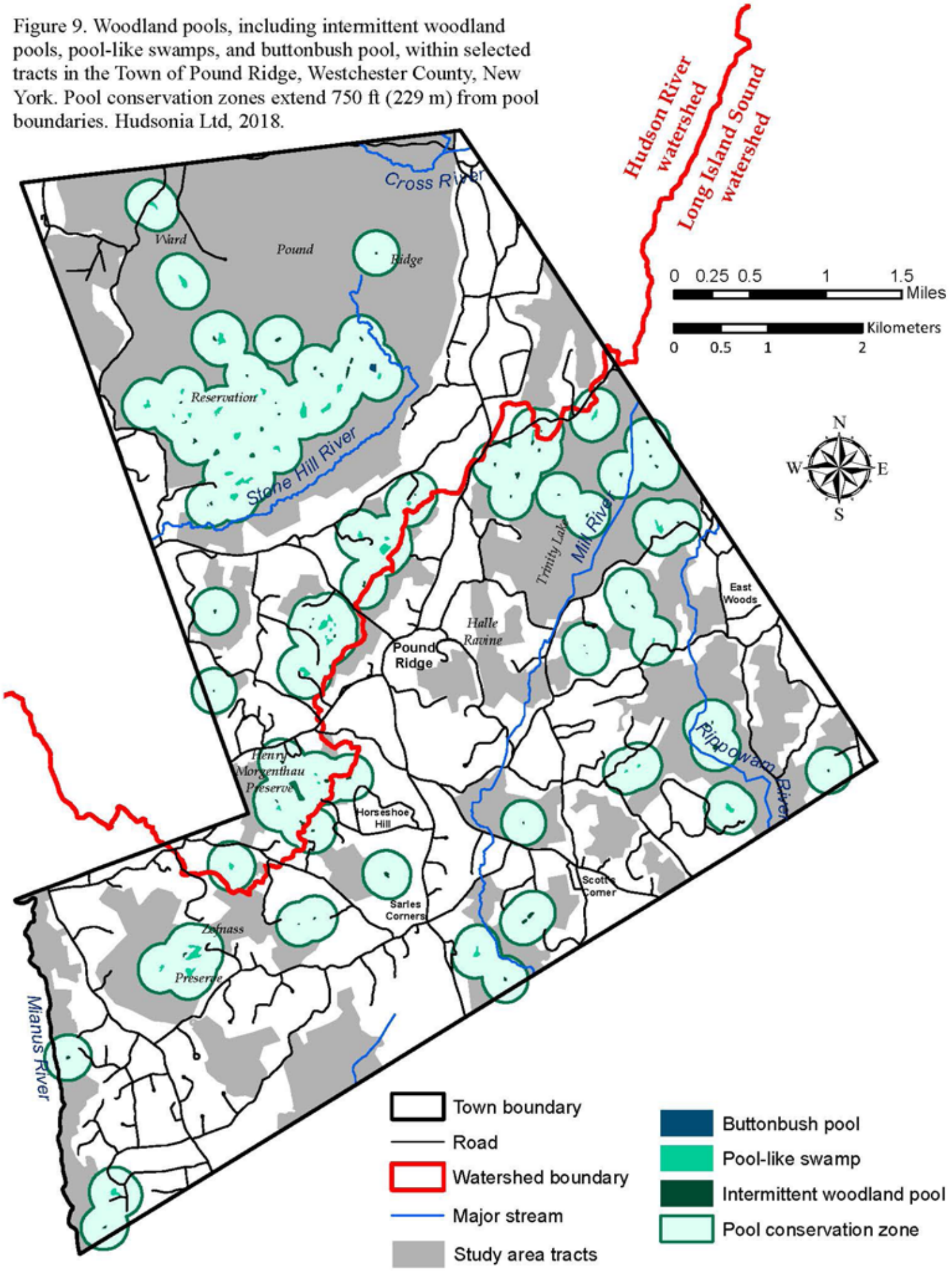
3. **Avoid creating stormwater detention basins and other artificial depressions** that intermittently hold water (e.g. vehicle ruts) within 750 ft (230 m) of an intermittent woodland pool or in areas that might serve as overland migration routes between pools. These "decoy wetlands" can attract large numbers of pool-breeding amphibians, but the eggs laid in them rarely survive due to the high sediment and pollutant loads and (sometimes) short hydroperiod. Ruts, for example, may also serve as larval habitats for undesirable species of mosquitoes.

4. **Modify potential pitfall hazards** such as swimming pools, excavations, window wells, or storm drain catch basins to prevent the entrapment and death of migrating amphibians. Soil test pits should be backfilled immediately after tests are completed.

5. **Schedule construction activities to occur outside the peak amphibian movement periods of spring and early summer (late summer and fall for marbled salamander)**. If construction activity during this time period cannot be avoided, install temporary exclusion fencing before the breeding migration around the entire site to keep amphibians out of the active construction areas.

For recommendations on protecting intermittent woodland pools in working forests, both for forest management planning and for harvest operations, see Calhoun & DeMaynadier (2004). Other resources for conservation of small wetlands in New York are listed on the NYSDEC website (http://www.dec.ny.gov/docs/remediation_hudson_pdf/hrebswres.pdf).

Figure 9. Woodland pools, including intermittent woodland pools, pool-like swamps, and buttonbush pool, within selected tracts in the Town of Pound Ridge, Westchester County, New York. Pool conservation zones extend 750 ft (229 m) from pool boundaries. Hudsonia Ltd, 2018.



FENS

Target Areas

We mapped 12 fens in the Town of Pound Ridge (Figure 10), all in the vicinity of the band of Inwood marble that runs north to south from Lake Kitchawan to the intersection of Woods and Fancher Roads (see Figure 2). This number is probably an underestimate, since these habitats are best identified in the field. All of the fens were small, with the two largest being between 0.5 and 0.6 ac (0.2 – 0.25 ha). Several were clustered together in wetland complexes, so that, overall, there were five distinct fen clusters, or complexes. One such cluster occurred on public land in the Isaacson Preserve, and another in the Thalheim Preserve. The greatest concentration of fen habitat occurred within a shrub swamp-hardwood swamp complex, in a utility corridor on water company land.

Grass pink, a regionally rare orchid of fens and bogs

Conservation Issues for Selected Focal Species

Fens and calcareous wet meadows are uncommon in the northeastern US and many provide important habitat for plant and animal species of conservation concern (see Appendix A). One of the most imperiled species associated with fens in the region is the bog turtle,* listed as Endangered in New York and Threatened on the federal list. Fens are the core habitat of the bog turtle in southeastern New York. While bog turtles are believed to be extirpated (or nearly so) in Westchester and Rockland counties, it is still possible that some of the higher-quality fens in the Town of Pound Ridge could support bog turtles now or in the future.

Fens are home to numerous regionally- and state-rare plants whose persistence depends on the particular environmental conditions of fens. At least 12 state-listed rare plants are found almost exclusively in fen habitats, including handsome sedge,* Schweinitz's sedge,* brown bog sedge (which we found in Pound Ridge),* bog valerian,* scarlet Indian paintbrush,* spreading globeflower,* and swamp birch.* Fens are maintained by mineral-rich, calcareous groundwater seepage. Alterations to the quality or quantity of groundwater or surface water feeding the fen, due to nearby development or human activities, including use of fertilizers or pesticides, can render the habitats unsuitable for many of the plants of conservation concern found in fens. Direct disturbance to the fens themselves can, of course, also alter fen plant communities and threaten populations of rare plants.

Recommendations

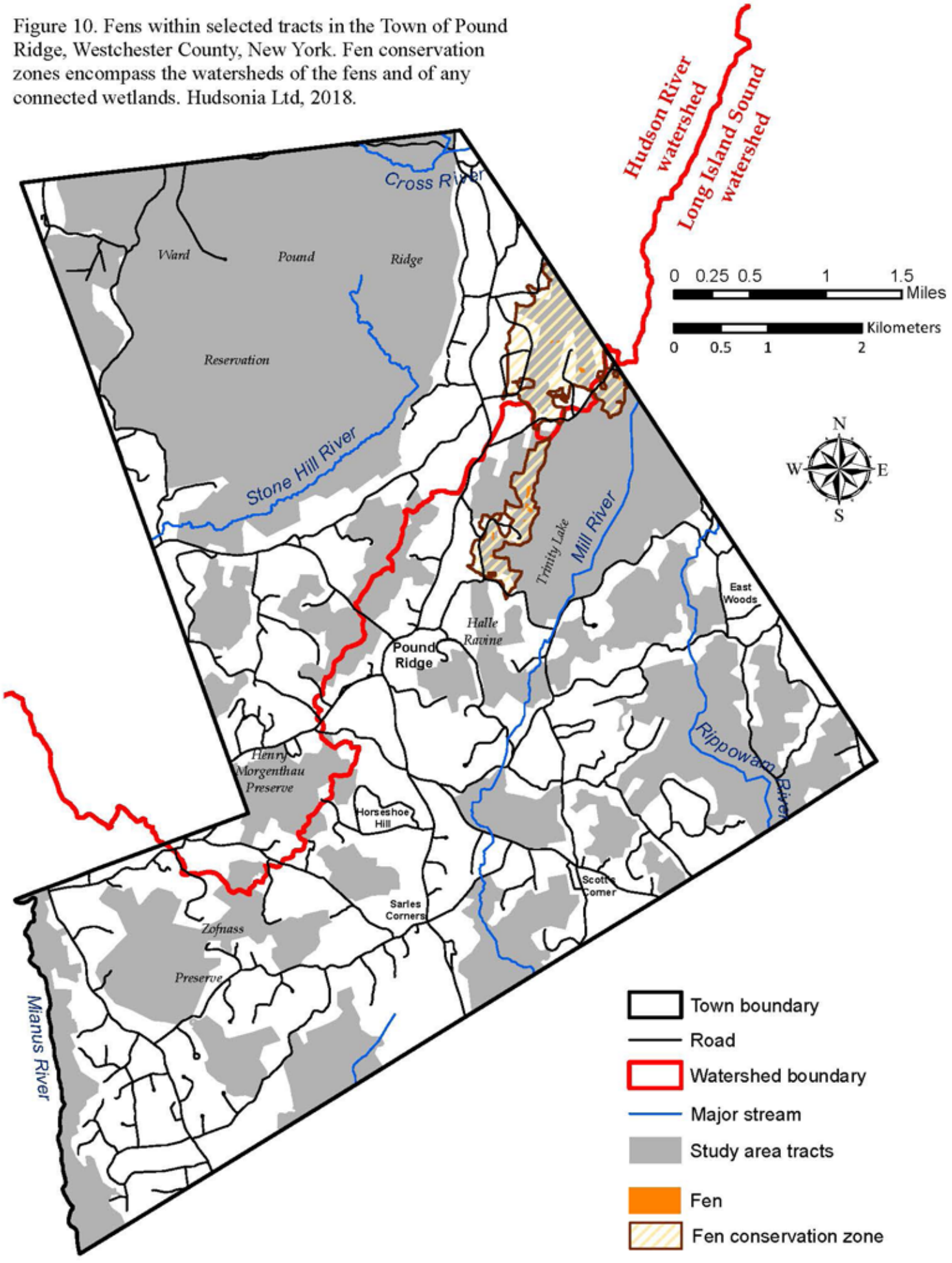
Conservation of fens requires attention not only to the fen itself, but also to surrounding land uses. Because some of the high quality fen complexes (and their associated conservation zones) in Pound Ridge cross multiple privately owned parcels, fen conservation also requires coordinating across property boundaries. We recommend protecting the wetland complex and prohibiting disturbance and development within the watershed of the fen. This buffer may be crucial to safeguarding wetland habitat quality and hydrology, which is critical for protecting rare plant populations. To protect the rare plants and unusual biological communities of fens, we recommend the following:

1. **Protect the wetland footprint**. Within the entire wetland, not just those portions identified as "fen," avoid the following:
    - Development of any kind.
    - Wetland draining, ditching, tiling, filling, excavation, stream diversion, or construction of impoundments.
    - Herbicide, pesticide, or fertilizer application.
    - Mowing or cutting of vegetation (except as part of an approved fen management plan).
    - Delineation of lot lines for development, even if the proposed building or structure will not be in the wetland.

2. **Establish a 300 ft buffer zone**. This will help prevent or minimize the effects of human activities that could indirectly destroy or degrade the fen habitat over the short or long term. Within this zone, avoid the following:
    - Development of roads, residences, driveways, parking lots, sewer lines, utility lines, stormwater or sedimentation basins, or other structures.
    - Mining.
    - Herbicide, insecticide, other pesticide, or fertilizer application.
    - Farming (with the exception of light to moderate grazing).
    - Stream bank stabilization (e.g., rip-rap or other hardening).
3. **Assess potential impacts within the watershed of the fen**. Despite the distance, development activities (construction of impervious surfaces, installation of septic systems, mining) occurring within the watershed of the fen may adversely affect the groundwater feeding the fen.

grass-of-Parnassus, a fen indicator plant

Figure 10. Fens within selected tracts in the Town of Pound Ridge, Westchester County, New York. Fen conservation zones encompass the watersheds of the fens and of any connected wetlands. Hudsonia Ltd, 2018.



WETLAND COMPLEXES

Target Areas

A wetland complex is any group of adjacent and nearby swamps, marshes, wet meadows, ponds, other wetland types, or streams. Characteristics that lend especially high biodiversity value to wetland complexes are large size, inclusion of a wide variety of wetland types, and intact (undeveloped) upland habitat between wetlands.

Eastern spring beauty in a hardwood swamp

Large and varied wetland complexes occurred throughout the study area (Figure 11). Hardwood swamps were the most common wetland type and reached the largest size, excepting open water bodies. Two of the largest wetlands were hardwood swamps around the outside of the Ward Pound Ridge plateau: one along the Stone Hill River (116 ac [47 ha]), and one along the Mill River (77 ac [31]). The Eastwoods area has numerous large wetland complexes, and also, interestingly, the band of Inwood marble corresponds with a band of large wetland complexes, including two of the largest in the town: at the north end, a 109-ac (44-ha) complex consisting of extensive hardwood swamp, marshes, fens, and Lake Kitchawan; and at the south end, a 47-ac (19-ha) hardwood swamp.

Conservation Issues

Many animals move among several types of wetland and upland habitats to fulfill their life needs. For instance, spotted turtle* (NYS Species of Special Concern), which is known from Pound Ridge (Miller and Klemens 2002), is a highly mobile species that depends on a variety of habitats to survive and reproduce. It is known to use marsh, fen, wet meadow, hardwood and shrub swamp, buttonbush pool, intermittent woodland pool, and open water habitats within a single year (Fowle 2001). Furthermore, although it depends on a large number of wetlands, spotted turtle may spend up to three-quarters of its time during the active season in uplands. This

species follows an annual pattern of activity (which likely varies by individual, population, and region): it usually overwinters in bottomland hardwood swamps or wet meadows, spends spring and early summer in one to several seasonal and permanent pools, travels up to 1,870 ft (570 m) to nest in open upland habitat, and spends late summer aestivating (quiescent) in upland forest. It can travel 3,300 ft (1,000 m) or more between wetlands. Because of this intricate annual pattern of habitat use, whole complexes of wetland and upland habitats are required to support spotted turtle populations, including seasonal wetlands such as intermittent woodland pools (Joyal et al. 2001, Milam and Melvin 2001). The spotted turtle exemplifies mobile wildlife species that depend on a mosaic of wetland and upland habitats and require safe travel routes between those habitats.

Recommendations

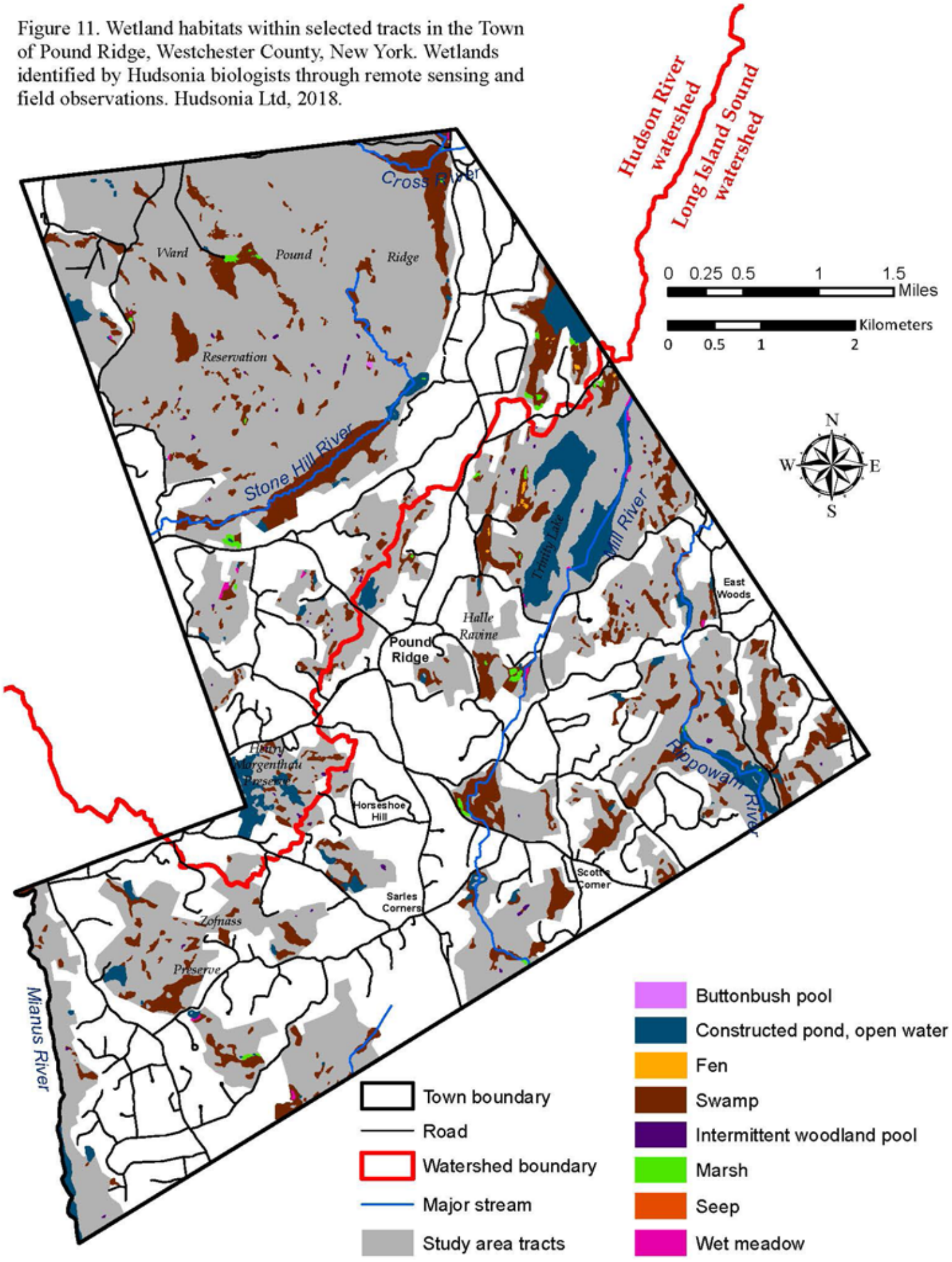
1. **Protect intermittent woodland pools, pool-like swamps, buttonbush pools, and their conservation zones** as described in previous sections of this report. These habitats are used by spotted turtle* and many other species of conservation concern.

2. **When those habitats are located within 1,500 ft (460 m) of a swamp, marsh, or wet meadow , protect the intervening upland habitats as much as possible**. These upland areas encompass spotted turtle travel corridors, and nesting, aestivation (summer dormancy), and basking sites.

3. **Protect from disturbance the potential spotted turtle nesting habitat areas within 390 ft (120 m) of all the wetlands**. Spotted turtle usually nests in open (unforested) sites such as fields or lawns, but sometimes also in sedge tussocks in wetlands.

spotted turtle

Figure 11. Wetland habitats within selected tracts in the Town of Pound Ridge, Westchester County, New York. Wetlands identified by Hudsonia biologists through remote sensing and field observations. Hudsonia Ltd, 2018.



STREAMS AND RIPARIAN CORRIDORS

Target Areas

The Cross River, Stone Hill River, Mill River, and Mianus River are the largest perennial streams in Pound Ridge. There are also numerous smaller perennial streams and myriad intermittent streams throughout the town. Both the streams themselves and associated floodplain forests provide habitat for many plants and animals (both resident and transient) and are important to the ecology of the entire stream watersheds (Figure 12).

Conservation Issues for Selected Focal Species

Low gradient, perennial streams can be essential core habitat for the wood turtle (NYS Special Concern), which is known to live in Pound Ridge (Miller and Klemens 2002). Wood turtles use streams with overhanging banks, muskrat burrows, submerged logs, or other underwater shelter for overwintering. In early spring, they use logs and stream banks for basking. In late spring and summer, wood turtles (especially females) move into and beyond the adjacent riparian zone to bask and forage in a variety of wetland and upland habitats, and females may travel long distances from their core stream habitat to find open, sparsely vegetated upland nesting sites.

Conserving wood turtle populations requires protecting not only their core habitat (the perennial stream), but also their riparian wetland and upland foraging habitats, upland nesting areas, and the migration corridors between these habitats. The wood turtle habitat complex can encompass the wetland and upland habitats within 820 ft (250 m) or more of a core stream habitat (Carroll and Ehrenfeld 1978, Harding and Bloomer 1979, Buech et al. 1997, Foscarini and Brooks 1997, Tingley et al. 2009). Human land uses within this habitat complex can have significant adverse effects on wood turtles and their habitats, including habitat degradation from stream alteration; habitat fragmentation from culverts, bridges, roads, and other structures; direct loss of wetland habitat; degraded water quality from siltation, pesticides, fertilizers, sewage, and toxic compounds; increased nest predation by human-subsidized predators; disturbance from human recreational activities; and road mortality of nesting females and other individuals migrating between habitats.

Water quality in large streams depends in large part on the water quality and quantity of the smaller perennial and intermittent streams that feed them (Lowe and Likens 2005), and on the condition of land and water throughout the watershed. To help protect water quality and habitat in small streams, the adjoining lands (soil and vegetation) should be protected to at least 160 ft (50 m) on each side of the stream. This conservation zone provides a buffer for the stream and can filter sediment, nutrients, and contaminants from runoff, stabilize stream banks, prevent channel erosion, contribute organic material, regulate microclimate, and preserve other ecosystem processes (Saunders et al. 2002).

Recommendations

To help protect wood turtles and the habitat complexes they require, we recommend the following measures:

1. **Protect the integrity of stream habitats**.
    - Prohibit engineering practices that alter the physical structure of the stream channel such as stream channelization, artificial stream bank stabilization (e.g. rock riprap, concrete), construction of dams or artificial weirs, vehicle crossing (e.g. construction or logging equipment, ATVs), and the clearing of natural stream bank vegetation. These activities can destroy key hibernation and basking habitats for the wood turtle.
    - Avoid direct discharge of stormwater runoff, chlorine-treated wastewater, agricultural by-products, and other potential pollutants.
    - Establish a stream conservation zone extending at least 160 ft (50 m) on either side of all streams in the watershed, including perennial and intermittent streams, regardless of whether or not they are used by wood turtles. Keep these zones naturally vegetated and undisturbed by construction, conversion to impervious surfaces, cultivation and livestock use, pesticide and fertilizer application, and installation of septic leachfields or other waste disposal facilities.

2. **Protect riparian wetland and upland habitats.** Protect all riparian wetlands adjacent to known or potential wood turtle streams from filling, dumping, drainage, impoundment, incursion by construction equipment, siltation, polluted runoff, water withdrawals, and hydrological alterations. In addition, preserve large, contiguous blocks of upland habitats (e.g., forests, meadows, and shrublands) within 820 ft (250 m) of a core wood turtle stream to the greatest extent possible to provide basking, foraging, and nesting habitat, and safe travelways for this species. Special efforts may be needed to protect particular

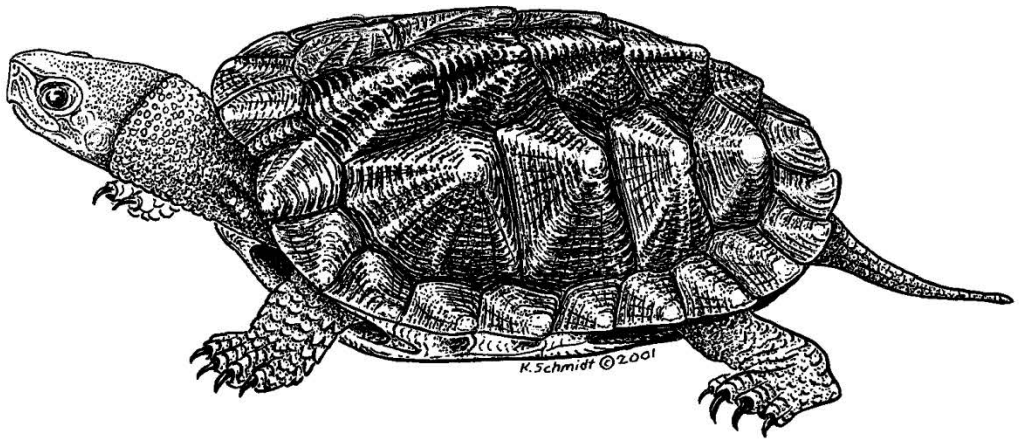
components of the habitat complex such as wet meadows and alder stands—wood turtle has been found to favor stands of alder, and wet meadows are often sought by wood turtles, especially females, for spring basking and foraging (Kaufmann 1992). These wetlands, however, are often omitted from state, federal, and site-specific wetland maps and are frequently overlooked in the environmental reviews of development proposals.

3. **Minimize impacts from new and existing stream crossings**. Undersized bridges and narrow culverts may be significant barriers to wood turtle movement along their core stream habitats. Wood turtles may shy away from passing beneath or entering such structures, and instead choose an overland route to reach their destination. Typically, this overland route involves crossing a road or other developed area, often resulting in the death of the turtle. If a stream crossing completely blocks the passage of turtles, individuals can be cut off from important foraging or basking habitats, or be unable to interbreed with turtles of neighboring populations. Such barriers could significantly diminish the long-term viability of wood turtle populations. If new stream crossings must be constructed, we recommend that they be specifically designed to accommodate the passage of turtles and other wildlife. The following prescriptions may offer important first steps to improving the connectivity of stream corridors (adapted from Singler and Graber 2005):
    - Use bridges and open-bottomed arches instead of culverts.
    - Use structures that span at least 1.2 times the full width of the stream so that one or both banks remain in a semi-natural state beneath the structure. This may encourage the safe passage of turtles and other wildlife.
    - Design the structure to be at least 4 ft (1.2 m) high and have an openness ratio of at least 0.5 (openness ratio = the cross-sectional area of the structure divided by its length). Higher openness ratio values mean that more light is able to penetrate into the interior of the crossing. Brighter conditions beneath a crossing may be more favorable for the passage of wood turtles and other animals.
    - Construct the substrate within the structure of natural materials and match the texture and composition of upstream and downstream substrates. If possible, install the crossing in a manner that does not disturb the natural substrate of the stream bed.
    - If the stream bed must be disturbed during construction, design the final elevation and gradient of the structure bottom to maintain water depth and velocities at low flow that are comparable to those found in natural stream segments just upstream and downstream of the structure. Sharp drops in elevation at the inlet or outlet of the structure can be a physical barrier to passage by wood turtles and other stream organisms.

4. **Minimize impacts from new and existing roads**. Road mortality of nesting females and individuals dispersing to new habitats is one of the greatest threats to wood turtle populations. To help minimize the adverse effects of roads on this species, we recommend the following actions be undertaken within the 820 ft (250 m) wide stream conservation zone:
    - Prohibit the building of new roads crossing or adjoining wood turtle habitat complexes. This applies to public and private roads of all kinds, including driveways.
    - Keep vehicle speeds low on existing roads by installing speed bumps, low speed limit signs, and wildlife crossing signs.

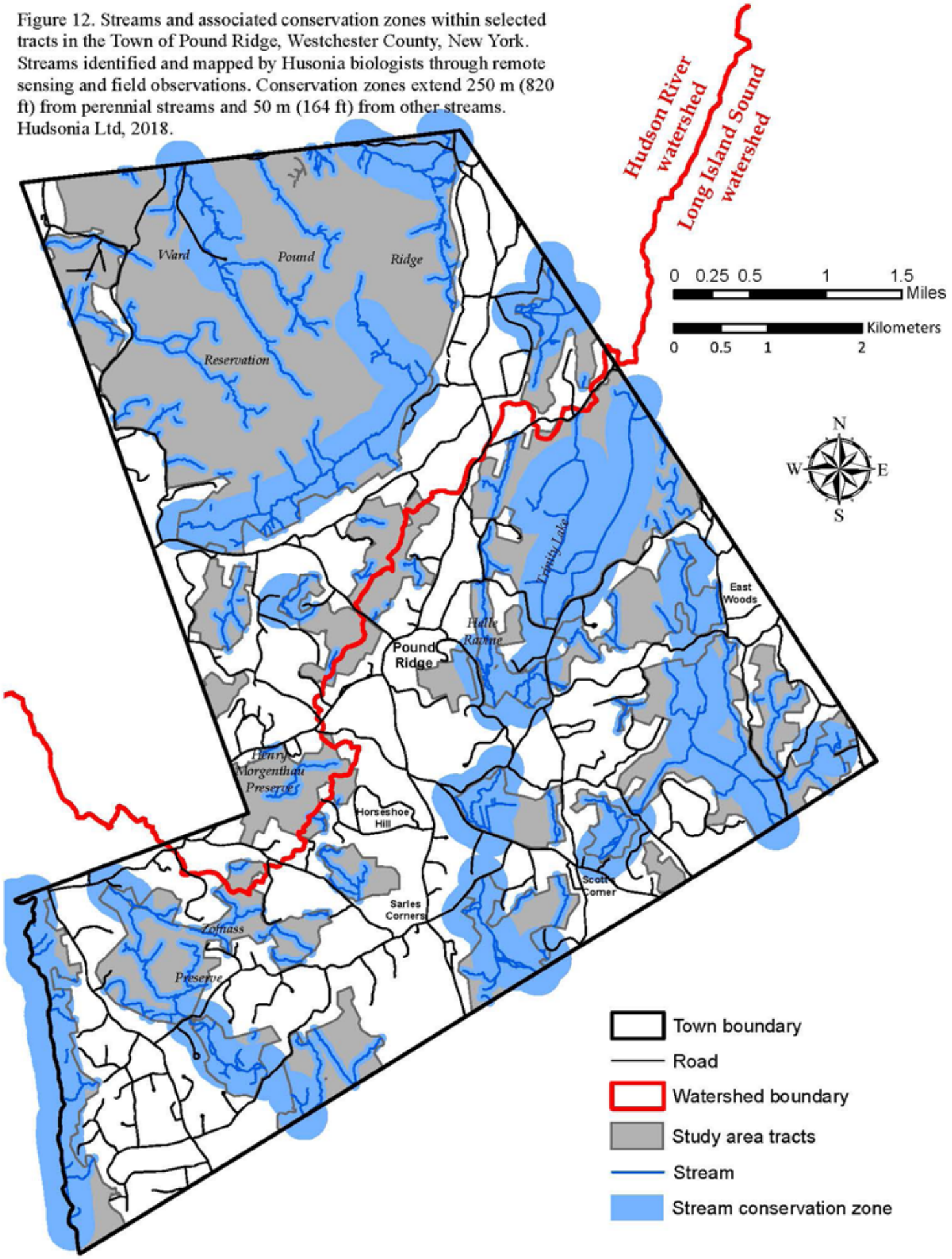
5. **Maintain broad corridors between habitats and habitat complexes**. Broad, naturally vegetated travel corridors should be maintained between individual habitats within a complex (e.g. between core stream habitats, foraging wetlands, and potential nesting areas) and between neighboring habitat complexes.

6. **Protect nesting areas**. Wood turtles often nest in upland meadow or open shrublands, habitats that also tend to be prime areas for development. Construction of roads, houses, and other structures on potential nesting habitats could severely limit the reproductive success of the turtles over the long term. We recommend that large areas of potential nesting habitat within the 820 ft (250 m) stream conservation zone (e.g. upland meadows, upland shrublands, waste ground with exposed gravelly or sandy soils) be protected from development and other disturbance. Management of known or potential nesting habitat may be necessary to keep it open.



wood turtle

Figure 12. Streams and associated conservation zones within selected tracts in the Town of Pound Ridge, Westchester County, New York. Streams identified and mapped by Husonia biologists through remote sensing and field observations. Conservation zones extend 250 m (820 ft) from perennial streams and 50 m (164 ft) from other streams. Hudsonia Ltd, 2018.



ENHANCEMENT OF SETTLED AREAS

For this project we studied only the largest areas of intact habitats, but many smaller areas of ecologically significant habitats are also present between the study area tracts. Many of these areas are worthy of conservation attention, as they may be important for protecting water resources, may support plants and animals of conservation concern, and may serve as travel corridors for animals moving across the landscape.

In fact, conservation measures can be employed on every land parcel, including every half-acre, two-acre, or larger residential lot. Although human-settled areas are much used by common wildlife species that are well-adapted to human activities and infrastructure (e.g., rock pigeon, European starling, gray squirrel, raccoon, striped skunk), uncommon species can also inhabit or travel through developed areas if nearby habitats are suitable. Bats, for example, will roost in small forest patches in suburban neighborhoods, and box turtle* (NYS Special Concern) sometimes nests in lawns and gardens.

There are many landscape modifications and land-use practices that can be applied to the more developed parts of Pound Ridge that would assist in the protection of species of conservation concern. In areas of concentrated development, some small areas of habitat may serve as buffers to intact habitats by moderating the effects of development, some may provide travel corridors for wildlife, and some may themselves provide habitat for certain species. Hudsonia did not map smaller habitat areas due to the limited scope of the project.

Following are some examples of conservation measures for developed areas (adapted in part from Adams and Dove 1989, and Adams 1994). There are many additional ways in which settled areas can be modified to reduce their negative environmental impacts and even contribute positively to the natural environment; many examples of their implementation can be found in European cities (Beatley 2000). The costs of implementing these measures and their effectiveness at particular locations will vary, and while some must be implemented by town agencies or other government entities, others can be practiced by private landowners. The town

can take a leading role in educating the general public about such actions and encouraging landowner participation.

ENHANCING HABITAT CHARACTERISTICS

1. ***Leave woodlots intact, and preserve trees of a variety of species and age classes.*** Trees are an important component of the habitat of many wildlife species, and many species of plants and animals can use small woodlots and hedgerows as habitat corridors. Trees also provide services such as moderating climate extremes, reducing wind velocities, controlling erosion, and abating noise.
    - Leave forested lots in forest, even if being selectively harvested. A complex array of forest patches and corridors offers habitat for species that use such patchy habitats, and provides travel corridors between larger habitat blocks in the region
    - Allow natural processes, such as tree death, tree fall, and forest floor decay, to play out in wooded areas. These processes help preserve natural levels of nutrient cycling and organic matter buildup, and form the basis for the forest food web.
    - Preserve large trees wherever possible, and especially those with exfoliating bark that might serve as summer roost sites for bats.
    - Plant a variety of native tree species along streets, and reduce the use of salt on roads to minimize damage to the trees.
    - Allow natural regeneration of trees where possible, to provide replacements for older trees and those that must be removed for safety reasons.
    - Allow dead trees (snags) to remain standing and fallen trees to decay in place where safety concerns allow. Snags provide good habitat for animals such as insects, bats, cavity-nesting birds, and certain amphibians; decomposing trees provide both habitat and a source of nutrients for plants.

2. ***Replace lawn areas with multi-layered landscapes.*** Manicured lawns have little biodiversity value and their maintenance requires higher inputs of water and chemicals than other types of horticultural landscaping, such as native wildflower meadows, perennial gardens, or ornamental woodlands. Lawns are usually maintained with motorized lawn mowers and leaf-blowers, which contribute to air and noise pollution. Wildflower meadows will not only help to support native animals, but their maintenance requires less mowing, and thus produces fewer carbon emissions to the atmosphere. Use of native species in ornamental plantings is important, as native ornamental shrubs tend

to support many times the number of native invertebrates and birds that non-native ornamentals do (Tallamy 2007), and some non-native ornamentals are aggressive invasives that threaten nearby habitats. While the choice to maintain lawns in residential areas is often one of personal taste or safety, public education and landowner incentives can promote native plant landscaping that provides higher quality resources for wildlife while reducing water, air, and noise pollution in developed areas.

3. ***Manage constructed ponds (such as stormwater control ponds and ornamental ponds) for wildlife.***
    - Avoid or minimize the use of pesticides and fertilizers in and near ponds.
    - Plant or maintain shoreline vegetation.
    - Add small, gently sloping, vegetated islands to large ponds (> 5 ac [2 ha]).
    - Encourage a combination of emergent vegetation and open water (i.e., interspersed shallow and deep areas).
    - Include irregular shorelines, gently sloped shores, and the capability for controlling water levels in the design of new ponds.

4. ***Restore natural stream buffers wherever possible.*** Vegetated streambanks and floodplains help to prevent erosion, moderate flooding, and protect water quality. They enhance the habitat quality of the stream and in some cases its recreational value. They also allow for natural movements of the stream channel over time, which improves the stream's capacity to dissipate the energy of water flow. (See the Streams and Riparian Corridors priority habitat section above).

5. ***Maximize onsite infiltration of rainwater and snowmelt.*** Impervious surfaces such as pavement and roofs alter hydrological patterns by preventing precipitation from infiltrating the soil, and instead promote rapid overland flow to ditches, streams, and ponds. This prevents the recharge of groundwater and the filtration of pollutants by soil and vegetation, while increasing the likelihood of flooding, stream bank erosion, and surface water pollution (including sedimentation).
    - Encourage the use of pervious driveway materials in residential and commercial construction and renovation.
    - Construct stormwater retention ponds, wetlands, and rain gardens that allow infiltration of surface water to groundwater.

- Follow stormwater Best Management Practices (BMPs) in areas of new construction. Examples of BMPs include preserving natural vegetation and installing and maintaining soil retention structures, check dams, soil traps, and silt fences. A New York State Stormwater Management Design Manual can be found on the NYS DEC website (https://www.dec.ny.gov/chemical/29072.html).
- Encourage the collection of rainwater for use in gardens and lawn areas.

Oyster mushrooms on a sugar maple log

MINIMIZING DISTURBANCE TO RESIDENT AND MIGRATORY BIOTA

1. ***Minimize the impacts of roads on wildlife.*** One of the greatest immediate threats to wildlife in settled areas is road mortality. A study to identify roadways with the highest incidence of wildlife mortality could be used to direct the following measures to the places where they will be most effective. The maps of conservation zones in this report could also inform such efforts. (For example, roads within conservation zones for intermittent woodland pools could be priorities for facilitating amphibian crossings.)
    - Reduce speed limits and post wildlife crossing signs along road segments where wildlife crossings are concentrated.
    - Install structures for safe wildlife crossing, such as culverts, overpasses, underpasses, and modified roadside curbs. Design such passageways to accommodate the largest possible number of species. Information about wildlife crossings is provided online by agencies such as the U.S. Department of Agriculture and U.S. Department of Transportation.
    - Modify the immediate roadside areas to promote safer wildlife crossings. Factors to be considered include the location of barriers such as guardrails, type of roadside vegetation, and distance of vegetation to the road's edge (Barnum 2003, Clevenger et al 2003).

2. ***Minimize noise and light pollution.*** High levels of noise and light in residential areas can be a deterrent to many wildlife species. While some noise and light are inevitable in settled environments, certain sources can be minimized. Below are examples of measures that could be incorporated into municipal codes to help reduce harm to wildlife from noise and light pollution.
    - Require that outdoor lights be directed downward (rather than outward or upward) to minimize light pollution in offsite and overhead areas.
    - Encourage the use of light technologies (such as low-pressure sodium lights) that minimize the attraction of flying insects, and prohibit the use of "bug-zappers."
    - Prohibit the use of fireworks to minimize wildlife disturbance.

3. ***Discourage human-subsidized predators.*** Human-sponsored predators are species such as raccoon, opossum, and striped skunk, whose populations often burgeon in response to conditions created by humans. These species are serious predators on bird eggs and nestlings, turtle eggs, and other wildlife. Domestic cats and dogs can be similarly

disruptive to native wildlife. In addition, human interference with the habits and diets of wild animals affects population dynamics and can lead to nuisance behavior.

- Properly secure trash receptacles and compost piles.
- Feed pets indoors, and do not intentionally feed wildlife.
- Supervise cats and dogs when they are outdoors, and keep cats indoors if possible.

4. ***Include biodiversity considerations in development planning.***

- Plan for lower-disturbance human activities/developments adjacent to intact habitats, and establish undisturbed buffer zones outside of sensitive habitat areas.
- Consider wildlife travel routes in the placement of developments and buildings.
- Fence, fill in, or cover pitfall hazards such as window wells, soil test pits, and in-ground pools that can trap small mammals, amphibians, and reptiles.
- In critical habitat areas, identify potential barriers to wildlife movement, such as stone walls or chain-link fences (excluding those designed to prevent access to pitfalls), and design or modify them to have spaces or openings to allow safe passage.
- Encourage building designs that minimize harm to wildlife. For example, consult New York City Audubon's publication "Bird-Safe Building Guidelines" (Brown and Caputo 2007) when planning building construction and renovation.

CONCLUSION

Pound Ridge is home to an impressive diversity of high-quality, large habitat patches and unusual habitat types. The WPRR holds a 2,000+-ac (800+-ha) upland forest block, and three other forest patches exceeding 400 ac (160 ha). On the WPRR plateau and elsewhere throughout town, crest, ledge, and talus habitat is extensive, and numerous rocky barrens dot the landscape. Intermittent woodland pools and pool-like swamps are myriad, and in one location form an intact complex of 35 pools. Over the town's marble bedrock, rare habitats such as fens and calcareous crest, ledge, talus are present and in some cases of high quality. Numerous large, intact wetland complexes, many surrounded by upland forest, feed the town's network of intermittent and perennial streams.

There are significant opportunities for biodiversity conservation throughout the Town of Pound Ridge, but the "habitat approach" to conservation is quite different from the traditional parcel-by-parcel approach to land-use decision making. It requires examining the landscape beyond the boundaries of any particular land parcel, and considering the size and juxtaposition of habitats in the landscape, the kinds of biological communities and species they support, and the ecological processes that help to maintain those habitats and species.

The map accompanying this report shows the location and extent of remaining unfragmented habitat blocks and areas where uncommon and rare habitats occur. This kind of general information can help the town consider where future development should be concentrated and where future conservation efforts should be targeted. An understanding of the significant ecological resources in the town will enable local decision- makers to focus limited conservation resources where they will have the greatest impact.

At the site-specific scale, we hope the map will be used as a resource for routine deliberations over development proposals and other proposed land-use changes. The map and report provide an independent body of information for environmental reviews, and will help raise questions about important biological resources that might otherwise be overlooked. We strongly emphasize, however, that the map has not been exhaustively field verified and should therefore be used only as a source of general information. In an area proposed for development, for

example, the habitat map can provide basic ecological information about the site and the surrounding lands, but should not be considered a substitute for site visits by qualified professionals. During site visits, the presence and boundaries of important habitats should be verified, changes that have occurred since our mapping should be noted, and additional ecological values should be assessed. Based on this information, decisions can be made about the need for rare species surveys or other assessments of biological resources. Detailed, up-to-date ecological information is essential to making informed decisions about specific development proposals.

After presenting the completed habitat map, database, and report to the Town of Pound Ridge, Hudsonia hopes to assist town officials, landowners, and other interested individuals and groups in interpreting the map, understanding the ecological resources of the town, and devising ways to integrate this new information into land-use planning and decision making.

Conservation of habitats is one of the best ways to protect biological and water resources. We hope that the information contained in the habitat map and in this report will help the Town of Pound Ridge plan wisely for future development while taking steps to protect biological resources. Incorporating this approach into planning and decision making will help to minimize the adverse effects of human activities on the landscape, integrate the needs of the human community with those of natural communities, and protect the ecological patterns and processes that support us and the rest of the living world.

REFERENCES CITED

Adams, L.W. 1994. Urban wildlife habitats. University of Minnesota Press, Minneapolis, MN.

Adams, L.W. and L.E. Dove. 1989. Wildlife reserves and corridors in the urban environment. National Institute for Urban Wildlife, Columbia, MD.

Aerts, R. and F. Berendse. 1988. The effect of increased nutrient availability on vegetation dynamics in wet heathlands. Vegetatio 76:63-69.

Ambuel, G. and S.A. Temple. 1983. Songbird populations in southern Wisconsin forests: 1954 and 1979. Journal of Field Ornithology 53:149-158.

Askins, R.A. 1993. Population trends in grassland, shrubland, and forest birds in eastern North America. Current Ornithology 11:1-34.

Askins, R.A., B. Zuckerberg, and L. Novak. 2007. Do the size and landscape context of forest openings influence the abundance and breeding success of shrubland songbirds in southern New England? Forest Ecology and Management 250:137-147.

Bailey, J.A. and M.M. Alexander. 1960. Use of closed conifer plantations by wildlife. New York Fish and Game Journal 7(2):130-148.

Barnum, S.A. 2003. Identifying the best locations along highways to provide safe crossing opportunities for wildlife: A handbook for highway planners and designers. Colorado Department of Transportation report # CDOT-DTD-UCD-2003-9. 69 p.

Beatley, T. 2000. Green urbanism. Island Press, Washington, DC. 491 p.

Bednarz, J.C. and J.J. Dinsmore. 1982. Nest sites and habitat of red-shouldered and red-tailed hawks in Iowa. Wilson Bulletin 94(1):31-45.

Bell, K., C. Dickert, J. Tollefson, and G. Stevens. 2005. Significant habitats in the Town of Stanford, Dutchess County, New York. Report to the Millbrook Tribute Garden, the Dyson Foundation, the Town of Stanford, and the Dutchess Land Conservancy. Hudsonia Ltd., Annandale, NY. 123 p.

Billings, G. 1990. Birds of prey in Connecticut. Rainbow Press, Torrington, CT. 461 p.

Blouin-Demers, G. and P. J. Weatherhead. 2002. Implications of movement patterns for gene flow in black ratsnakes (*Elaphe obsoleta*). Canadian Journal of Zoology 80:1162-1172.

Bormann, F.H., G.E. Likens, and J.S. Eaton. 1969. Biotic regulation of particulate and solution losses from a forest ecosystem. BioScience 19:600-610.

Bormann, F.H., G.E. Likens, T.G. Siccama, R.S. Pierce, and J.S. Eaton. 1974. The export of nutrients and recovery of stable conditions following deforestation at Hubbard Brook. Ecological Monographs 44(3):255-277.

Brown, H. and S. Caputo. 2007. Bird-safe building guidelines. New York City Audubon Society, Inc., New York. 59 p.

Brown, R. and G. Harris. 2005. Comanagement of wildlife corridors: The case for citizen participation in the Algonquin to Adirondack proposal. Journal of Environmental Management 74: 97-106.

Buech, R., L.G. Hanson, and M.D. Nelson. 1997. Identification of wood turtle nesting areas for protection and management. In J. Van Abbema, ed., Proceedings: Conservation, Restoration, and Management of Tortoises and Turtles—An International Conference. New York Turtle and Tortoise Society and the WCS Turtle Recovery Program. New York.

Cadwell, D.H, G.G. Connally, R.J. Dineen, P.J. Fleisher, M.L. Fuller, L. Sirkin, and G.C. Wiles. 1989. Surficial geologic map of New York (Lower Hudson sheet). Map and Chart Series 40, 1:250,000, 100 ft. contour. New York State Museum, Albany.

Calhoun, A.J.K. and P. DeMaynadier. 2004. Forestry habitat management guidelines for vernal pool wildlife. Metropolitan Conservation Alliance Technical Paper No. 6. Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, NY. 32 p.

Calhoun, A.J.K. and M.W. Klemens. 2002. Best development practices: Conserving pool-breeding amphibians in residential and commercial developments in the northeastern United States. MCA Technical Paper No. 5, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, NY. 57 p.

Carroll, T.E. and D.H. Ehrenfeld. 1978. Intermediate-range homing in the wood turtle, *Clemmys insculpta*. Copeia 978:117-126.

Clevenger, A.P., B. Chruszcz, and K.E. Gunson. 2003. Spatial patterns and factors influencing small vertebrate fauna road-kill aggregations. Biological Conservation 109:15-26.

Crocoll, S.T. 1994. Red-shouldered hawk (*Buteo lineatus*). In A. Poole and F. Gill, eds. The Birds of North America, No. 107. Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC.

Davies, K.F., C. Gascon, and C. Margules. 2001. Habitat fragmentation: Consequences, management, and future research priorities. P. 81-98 in M.E. Soule and G.H. Orians, eds., Conservation Biology: Research Priorities for the Next Decade. Island Press, Washington, DC.

Debinski, D. and R. Holt. 2000. A survey and overview of habitat fragmentation experiments. Conservation Biology 14(2): 342-355.

Deppen, J., N. Tabak, G. Stevens, and K. Bell. 2009. Significant habitats in the Town of Beekman, Dutchess County, New York. Report to the Town of Beekman. Hudsonia Ltd., Annandale, NY. 151 p.

Drexler, J.Z. and B.L. Bedford. 2002. Pathways of nutrient loading and impacts on plant diversity in a New York peatland. Wetlands 22:263-281.

Edinger, G.J., D.J. Evans, S. Gebauer, T.G. Howard, D.M. Hunt, and A.M. Olivero (eds). 2002. Ecological communities of New York State. Second Edition. A revised and expanded edition of Reschke (1990) (Draft for review). New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany.

Environmental Law Institute. 2003. Conservation thresholds for land-use planners. Environmental Law Institute, Washington, DC. 55 p.

Environmental Systems Research Institute, Inc. 2018. ArcView 10.6 GIS software. Redlands, CA.

Environmental Systems Research Institute, Inc. 2017. ArcView 10.5 GIS software. Redlands, CA.

Fahrig, L., J.H. Pedlar, S.E. Pope, P.D. Taylor, and J.F. Wegner. 1995. Effect of road traffic on amphibian density. Biological Conservation 73: 177-182.

Findlay, C.S. and J. Bourdages. 2000. Response time of wetland biodiversity to road

construction on adjacent lands. Conservation Biology 14(1):86-94.

Fisher, D.W., Y.W. Isachsen, and L.V. Rickard. 1970. Geologic map of New York (Lower Hudson Sheet). Map and Chart Series 15. 1:250,000, 100 ft. contour. New York State Museum and Science Service, Albany.

Fitch, H.S. 1960. Autecology of the copperhead. University of Kansas publication. Museum of Natural History 13:85-288.

Forman, R.T.T. and R.D. Deblinger. 2000. The ecological road-effect zone of a Massachusetts (U.S.A.) suburban highway. Conservation Biology 14(1):36-46.

Foscarini, D.A. and R.J. Brooks. 1997. A proposal to standardize data collection and implications for management of the wood turtle, *Clemmys insculpta*, and other freshwater turtles in Ontario, Canada. In J. Van Abbema, ed., Proceedings: Conservation, Restoration, and Management of Tortoises and Turtles—An International Conference. New York Turtle and Tortoise Society and the WCS Turtle Recovery Program. New York.

Fowle, S.C. 2001. Priority sites and proposed reserve boundaries for protection of rare herpetofauna in Massachusetts. Report to the Massachusetts Department of Environmental Protection. Westborough, MA. 107 p.

Gibbons, J.W. 2003. Terrestrial habitat: A vital component for herpetofauna of isolated wetlands. Wetlands 23(3):630-635.

Godin, A.J. 1977. Wild mammals of New England. Johns Hopkins University Press, Baltimore. 304 p.

Graham, C., K..B. Travis, and G. Stevens. 2012. Significant habitats in the Town of Clinton, Dutchess County, New York. Report to the Town of Clinton, the Hudson River Estuary Program, the Millbrook Tribute Garden, and the Dutchess Land Conservancy. Hudsonia Ltd., Annandale, NY. 171 p.

Gremaud, P. 1977. The ecology of the invertebrates of three Hudson Valley brooklets. Senior project, Bard College, Annandale, NY. 61 p.

Haeckel, I., O. Vazquez-Dominguez, and G. Stevens. 2012. Significant habitats in the Town of Woodstock, Ulster County, New York. Report to Town of Woodstock, the New York State Department of Environmental Conservation, the Ashokan Watershed Stream Management Program, and the Catskill Watershed Corporation. Hudsonia Ltd., Annandale, NY. 142 p.

Harding, J.H. and T.J. Bloomer. 1979. The wood turtle (*Clemmys insculpta*): A natural history. Bulletin of the New York Herpetological Society 15(1):9-26.

Heady, L.T. and E. Kiviat. 2000. Grass carp and aquatic weeds: Treating the symptom instead of the cause. News from Hudsonia 15(1):1-3.

Hill, N.P. and J.M. Hagan. 1991. Population trends of some northeastern North American landbirds: A half-century of data. Wilson Bulletin 103(2):165-182.

Holthuijzen, A.M.A. and T.L. Sharik. 1984. Seed longevity and mechanisms of regeneration of eastern red cedar (*Juniperus virginiana* L.). Bulletin of the Torrey Botanical Club 111(2):153-158.

Howard, T. and M. Schlesinger. 2013. Wildlife habitat connectivity in the changing climate of New York's Hudson Valley. Annals of the New York Academy of Sciences 1298: 103-119.

Johnson, V.S., J.A. Litvaitis, T.D. Lee, and S.D. Frey. 2006. The role of spatial and temporal scale in colonization and spread of invasive shrubs in early successional habitats. Forest Ecology and Management 228:124-134.

Joyal, L.A., M. McCollough, and M.L. Hunter, Jr. 2001. Landscape ecology approaches to wetland species conservation: A case study of two turtle species in southern Maine. Conservation Biology 15:1755-1762.

Kaufmann, J.H. 1992. Habitat use by wood turtles in central Pennsylvania. Journal of Herpetology 26(3):315-321.

Kiviat, E. 2009. Non-target impacts of herbicides. News for Hudsonia 23(1):1-3.

Kiviat, E. and G. Stevens. 2001. Biodiversity assessment manual for the Hudson River estuary corridor. New York State Department of Environmental Conservation, Albany. 508 p.

Kiviat, E. and N. Zeising, 1976. The wetland flora of Thompson Pond, New York. In P.S. Busch ed. The Ecology of Thompson Pond in Dutchess County, New York. The Nature Conservancy, Boston.

Klemens, M.W. 1993. Amphibians and reptiles of Connecticut and adjacent regions. State Geological and Natural History Survey of Connecticut, Bulletin 112, Hartford.

Knab-Vispo, C., K. Bell, and G. Stevens. 2008. Significant habitats in the Town of North East, Dutchess County, New York. Report to the Town of North East, the Millbrook Tribute Garden, the Dyson Foundation and the Dutchess Land Conservancy. Hudsonia Ltd., Red Hook, NY. 150 p.

LaBruna, D.T., and M. W. Klemens. 2007. Eastern Westchester Biotic Corridor: Bedford Addendum. MCA Technical Paper No. 4-A, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, NY.

Lampila, P., M. Monkkonen, and A. Desrochers. 2005. Demographic responses by birds to forest fragmentation. Conservation Biology 19(5):1537-1546.

Lehtinen, R.M., S.M. Galatowitsch, and J.R. Tester. 1999. Consequences of habitat loss and fragmentation for wetland amphibian assemblages. Wetlands 19:1-12.

Likens, G.E., F.H. Bormann, N.M. Johnson, D.W. Fisher, and R.S. Pierce. 1970. Effects of forest cutting and herbicide treatment on nutrient budgets in the Hubbard Brook watershed-ecosystem. Ecological Monographs 40(1):23-47.

Lowe, W.H. and G.E. Likens. 2005. Moving headwater streams to the head of the class. BioScience 55(3):196-197.

Lundgren, M.R., C.J. Small, and G.D. Dreyer. 2004. Influence of land use and site characteristics on invasive plant abundance in the Quinebaug Highlands of southern New England. Northeastern Naturalist 11:313-332.

Madison, D.M. 1997. The emigration of radio-implanted spotted salamanders, *Ambystoma maculatum*. Journal of Herpetology 31:542-552.

Marchand, M.N. and J.A. Litvaitis. 2004. Effects of habitat features and landscape composition on the population structure of a common aquatic turtle in a region undergoing rapid development. Conservation Biology 18(3):758-767.

McClure M.S. 1991. Density-dependent feedback and population-cycles in *Adelges tsugae* (Homoptera, Adelgidae) on *Tsuga canadensis*. Environmental Entomology 20:258–264. (Originial not seen; cited in Paradis et al. 2008.)

McKinney, R.A. and P.W.C. Paton. 2009. Breeding birds associated with seasonal pools in the northeastern United States. Journal of Field Ornithology 80:380-386.

Merritt, J.F. 1987. Guide to mammals of Pennsylvania. University of Pittsburgh Press, Pittsburgh. 408 p.

Metropolitan Conservation Alliance. 2002. Conservation overlay district: A model local law. Technical Paper Series, No. 3. Wildlife Conservation Society, Bronx, NY. 46 p.

Meyer, J.L., D.L. Strayer, J.B. Wallace, S.L. Eggert, G.S. Helfman, and N.E. Leonard. 2007. The contribution of headwater streams to biodiversity in river networks. Journal of the American Water Resources Association 43(1):86-103.

Milam, J.C. and S.M. Melvin. 2001. Density, habitat use, movements, and conservation of spotted turtles (*Clemmys guttata*) in Massachusetts. Journal of Herpetology 35(3):418-427.

Miller, N.A. and M.W. Klemens. 2002. Eastern Westchester Biotic Corridor. MCA Technical Paper No. 4, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York.

Morelli, T., C. Daly, S. Dobrowski, D. Dulen, J. Ebersole, S. Jackson, J. Lundquist, C. Millar, S. Maher, W. Monahan, K. Nydick, K. Redmond, S. Sawyer, S. Stock, and S. Beissinger. 2016. Managing climate change refugia for climate adaptation. PLoS ONE 11(8): e0159909. doi:10.1371/journal. pone.0159909.

Morley,T.R. and A.J.K. Calhoun. 2009. Vegetation characteristics of forested hillside seeps in eastern Maine, USA. Journal of the Torrey Botanical Society 136:520-531.

Murcia, C. 1995. Edge effects in fragmented forests: Implications for conservation. Trends in Ecology and Evolution 10:58-62.

New York Natural Heritage Program (NYNHP). 2018. Rare species database.

New York State Department of Environmental Conservation and New York State Department of State. 2004. Local open space planning guide. New York State Department of Environmental Conservation, NewYork State Department of State, Hudson Valley Greenway, New York State Department of Agriculture and Markets, and New York State Office of Parks, Recreation, and Historic Preservation. Albany. 64 p.

NewYork State Department of Environmental Conservation. 2018. Emerald ash borer. Accessed 08/22/2018. http://www.dec.ny.gov/animals/7253.html

NewYork State Department of Environmental Conservation. 2017. Asian long-horned beetle. Accessed 08/22/2018. http://www.dec.ny.gov/docs/lands_forests_pdf/albfactsheet.pdf

NewYork State Department of Environmental Conservation. 2012. Firewood and Invasive Pests. Accessed 08/22/2018. http://www.dec.ny.gov/animals/28722.html

National Invasive Species Information Center. 2018. Species profiles: Asian long-horned beetle. Accessed 08/22/2018. https://www.invasivespeciesinfo.gov/animals/asianbeetle.shtml

Panno, S.V., V.A. Nuzzo, K. Cartwright, B.R. Hensel, and I.G. Krapac. 1999. Impact of urban development on the chemical composition of ground water in a fen-wetland complex. Wetlands 19:236-245.

Parsons, T. and G. Lovett. 1993. Effects of land use on the chemistry of Hudson River tributaries. In J.R. Waldman and E.A. Blair, eds., Final Reports of the Tibor T. Polgar Fellowship Program, 1991. Hudson River Foundation, New York.

Penhollow, M.E., P.G. Jensen, and L.A. Zucker. 2006. Wildlife and habitat conservation framework: An approach for conserving biodiversity in the Hudson River Estuary Corridor. New York Cooperative Fish and Wildlife Research Unit, Cornell University and New York State Department of Environmental Conservation, Hudson River Estuary Program, Ithaca, NY. 139 p.

Rosenberg, K.V., J. A. Kennedy, R. Dettmers, R. P. Ford, D. Reynolds, J.D. Alexander, C. J. Beardmore, P. J. Blancher, R. E. Bogart, G. S. Butcher, A. F. Camfield, A. Couturier, D. W. Demarest, W. E. Easton, J.J. Giocomo, R.H. Keller, A. E. Mini, A. O. Panjabi, D. N. Pashley, T. D. Rich, J. M. Ruth, H. Stabins, J. Stanton, T. Will. 2016. Partners in Flight Landbird Conservation Plan: 2016 Revision for Canada and Continental United States. Partners in Flight Science Committee. Cornell Lab of Ornithology, Ithaca, NY. 119 p.

Richburg, J.A., W.A. Patterson III, and F. Lowenstein. 2001. Effects of road salt and *Phragmites australis* invasion on the vegetation of a western Massachusetts calcareous lake-basin fen. Wetlands 21:247-255.

Ricketts, T. 2001. The matrix matters: Effective isolation in fragmented landscapes. The American Naturalist 158(1): 87-99.

Robbins, C.S. 1979. Effect of forest fragmentation on bird populations. P. 198-212 in R.M. DeGraaf and K.E. Evans, eds., Management of North-Central and Northeastern Forests for Nongame Birds, General Technical Report NC-51, USDA Forest Service, North Central Forest Experimental Station, St. Paul, MN.

Robbins, C.S. 1980. Effect of forest fragmentation on breeding bird populations in the Piedmont of the Mid-Atlantic region. Atlantic Naturalist 33:31-36.

Robbins, C. S., D. K. Dawson, and B. A. Dowell. 1989. Habitat requirements of breeding forest birds of the middle Atlantic states. Wildlife Monographs 103:1-34.

Rosenberg, K.V., R.W. Rohrbaugh, Jr., S.E. Barker, R.S. Hames, J.D. Lowe, and A.A. Dhondt. 1999. A land manager's guide to improving habitat for scarlet tanagers and other forest-interior birds. Cornell Lab of Ornithology, Ithaca, NY. 24 p.

Rosenberg, K.V., S.E. Barker, and R.W. Rohrbaugh. 2000. An atlas of cerulean warbler populations: Final report to USFWS 1997-2000 breeding seasons. Cornell Lab of Ornithology, Ithaca, NY.

Rosenberg, K.V., R.S. Hames, R.W. Rohrbaugh, Jr., S.B. Swarthout, J.D. Lowe, and A.A. Dhondt. 2003. A land manager's guide to improving habitat for forest thrushes. Cornell Lab of Ornithology, Ithaca, NY. 32 p.

Rothermel, B.B. and R.D. Semlitsch. 2002. An experimental investigation of landscape resistance of forest versus old-field habitats to emigrating juvenile amphibians. Conservation Biology 16(5):1324-1332.

Saunders, D.L., J.J. Meeuwig, and A.C.J. Vincent. 2002. Freshwater protected areas: Strategies for conservation. Conservation Biology 16(1):30-41.

Saura, S., O. Bodin, and M. Fortin. 2014. Stepping stones are crucial for species long-distance dispersal and range expansion through habitat networks. Journal of Applied Ecology 51: 171-182.

Schlossberg, S. and D.I. King. 2008. Are shrubland birds edge specialists? Ecological Applications 18:1325-1330.

Semlitsch, R.D. 1998. Biological delineation of terrestrial buffer zones for pond-breeding salamanders. Conservation Biology 12:1112-1119.

Semlitsch, R.D. 2000. Size does matter: The value of small isolated wetlands. National Wetlands Newsletter 22(1):5-6,13.

Semlitsch, R.D. and J.R. Bodie. 1998. Are small, isolated wetlands expendable? Conservation Biology 12(5):1129-1133.

Shake, C.S., C.E. Moorman, J.D. Riddle, and M.R. Burchell II. 2012. Influence of patch size and shape on occupancy by shrubland birds. The Condor 114:268-278.

Seifried, S.T. 1994. Soil survey of Putnam and Westchester Counties, New York. Natural Resources Conservation Serice, US Department of Agriculture. 205 p. + maps.

Smith, D.G. 1988. Keys to the freshwater macroinvertebrates of Massachusetts (No. 3): Crustacea Malacostraca (crayfish, isopods, amphipods). Report to Massachusetts Division of Water Pollution Control, Executive Office

of Environmental Affairs, Department of Environmental Quality Engineering, and Division of Water Pollution Control. Boston. 53 p.

Stevens, G. and E. Broadbent. 2002. Significant habitats of the Town of East Fishkill, Dutchess County, New York. Report to the Marilyn Milton Simpson Charitable Trusts and the Town of East Fishkill. Hudsonia Ltd., Annandale, NY. 56 p.

Strong, K. 2008. Conserving natural areas and wildlife in your community: Smart growth strategies for protecting the biological diversity of New York's Hudson River Valley. New York Cooperative Fish and Wildlife Research Unit, Cornell University, and New York State Department of Environmental Conservation, Hudson River Estuary Program, Ithaca, NY. 101 p.

Tabak, N., K. Bell, and G. Stevens. 2006. Significant habitats in the Town of Amenia, Dutchess County, New York. Report to the Town of Amenia, the Dyson Foundation, and the Dutchess Land Conservancy. Hudsonia Ltd., Annandale, NY. 133 p.

Tallamy, D.W. 2007. Bringing nature home: How native plants sustain wildlife in our gardens. Timber Press, Portland, OR. 288 p.

Thompson, J. E. and T. J. Sarro. 2008. Forest change in the Mohonk Preserve: A resurvey of two vegetation studies. Prepared for the Shawangunk Ridge Biodiversity Partnership. Mohonk Preserve, New Paltz, NY. 29 p.

Tingley, R., D.G. McCurdy, M.D. Pulsifer, and T.B. Herman. 2009. Spatio-temporal differences in the use of agrigultural fields by male and female wood turtles (*Glyptemys insculpta*) inhabiting an agri-forest mosaic. Herpetological Conservation and Biology 4:185-190.

Todd, C. S. 2000. Northern black racer assessment. Maine Department of Inland Fisheries and Wildlife, Augusta. 43 p.

Trombulak, S.C. and C.A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14(1):18-30.

Veysey, J.S., S.D. Mattfeldt, and K.J. Babbitt. 2011. Comparative influence of isolation, landscape, and wetland characteristics on egg-mass abundance of two pool-breeding amphibian species. Landscape Ecology 26(5): 661-672.

Vispo, C. and C. Knab-Vispo. 2012. Profiles of on-farm creatures in Columbia County, NY: The effects of nature on farm production; the effect of farm use on nature. Hawthorne Valley Farmscape Ecology Program, Ghent, NY. 39 p.

Walther, G., E. Post, P. Convey, A. Menzel, C. Parmesan, T. Beebee, J. Fromentin, O. Hoegh-Guldberg, and F. Bairlein. 2002. Ecological responses to recent climate change. Nature 416: 389-395.

Weldy, Troy and David Werier. 2018. 2018 New York Flora Atlas. New York Flora Association, Albany, NY. Available from: http://newyork.plantatlas.usf.edu/Default.aspx. Accessed 22 August 2018.

Wiens, J.A. 1969. An approach to the study of ecological relationships among grassland birds. Ornithological Monographs 8. 93 p.

Wilcove, D.S. 1985. Nest predation in forest tracts and the decline of migratory songbirds. Ecology 66(4):1211-1214.

Wilder, A. and E. Kiviat. 2008. The functions and importance of forests, with applications to the Croton and Catskill/Deleware watersheds of New York. Report to the Croton Watershed Clean Water Coalition. Hudsonia Ltd., Annandale, NY. 17 p.

APPENDICES

Appendix A. Mapping conventions for defining and delineating habitat types.

Buttonbush pool. These are fairly deep-flooding, isolated from perennial streams, and have a shrub-dominated flora with buttonbush normally the dominant plant.

Crest, ledge, and talus. Because crest, ledge, and talus habitats are usually embedded within other habitat types (most commonly upland forest), we depicted them as an overlay on the base habitat map. Except for the most exposed ledges, these habitats have no distinct signatures on aerial photographs and were therefore mapped based on a combination of field observations and inference based on topographic and soils signature. The final overlay of crest, ledge, and talus habitats is therefore an approximation; we expect that there are additional bedrock exposures outside the mapped areas. The precise locations and boundaries of these habitats should be determined in the field as needed. The distinction between calcareous and non-calcareous crest, ledge, and talus habitats can only be made in the field. Rocky areas not known to be calcareous (i.e., of both non-calcareous and unknown bedrock) were mapped simply as "crest, ledge, and talus."

Cultural. We define "cultural" habitats as areas that are significantly altered and intensively managed (e.g., mowed) but not otherwise developed with wide pavement or structures. These include playing fields, cemeteries, large gardens, and large lawns, if surrounded by developed areas on fewer than three sides. It was sometimes difficult to distinguish extensive lawns from upland meadows using aerial photos, so in the absence of field verification some large lawns may have been mapped as upland meadow.

Developed area. Habitats surrounded by or intruding into developed land (buildings, paved and gravel roads, lawns, and parking areas) were identified as ecologically significant and mapped only if their dimensions exceeded 50 m (165 ft) in all directions, or if they seemed to provide important connections to other large habitat areas. Exceptions to this protocol were wetlands within developed areas. Even though such wetlands may lack many of the habitat values of wetlands in more natural settings, they still may serve as important drought refuges for rare species and other species of conservation concern. Lawns near buildings and roads were mapped as developed; large lawns adjacent to significant habitats were mapped as "cultural" habitats.

Fens. Fens are distinguished by their distinctive plant communities and the frequent presence of small rivulets. They are most likely to occur over calcareous bedrock. Fens are only identifiable in the field, though suspected fens may be identified from aerial photographs.

Intermittent woodland pool and pool-like swamp. Intermittent woodland pools are generally recognizable throughout the year (except under deep snow cover), but are most obvious in the spring when the pools are full of water and occupied by invertebrates and breeding amphibians. For those intermittent woodland pools we visited in late summer and fall, we relied on general physical features of the site to distinguish them from isolated swamps. We classified hydrologically isolated wetlands with an open basin as intermittent woodland pools and those dominated by trees or shrubs as pool-like swamps (a subcategory of swamps), but the two often

serve similar ecological functions. A few wetlands that had only an ephemeral (very brief and minor) stream connection to water bodies were classified as isolated pools, as they may be free of fish in many years. Many intermittent woodland pools can also be mapped remotely since they have a distinct signature on aerial photographs and are readily visible within areas of deciduous forest on photographs taken in a leaf-off season. Intermittent woodland pools located within areas of conifer forest, however, are not easily identified on aerial photographs, and we may have missed some of these in areas we were unable to visit.

Open water and constructed pond. We distinguish between the habitat categories "open water" and "constructed pond" based mostly on the degree to which the water body and its shorelines are managed. Most small to medium open water bodies in our region were probably created by damming or excavation and were mapped as constructed ponds because of shoreline development and/or likely management. Those that we mapped as "open water" habitats included large, substantially unvegetated pools within marshes and swamps and artificial ponds and reservoirs that are now surrounded by unmanaged vegetation.

Springs & seeps. Springs and seeps are difficult to identify by remote sensing. We mapped only those we happened to see in the field and the few that were either identified on soils maps or had an identifiable signature on topographic maps or aerial photographs. We expect there were many more springs and seeps in the Town of Pound Ridge that we did not map. The presence of most seeps and springs must be determined by site visits. Seeps were mapped as an overlay atop other habitats, either upland or wetland (based on vegetation).

Streams. We created a stream map in our GIS that was based on field observations and interpretation of topographic maps and aerial photographs. We depicted streams as continuous where they flowed through ponds, impoundments, or large wetlands, and when they flowed underground for relatively short distances (e.g., under roads or small developed areas). We expect there were additional intermittent streams that we did not map, and we recommend these be added to the database as information becomes available. Because it was often difficult to distinguish between perennial and intermittent streams based on aerial photograph and map interpretation, these distinctions were made using our best judgment. Streams that were channelized or diverted by humans (i.e., ditches) were mapped when observed in the field or on aerial photos; we mapped ditches as "streams" because they function as such from a hydrological perspective.

Upland forest. We mapped just three types of upland forests: hardwood, mixed, and conifer forest. Although these forests are extremely variable in species composition, size and age of trees, vegetation structure, soil drainage and texture, and other factors, we used these broad categories for practical reasons. Hardwood and coniferous trees are generally distinguishable in aerial photos taken in the spring, although dead and deciduous conifers can be mistaken for hardwoods. Different forest communities and ages are not easily distinguished on aerial photographs, however, and we could not consistently and accurately separate forests according to dominant tree species or size of overstory trees. Our "upland forest" types include non-wetland forests of all ages, at all elevations, and of all species mixtures. Grass and dirt roads within forest (where identifiable) were mapped as boundaries of adjacent forested habitat areas, since they can be significant fragmenting features.

Upland meadow and upland shrubland. We mapped upland meadows divided by fences, tree-lines, and hedgerows as separate polygons (to the extent that these features were visible on aerial photographs or observed in the field), because such dividing features can serve as perching sites for birds of prey and shelter for other predators that reduce success rates of grassland-breeding bird species. Because oldfields often have a substantial shrub component, the distinction between upland meadows and upland shrubland habitats is somewhat arbitrary. We defined upland shrubland habitats as those with widely distributed shrubs that accounted for more than 20% of the cover.

Wetland. We mapped wetlands remotely using topographic maps, soils data, and aerial photographs. In the field, we identified wetlands primarily by the predominance of hydrophytic vegetation and easily visible indicators of surface hydrology (Environmental Laboratory 1987). We did not examine soil profiles. All wetland boundaries on the habitat map should be treated as approximations, and should not be used for jurisdictional determinations. Wherever the actual locations of wetland boundaries are needed to determine jurisdictional limits, the boundaries must be identified in the field by a wetland scientist and mapped by a land surveyor. We attempted to map all wetlands in the study area tracts, including those that were isolated from other habitats by development.

Appendix B. Explanation of ranks of species of conservation concern listed in Appendix C. Explanations of New York State ranks and New York Natural Heritage Program ranks are from the New York Natural Heritage Program and New York State Department of Environmental Conservation websites, accessed in August 2018.

NEW YORK STATE RANKS

For animals, categories of Endangered and Threatened species are defined in New York State Environmental Conservation Law section 11-0535. Endangered, Threatened, and Special Concern species are listed in regulation 6NYCRR 182.5. For plants, the Endangered, Threatened, and Rare categories are defined in regulation 6NYCRR 193.3 and apply to New York State Environmental Conservation Law section 9-1503.

ANIMALS

E **Endangered Species**. Any species that meet one or both of the following criteria: 1) Any native species in imminent danger of extirpation; 2) Any species listed as endangered by the US Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

T **Threatened Species**. Any species that meet one or both of the following criteria: 1) Any native species likely to become an endangered species within the foreseeable future in New York; 2) Any species listed as threatened by the US Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

SC **Special Concern Species**. Those species that are not yet recognized as Endangered or Threatened, but for which documented concern exists for their continued welfare in New York. Unlike the first two categories, Species of Special Concern receive no additional legal protection under Environmental Conservation Law section 11-0535 (Endangered and Threatened Species).

PLANTS

E **Endangered Species**. Listed species are those 1) with five or fewer extant sites, or 2) with fewer than 1,000 individuals, or 3) restricted to fewer than 4 USGS 7.5 minute map quadrangles, or 4) listed as endangered by the US Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

T **Threatened Species**. Listed species are those 1) with 6 to fewer than 20 extant sites, or 2) with 1,000 or fewer than 3,000 individuals, or 3) restricted to not less than 4 or more than 7 USGS 7.5 minute map quadrangles, or 4) listed as threatened by the US Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

R **Rare Species**. Listed species are those with 1) 20-35 extant sites, or 2) 3,000 to 5,000 individuals statewide.

NEW YORK NATURAL HERITAGE PROGRAM RANKS – ANIMALS AND PLANTS

Each element is assigned a state rank reflecting the rarity within New York State as determined by the New York Natural Heritage Program. These ranks carry no legal weight.

S1 Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making it especially vulnerable in New York State.

S2 Typically 6-20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.

S3 Typically 21-100 occurrences, limited acreage, or miles of stream in New York State.

S4 Apparently secure in New York State.

SH Historically known from New York State, but not seen in the past 15-20 years.

B,N These modifiers indicate when the breeding status of a migratory species is considered separately from individuals passing through or not breeding within New York State. B indicates the breeding status; N indicates the non-breeding status.

SPECIES OF GREATEST CONSERVATION NEED (SGCN) IN NEW YORK - ANIMALS

Species that meet one or more of the following criteria (NYSDEC 2005, 2015):

- Species on the current federal list of endangered or threatened species that occur in New York.
- Species which are currently state-listed as endangered, threatened, or of special concern.
- Species with 20 or fewer elemental occurrences in the New York Natural Heritage Program database.
- Estuarine and marine species of greatest conservation need as determined by New York Department of Environmental Conservation, Bureau of Marine Resources staff.
- Other species determined to be in great conservation need due to status, distribution, vulnerability, or disease.

REGIONAL STATUS (HUDSON VALLEY) – ANIMALS AND PLANTS

RG Hudsonia has compiled lists of native plants and animals that are rare in the Hudson Valley but do not appear on statewide or federal lists of rarities (Kiviat and Stevens 2001). We use ranking criteria similar to those used by the NYNHP, but we apply those criteria to the Hudson Valley below the Troy Dam. Our regional lists are based on the extensive field experience of biologists associated with Hudsonia and

communications with other biologists working in the Hudson Valley. These lists are subject to change as we gather more information about species occurrences in the region. In Appendix C we denote all regional ranks (rare, scarce, declining, vulnerable) with a single code (RG). Species with New York State, New York Natural Heritage Program, or SGCN ranks are presumed to also be regionally rare, but are not assigned an 'RG' rank. For birds, the RG code sometimes refers specifically to their breeding status in the region.

BIRDS - PARTNERS IN FLIGHT PRIORITY SPECIES LISTS

The Partners in Flight (PIF) WatchList is a list of landbirds considered to be of highest conservation concern, excluding those already designated as endangered under the federal Endangered Species Act. The WatchList is compiled jointly by several federal and private associations, including the Colorado Bird Observatory, the American Bird Conservancy, Partners in Flight, and the U.S. Fish and Wildlife Service. The current PIF WatchList is based on a series of scores assigned to each species for seven different aspects of vulnerability: population size, breeding distribution, non-breeding distribution, threats to breeding, threats to non-breeding, population trend, and "area importance" (relative abundance of the species within a physiographic area compared to other areas in the species' range). Scores for each of these factors range from 1 (low priority) to 5 (high priority), and reflect the degree of the species' vulnerability associated with that factor. Species are assigned "**High Regional Priority**" if their scores indicate high vulnerability in a physiographic area (delineated similarly to the physiographic areas used by the Breeding Bird Survey), and "**High Continental Priority**" if they have small and declining populations, limited distributions, or deteriorating habitats throughout their entire range. We used data from the Avian Conservation Assessment Database (2017), available online at http://pif.birdconservancy.org/acad/. Regional priorities reflect 2012 data. We referred to Bird Conservation Areas #28-Appalachian Mountains and #30- New England/Mid-Atlantic Coast for setting regional priorities.

PIF1* High continental priority (Tier IA and IB species)
PIF2 High regional priority (Tier IIA, IIB, and IIC species)

Appendix C. Species of conservation concern potentially associated with habitats in the Town of Pound Ridge. These are not comprehensive lists, but merely a sample of the species of conservation concern known to use these habitats in the region. The letter codes given with each species name denote its conservation status. Codes include **New York State ranks** (E, T, R, SC), **New York Natural Heritage Program ranks** (S1, S2, S3), **NYSDEC Species of Greatest Conservation Need** (SGCN) and **Hudsonia's regional ranks** (RG). For birds, we also indicate those species listed by **Partners in Flight** as **high conservation priorities** at the continental (PIF1) and regional (PIF2) level. These ranks are explained in Appendix B.

UPLAND HARDWOOD FOREST		
Plants	***Vertebrates (cont.)***	***Vertebrates (cont.)***
ambiguous sedge (E, S3)	marbled salamander (SC, S3, SGCN)	Acadian flycatcher (PIF2, S3)
red pinesap (S3?, RG)	four-toed salamander (RG)	wood thrush (PIF1, SGCN)
silvery spleenwort (RG)	eastern box turtle (SC, S3, SGCN^{HP})	cerulean warbler (SC, PIF1, S3?B, SGCN)
American ginseng (S3S4)	eastern worm snake (SC, S2, SGCN)	Canada warbler (PIF1, SGCN^{HP})
red baneberry (RG)	northern black racer (SGCN)	Kentucky warbler (S2, PIF1, SGCN^{HP})
poke milkweed (RG)	eastern ratsnake (SGCN)	black-and-white warbler (PIF2)
lopseed (RG)	northern goshawk (SC, S3S4B,S3N, SGCN)	black-throated green warbler (RG)
winter grape (E, S1)	red-shouldered hawk (SC, S4B, SGCN)	worm-eating warbler (PIF2, SGCN)
leatherwood (RG)	Cooper's hawk (SC, S4)	hooded warbler (PIF2, RG)
black cohosh (RG)	sharp-shinned hawk (SC, S4)	ovenbird (RG)
Vertebrates	broad-winged hawk (PIF2, RG)	scarlet tanager (PIF2, SGCN)
wood frog (RG)	ruffed grouse (SGCN)	northern long-eared bat (T, S1, SGCN)
spotted salamander (RG)	American woodcock (SGCN)	black bear (RG)
Jefferson salamander (SC)	whip-poor-will (SC, PIF1, S3, SGCN^{HP})	bobcat (RG)
blue-spotted salamander (SC, SGCN^{HP})	eastern wood-pewee (PIF2)	New England cottontail (SC, S1S2, SGCN^{HP})
		fisher (RG)
UPLAND CONIFER FOREST		
Plants	***Vertebrates (cont.)***	***Vertebrates (cont.)***
red pinesap (S3?, RG)	Cooper's hawk (SC, S4)	red-breasted nuthatch (RG)
common rattlebox (S1,E)	sharp-shinned hawk (SC, S4)	black-throated green warbler (RG)
Vertebrates	American woodcock (SGCN)	purple finch (RG)
blue -spotted salamander (SC, SGCN^{HP})		
RED CEDAR WOODLAND		
Plants	***Vertebrates***	***Vertebrates (cont.)***
yellow wild flax (T, S2)	wood turtle (SC, S3, SGCN^{HP})	eastern bluebird (RG)
whorled milkweed (R, S3)	eastern box turtle (SC, S3, SGCN^{HP})	brown thrasher (PIF2, S3S4B, SGCN^{HP})
butterflyweed (RG)	eastern hognose snake (SC, S3, SGCN^{HP})	golden-winged warbler (SC, PIF1, S3, SGCN^{HP})
Invertebrates	ruffed grouse (SGCN)	blue-winged warbler (PIF2, SGCN)
olive hairstreak (butterfly) (RG)	black-billed cuckoo (PIF1, SGCN)	eastern towhee (PIF2)
spotted turtle (SC, S3, SGCN^{HP})	whip-poor-will (SC, PIF1, S3, SGCN^{HP})	
NON-CALCAREOUS CREST/LEDGE/TALUS		
Plants	***Invertebrates (cont.)***	***Vertebrates (cont.)***
Bicknell's sedge (R, S3)	olive hairstreak (butterfly) (RG)	eastern hognose snake (SC, S3, SGCN^{HP})
clustered sedge (T, S2S3)	northern hairstreak (butterfly) (S2S4, SGCN)	northern copperhead (S3, SGCN)
reflexed sedge (T, S2S3)	gray hairstreak (butterfly) (RG)	turkey vulture (RG)

Appendix C (cont.)

NON-CALCAREOUS CREST/LEDGE/TALUS (cont.)		
blunt-leaf milkweed (RG)	***Invertebrates (cont.)***	***Vertebrates (cont.)***
rock sandwort (RG)	Horace's duskywing (butterfly) (RG)	whip-poor-will (SC, PIF1, S3, SGCN^{HP})
goat's-rue (RG)	swarthy skipper (butterfly) (RG)	black vulture (RG)
slender knotweed (R, S3)	Leonard's skipper (butterfly) (RG)	common raven (RG)
dittany (RG)	***Vertebrates***	winter wren (RG)
Torrey's mountain-mint (E, S1)	Fowler's toad (SGCN)	eastern bluebird (RG)
stiff-leaved aster (RG)	northern slimy salamander (RG)	cerulean warbler (SC, PIF1, S3?B, SGCN)
Invertebrates	marbled salamander (SC, S3, SGCN)	worm-eating warbler (PIF2, SGCN)
Edward's hairstreak (butterfly) (S3S4)	eastern box turtle (SC, S3, SGCN^{HP})	eastern small-footed bat (SC, S1S3, SGCN)
striped hairstreak (butterfly) (RG)	eastern ratsnake (SGCN)	southern red-back vole (RG)
brown elfin (butterfly) (RG)	northern black racer (SGCN)	fisher (RG)
		bobcat (RG)
CALCAREOUS CREST/LEDGE/TALUS		
Plants	***Plants (cont.)***	***Invertebrates***
purple cliffbrake (RG)	yellow corydalis (R, S3)	anise millipede (RG)
walking fern (RG)	black cohosh (RG)	olive hairstreak (butterfly) (RG)
wall-rue (RG)	pellitory (RG)	***Vertebrates***
Emmons' sedge (R, S3)	northern blazing-star (T, S2)	eastern hognose snake (SC, S3, SGCN^{HP})
Bicknell's sedge (R, S3)	small-flowered crowfoot (R, S3)	northern black racer (SGCN)
yellow wild flax (T, S2)	roundleaf dogwood (RG)	eastern ratsnake (SGCN)
Allegheny-vine (RG)		northern copperhead (S3, SGCN)
ROCKY BARREN		
Plants	***Invertebrates (cont.)***	***Vertebrates (cont.)***
clustered sedge (T, S2S3)	Edward's hairstreak (butterfly) (S3S4)	common raven (RG)
dwarf shadbush (RG)	***Vertebrates***	prairie warbler (PIF1, SGCN)
Invertebrates	copperhead (S3, SGCN)	field sparrow (PIF2)
brown elfin (butterfly) (RG)	turkey vulture (RG)	vesper sparrow (SC, SGCN)
Leonard's skipper (butterfly) (RG)	whip-poor-will (SC, PIF1, SGCN)	eastern towhee (PIF2)
UPLAND SHRUBLAND		
Plants	***Vertebrates (cont.)***	***Vertebrates (cont.)***
stiff-leaf goldenrod (RG)	spotted turtle (SC, S3, SGCN^{HP})	blue-winged warbler (PIF2, SGCN)
shrubby St. Johnswort (T, S2)	eastern box turtle (SC, S3, SGCN^{HP})	golden-winged warbler (SC, PIF1, S3, SGCN^{HP})
butterflyweed (RG)	wood turtle (SC, S3, SGCN^{HP})	prairie warbler (PIF1, SGCN)
Invertebrates	ruffed grouse (SGCN)	yellow-breasted chat (SC, PIF2, S2?B, SGCN^{HP})
Aphrodite fritillary (butterfly) (RG)	black-billed cuckoo (PIF1, SGCN)	vesper sparrow (SC, S3, SGCN^{HP})
Leonard's skipper (butterfly) (RG)	whip-poor-will (SC, PIF1, S3, SGCN^{HP})	field sparrow (PIF2)
Vertebrates	brown thrasher (PIF2, S3S4B, SGCN^{HP})	grasshopper sparrow (SC, PIF2, S3, SGCN^{HP})
wood frog (RG)	white-eyed vireo (RG)	eastern towhee (PIF2)
		New England cottontail (SC, S1S2, SGCN^{HP})
UPLAND MEADOW		
Plants	***Invertebrates (cont.)***	***Vertebrates (cont.)***
small-flowered agrimony (R, S3)	Aphrodite fritillary (butterfly) (RG)	sedge wren (T, S3, SGCN^{HP})
Bush's sedge (R, S3)	northern oak hairstreak (S2S4, SGCN)	eastern bluebird (RG)
common rattlebox (E, S1)	Leonard's skipper (butterfly) (RG)	savannah sparrow (RG)
stiff-leaved goldenrod (T, S2)	swarthy skipper (butterfly) (RG)	vesper sparrow (SC, S3, SGCN^{HP})

(continued)

Appendix C (cont.)

UPLAND MEADOW (cont.)		
Invertebrates	***Vertebrates***	***Vertebrates (cont.)***
Baltimore (butterfly) (RG)	spotted turtle (SC, S3, SGCN^{HP})	grasshopper sparrow (SC, PIF2, S3, SGCN^{HP})
meadow fritillary (butterfly) (RG)	eastern box turtle (SC, S3, SGCN^{HP})	bobolink (PIF1, SGCN^{HP})
	wood turtle (SC, S3, SGCN^{HP})	eastern meadowlark (PIF2, SGCN^{HP})
SWAMP		
Plants	***Vertebrates***	***Vertebrates (cont.)***
swamp cottonwood (T, S2)	blue-spotted salamander (SC, SGCN^{HP})	Virginia rail (RG)
swamp lousewort (T, S2S3)	four-toed salamander (RG, SGCN^{HP})	American woodcock (SGCN)
winged monkey-flower (R, S3)	spotted turtle (SC, S3, SGCN^{HP})	red-shouldered hawk (SC, S4B, SGCN)
purple milkweed (S2S3, T)	wood turtle (SC, S3, SGCN^{HP})	white-eyed vireo (RG)
false hop sedge (T, S2)	eastern box turtle (SC, S3, SGCN^{HP})	eastern bluebird (RG)
Invertebrates	great blue heron (RG)	Canada warbler (PIF1, SGCN^{HP})
phantom cranefly (RG)	American bittern (SC, S4, SGCN)	Louisiana waterthrush (PIF2, SGCN)
INTERMITTENT WOODLAND POOL		
Plants	***Invertebrates (cont.)***	***Vertebrates (cont.)***
Virginia chain fern (RG)	springtime physa (snail) (RG)	spotted salamander (RG)
false hop sedge (T, S2)	***Vertebrates***	spotted turtle (SC, S3, SGCN^{HP})
featherfoil (T, S2)	wood frog (RG)	wood turtle (SC, S3, SGCN^{HP})
Invertebrates	Jefferson salamander (SC)	American black duck (S3, SGCN^{HP})
black dash (butterfly) (RG)	marbled salamander (SC, S3, SGCN)	Louisiana waterthrush (PIF2, SGCN)
mulberry wing (butterfly) (RG)	four-toed salamander (RG, SGCN^{HP})	
BUTTONBUSH POOL		
Plants	***Vertebrates***	***Vertebrates (cont.)***
Helodium paludosum (moss) (RG)	wood frog (RG)	spotted salamander (RG)
pale alkali-grass (RG)	blue-spotted salamander (SC, SGCN^{HP})	spotted turtle (SC, S3, SGCN^{HP})
short-awned foxtail (RG)	Jefferson salamander (SC)	common ribbon snake (SGCN)
	marbled salamander (SC, S3, SGCN)	American black duck (S3, SGCN^{HP})
MARSH		
Plant	***Vertebrates***	***Vertebrates (cont.)***
winged monkey-flower (R, S3)	Atlantic coast leopard frog (SGCN)	pied-billed grebe (T, S3, S1N, SGCN)
Invertebrates	southern leopard frog (SC)	American black duck (S3, SGCN^{HP})
black dash (butterfly) (RG)	spotted turtle (SC, S3, SGCN^{HP})	king rail (T, S1, SGCN^{HP})
bronze copper (butterfly) (RG)	American bittern (SC, S4, SGCN)	Virginia rail (RG)
mulberry wing (butterfly) (RG)	least bittern (T, S3, S1N, SGCN)	common moorhen (RG)
	great blue heron (RG)	marsh wren (PIF2, RG)
WET MEADOW		
Invertebrates	***Invertebrates (cont.)***	***Vertebrates (cont.)***
Baltimore (butterfly) (RG)	bronze copper (butterfly) (RG)	spotted turtle (SC, S3, SGCN^{HP})
mulberry wing (butterfly) (RG)	eyed brown (butterfly) (RG)	American bittern (SC, S4, SGCN)
black dash (butterfly) (RG)	phantom cranefly (RG)	Virginia rail (RG)
two-spotted skipper (butterfly) (RG)	***Vertebrates***	American woodcock (SGCN)
meadow fritillary (butterfly) (RG)	common ribbon snake (RG, SGCN)	sedge wren (T, S3, PIF2, SGCN^{HP})
FEN		
Plants	***Plants (cont.)***	***Invertebrates (cont.)***
wood horsetail (RG)	round-leaved sundew (RG)	Dion skipper (butterfly) (S3)
twig-rush (RG)	small-flowered agrimony (R, S3)	Baltimore (butterfly) (RG)
Schweinitz's sedge (T, S2S3)	buckbean (RG)	mulberry wing (butterfly) (RG)
Bush's sedge (R, S3)	alder-leaf buckthorn (RG)	black dash (butterfly) (RG)
slender lady's-tresses (RG)		

(continued)

Appendix C (cont.)

FEN (cont.)		
Plants (cont.)	***Invertebrates***	***Vertebrates***
rose pogonia (RG)	*Gammarus pseudolimnaeus* (amphipod) (RG)	Atlantic coast leopard frog (SGCN)
spreading globeflower (R, S3)	*Pomatiopsis lapidaria* (snail) (RG)	southern leopard frog (SC)
scarlet Indian paintbrush (E, S1)	phantom cranefly (RG)	bog turtle (E, S2, SGCN[HP])
grass-of-Parnassus (RG)	eyed brown (butterfly) (RG)	spotted turtle (SC, S3, SGCN[HP])
fringed gentian (RG)	silver-bordered fritillary (butterfly) (RG)	common ribbon snake (SGCN)
swamp lousewort (T, S2S3)	two-spotted skipper (butterfly) (RG)	sedge wren (T, S3, PIF2, SGCN[HP])
OPEN WATER/CONSTRUCTED POND		
Invertebrates	***Vertebrates (cont.)***	***Vertebrates (cont.)***
dusky dancer (S1, SGCN)	wood turtle (SC, S3, SGCN[HP])	pied-billed grebe (T, S3, S1N, SGCN)
Vertebrates	American bittern (SC, S4, SGCN)	osprey (SC, SGCN)
spotted turtle (SC, S3, SGCN[HP])	great blue heron (RG)	bald eagle (T, S2S3, SGCN)
	American black duck (S3, SGCN[HP])	river otter (SGCN)
SPRING/SEEP		
Plants	***Invertebrates***	***Vertebrates***
Bush's sedge (R, S3)	Piedmont groundwater amphipod (SGCN)	northern dusky salamander (RG)
devil's-bit (T, S1S2)	gray petaltail (dragonfly) (SC, S2, SGCN)	
	tiger spiketail (dragonfly) (S1, SGCN)	
STREAM & RIPARIAN CORRIDOR		
Plants	***Invertebrates (cont.)***	***Vertebrates (cont.)***
winged monkey-flower (R, S3)	*Sphaerium fabale* (fingernail clam) (RG)	Atlantic coast leopard frog (SGCN)
riverweed (T, S2)	arrowhead spiketail (dragonfly) (S2S3, SGCN)	northern dusky salamander (RG)
cattail sedge (T, S1)	tiger spiketail (S1, SGCN)	wood turtle (SC, S3, SGCN[HP])
Davis' sedge (T, S2)	mocha emerald (dragonfly) (S2S3, SGCN)	great blue heron (RG)
small-flowered agrimony (S3)	sable clubtail (dragonfly) (S1, SGCN)	American black duck (S3, SGCN[HP])
false-mermaid (RG)	ostrich fern borer (moth) (SGCN)	American woodcock (SGCN)
swamp rose-mallow (RG)	***Vertebrates***	bank swallow (RG)
may-apple (RG)	creek chubsucker (fish) (RG)	winter wren (RG)
Invertebrates	bridle shiner (fish) (RG)	cerulean warbler (SC, S3?B, PIF1, SGCN)
Marstonia decepta (snail) (RG)	brook trout (fish) (SGCN)	Louisiana waterthrush (PIF2, SGCN)
brook floater (mussel) (T, S1, SGCN)	slimy sculpin (fish) (RG)	river otter (SGCN)
Pisidium adamsi (fingernail clam) (RG)	southern leopard frog (SC)	northern long-eared bat (T, S1, SGCN)

Appendix D. Common and scientific names of plants mentioned in this report. Most scientific names follow the nomenclature of Weldy and Werier 2018.

Common Name	Scientific Name	Common Name	Scientific Name
agrimony, small-flowered	*Agrimonia parviflora*	cinquefoil, shrubby	*Dasiphora fruticosa*
alder	*Alnus*	cliffbrake, purple	*Pellaea atropurpurea*
alkali-grass, pale	*Puccinellia distans*	cliffbrake, smooth	*Pellaea glabella* ssp. *glabella*
Allegheny-vine	*Adlumia fungosa*	cohosh, black	*Actaea racemosa*
arrowhead, broad-leaved	*Sagittaria latifolia*	columbine, wild	*Aquilegia canadensis*
arrowwood, northern	*Viburnum dentatum* var. *lucidum*	cottonwood, swamp	*Populus heterophylla*
arum, arrow	*Peltandra virginica*	cranberry, large	*Vaccinium macrocarpon*
ash	*Fraxinus*	crowfoot, small-flowered	*Ranunculus micranthus*
ash, black	*Fraxinus nigra*	deerberry	*Vaccinium stamineum*
ash, green	*Fraxinus pennsylvanica*	devil's-bit	*Chamaelirium luteum*
ash, white	*Fraxinus americana*	dittany	*Cunila origanoides*
aspen, quaking	*Populus tremuloides*	dogwood, gray	*Cornus foemina* ssp. *racemosa*
aster, stiff-leaf	*Ionactis linariifolia*	dogwood, roundleaf	*Cornus rugosa*
azalea, swamp	*Rhododendron viscosum*	dogwood, silky	*Cornus amomum* ssp. *obliqua*
baneberry, red	*Actaea rubra*	duckweed, common	*Spirodela polyrrhiza*
barberry, Japanese	*Berberis thunbergii*	duckweed, lesser	*Lemna minor*
basswood, American	*Tilia americana* var. *americana*	elm, American	*Ulmus americana*
beech, American	*Fagus grandifolia*	elm, slippery	*Ulmus rubra*
birch	*Betula*	false-mermaid	*Floerkea proserpinacoides*
birch, black	*Betula lenta*	featherfoil	*Hottonia inflata*
birch, gray	*Betula populifolia*	fern, cinnamon	*Osmunda cinnamomea*
birch, swamp	*Betula pumila*	fern, fragile	*Cystopteris fragilis*
birch, yellow	*Betula alleghaniensis*	fern, maidenhair	*Adiantum pedatum*
bittersweet, oriental	*Celastrus orbiculatus*	fern, marginal wood	*Dryopteris marginalis*
blackberry, northern	*Rubus allegheniensis*	fern, marsh	*Thelypteris palustris* var. *pubescens*
bladdernut	*Staphylea trifolia*	fern, royal	*Osmunda regalis* var. *spectabilis*
blazing-star, northern	*Liatris aspera*	fern, sensitive	*Onoclea sensibilis*
bloodroot	*Sanguinaria canadensis*	fern, Virginia chain	*Woodwardia virginica*
blueberry	*Vaccinium*	fern, walking	*Asplenium rhizophyllum*
blueberry, highbush	*Vaccinium corymbosum*	flag, blue	*Iris versicolor*
bluegrass, Kentucky	*Poa pratensis* ssp. *pratensis*	flax, yellow wild	*Linum sulcatum*
bluestem, little	*Schizachyrium scoparium* var. *scoparium*	foxtail, short-awned	*Alopecurus aequalis* var. *aequalis*
bracken	*Pteridium aquilinum* var. *latiusculum*	gentian, fringed	*Gentianopsis crinita*
buckbean	*Menyanthes trifoliata*	ginger, wild	*Asarum canadense*
buckthorn, alder-leaved	*Rhamnus alnifolia*	ginseng, American	*Panax quinquefolius*
buckthorn, glossy	*Frangula alnus*	globeflower, spreading	*Trollius laxus*
bulrush, hard-stemmed	*Schoenoplectus acutus* var. *acutus*	goat's-rue	*Tephrosia virginiana*
butterflyweed	*Asclepias tuberosa* ssp. *interior*	goldenrod	*Solidago*
butternut	*Juglans cinerea*	goldenrod, stiff-leaved	*Solidago rigida*
buttonbush	*Cephalanthus occidentalis*	goldenseal	*Hydrastis canadensis*
cattail	*Typha*	grape, winter	*Vitis vulpina*
cedar, eastern red	*Juniperus virginiana* var. *virginiana*	grass, poverty	*Danthonia spicata*
cherry, black	*Prunus serotina*	grass, reed canary	*Phalaris arundinacea*
chokeberry	*Aronia*	grass-of-Parnassus	*Parnassia glauca*

(continued)

Appendix D. (cont.)

Common Name	Scientific Name	Common Name	Scientific Name
gum, black	*Nyssa sylvatica*	pepperbush, coast	*Clethra alnifolia*
hackberry, northern	*Celtis occidentalis*	pine	*Pinus*
hairgrass, common	*Avenela flexuosa*	pine, eastern white	*Pinus strobus*
harlequin, yellow	*Corydalis flavula*	pine, pitch	*Pinus rigida*
hawthorn	*Crataegus*	pine, red	*Pinus resinosa*
hemlock, eastern	*Tsuga canadensis*	pine, scotch	*Pinus sylvestris*
hickory, mockernut	*Carya tomentosa*	pinesap, red	*Monotropa hypopithys*
hickory, pignut	*Carya glabra*	pink, grass	*Calopogon tuberosus* var. *tuberosus*
hickory, shagbark	*Carya ovata*	plant, pitcher	*Sarracenia purpurea*
holly, winterberry	*Ilex verticillata*	pogonia, rose	*Pogonia ophioglossoides*
honeysuckle, Bell's	*Lonicera* x *bella*	polypody, rock	*Polypodium virginianum*
horsetail, wood	*Equisetum sylvaticum*	pond-lily, fragrant	*Nymphaea odorata* ssp. *odorata*
huckleberry, black	*Gaylussacia baccata*	pond-lily, yellow	*Nuphar advena* ssp. *advena*
iris, yellow	*Iris pseudacorus*	poplar, tulip	*Liriodendron tulipifera*
jewelweed, orange	*Impatiens capensis*	prickly-ash, American	*Zanthoxylum americanum*
Joe-Pye-weed, spotted	*Eutrochium maculatum* var. *maculatum*	rattlebox, common	*Crotalaria sagittalis*
knotweed, slender	*Polygonum tenue*	reed, common	*Phragmites australis*
lady's-tresses, slender	*Spiranthes lacera* var. *gracilis*	riverweed	*Podostemum ceratophyllum*
laurel, mountain	*Kalmia latifolia*	rose, multiflora	*Rosa multiflora*
leatherleaf	*Chamaedaphne calyculata*	rose-mallow, swamp	*Hibiscus moscheutos* ssp. *moscheutos*
leatherwood	*Dirca palustris*	rush, soft	*Juncus effusus*
locust, black	*Robinia pseudoacacia*	sandwort, rock	*Minuartia michauxii* var. *michauxii*
loosestrife, purple	*Lythrum salicaria*	sarsaparilla, bristly	*Aralia hispida*
lopseed	*Phryma leptostachya*	saxifrage, golden	*Chrysosplenium americanum*
lousewort, swamp	*Pedicularis lanceolata*	sedge, ambiguous	*Carex amphibola*
mannagrass	*Glyceria*	sedge, Bicknell's	*Carex bicknellii*
maple	*Acer*	sedge, bottle-shaped	*Carex utriculata*
maple, red	*Acer rubrum*	sedge, brown bog	*Carex buxbaumii*
maple, sugar	*Acer saccharum*	sedge, Bush's	*Carex bushii*
may-apple	*Podophyllum peltatum*	sedge, cattail	*Carex typhina*
meadowsweet	*Spiraea alba* var. *latifolia*	sedge, clustered	*Carex cumulata*
milkweed, blunt-leaf	*Asclepias amplexicaulis*	sedge, Davis'	*Carex davisii*
milkweed, poke	*Asclepias exaltata*	sedge, Emmons'	*Carex albicans* var. *emmonsii*
milkweed, purple	*Asclepias purpurascens*	sedge, false hop	*Carex lupuliformis*
milkweed, whorled	*Asclepias verticillata*	sedge, handsome	*Carex formosa*
monkey-flower, winged	*Mimulus alatus*	sedge, inland	*Carex interior*
(a moss)	*Helodium paludosum*	sedge, lakeside	*Carex lacustris*
mountain-mint, Torrey's	*Pycnanthemum torrei*	sedge, Pennsylvania	*Carex pensylvanica*
nettle, false	*Boehmeria cylindrica*	sedge, reflexed	*Carex retroflexa*
oak	*Quercus*	sedge, Schweinitz's	*Carex schweinitzii*
oak, black	*Quercus velutina*	sedge, Swan's	*Carex swanii*
oak, chestnut	*Quercus montana*	sedge, tussock	*Carex stricta*
oak, red	*Quercus rubra*	sedge, woolly-fruited	*Carex lasiocarpa* ssp. *americana*
oak, scarlet	*Quercus coccinea*	shadbush, dwarf	*Amelanchier spicata*
oak, scrub	*Quercus ilicifolia*	skunk-cabbage	*Symplocarpus foetidus*
oak, white	*Quercus alba*	spicebush	*Lindera benzoin*
paintbrush, scarlet Indian	*Castilleja coccinea*	spikemoss, hidden	*Selaginella eclipes*
pellitory	*Parietaria pennsylvanica*	spleenwort, ebony	*Asplenium platyneuron* var. *platyneuron*

(continued)

Appendix D. (cont.)

Common Name	Scientific Name	Common Name	Scientific Name
spleenwort, maidenhair	*Asplenium trichomanes* ssp. *trichomanes*	viburnum, maple-leaf	*Viburnum acerifolium*
spleenwort, mountain	*Asplenium montanum*	vine, mile-a-minute	*Persicaria perfoliata*
spleenwort, silvery	*Deparia acrostichoides*	violet	*Viola*
spruce, Norway	*Picea abies*	wall-rue	*Asplenium ruta-muraria*
St. Johnswort, shrubby	*Hypericum prolificum*	water-plantain	*Alisma triviale*
sundew, round-leaved	*Drosera rotundifolia*	water-shield	*Brasenia schreberi*
sweetfern	*Comptonia peregrina*	whitlow-grass, Carolina	*Draba reptans*
sycamore	*Platanus occidentalis*	willow	*Salix*
twig-rush	*Cladium mariscoides*	witch-hazel	*Hamamelis virginiana*
valerian, bog	*Valeriana uliginosa*	woolgrass	*Scirpus cyperinus*

Ward Pound Ridge reservation
Andrew Soleiman

At a Glance

APPENDIX A

DATA WAREHOUSE

APPENDIX B

CLIMATE PROJECTIONS IN THE HUDSON RIVER ESTUARY

APPENDIX C

CLIMATE IMPACTS: ADDITIONAL ONLINE RESOURCES

APPENDIX D

LEGEND: SOILS OF POUND RIDGE

APPENDIX E

GUIDE TO NYS WATER INDEX AND PRUP REPORT

APPENDIX F

MUNICIPAL PROFILE, 2005-2009

APPENDIX G

OPEN SPACE: ONLINE RESOURCES

APPENDIX H

NATURAL RESOURCE NAVIGATOR

Appendices

“The kiwi” by Peter Woytuck, not a substitute for nature!
C. Reppert 2018

APPENDIX A

DATA WAREHOUSE • TOWN OF POUND RIDGE GIS

The Town GIS is a data viewer and the data uploads come from multiple sources. Included in this Data Warehouse are data sources for uploads: listed in the Table of Contents; listed in the Staff Folder; and Data Sources, alphabetically arranged.

DATA: TABLE OF CONTENTS

Westchester GIS

These data layers are hosted by Westchester GIS and accessed from many sources, e.g. FEMA, National Wetlands Inventory, USGS, and others. Westchester County datasets are available for download. The Westchester GIS Data Warehouse is available at: http://giswww.westchestergov.com/wcgis/DataWarehouse.htm

POUND RIDGE

Data layers hosted by CAI Technology for Town of Pound Ridge and accessed from many sources as follows:

Property Map

CAI Technology uploads all data layers under the Property Map heading with the exception of the buildings layer. The Buildings Layer is uploaded by Westchester GIS (See note Westchester GIS).

Neighborhood Map

A tool utilized by tax assessors in some communities and provided by Westchester GIS (See Westchester GIS).

Lakes, Rivers and Streams Map

(See Westchester GIS.)

FEMA Flood Map (See Westchester GIS.)

NWI Wetland Map (Westchester GIS.)

Zoning Map (See Westchester GIS.)

Open Space Map: County and Local Parks

(See Westchester GIS.)

Open Space Map: Westchester Land Trust

Westchester Wilderness Walk/Zofnass Preserve data layers were provided by Westchester Land Trust (August 2017).

Open Space Map: Pound Ridge Land Conservancy Preserves

Created by Paul LaBella (2017) for the Conservation Board.

Open Space Map: Large Undeveloped Tracts

(See Westchester GIS).

Areas of Interest: LANDMARKS

Historic landmarks layer compiled by Paul LaBella (2017) for the Conservation Board.

Habitats and Wildlife Map: Eastern Westchester Biotic Corridor and E. Westchester Biotic Corridor Extension was provided by Laura Heady, Conservation and Land Use Coordinator, NYS DEC New Paltz, (Aug. 2016). Miller, N. A. and M.W. Klemens. 2002. Eastern Westchester Biotic Corridor. MCA Technical Paper No. 4, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, NY.

Habitats and Wildlife Map: Eastern Westchester Biotic Corridor Extension. See above.

Habitats and Wildlife Map: Eco Zones

Ecological Zones

Boundaries of the Ecological Regions of New York State, taken from Will et. al. (1982) and Dickinson (1983).

Data Set Details http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1131)

Forest Health Aerial Survey –

Data Set Details http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1264

The 2011 Forest Health Aerial Survey Report is a narrative for the aerial observations from the 2011 general forest health aerial surveys conducted for New York State, associated ground crew observations, and other forest health related information. The aerial surveys were conducted by the aerial sketchmapper and region foresters from New York State Department of Environmental Conservation (NYSDEC) in cooperation with the USDA Forest Service. A survey of Pound Ridge can be viewed by switching from the base map (third tab, upper right corner) to on the GIS viewer.

Water Resources Map: AWCPoundRidgeWatersheds

Upon request (August 2017), Aquarion Water Company provided seven shapefiles

(AWCPoundRidge Watersheds) from which watershed boundaries for Inland Long Island Sound, in the southern portion of Pound Ridge, can be inferred.

Water Resources Map: DRY_hydrants
Compiled by Paul LaBella for the Pound Ridge Conservation Board (2017).

Water Resources Map: Water Wells
This file shows locations and attributes for water wells in New York State. This information has been collected by DEC since April 2000 as required by law. Revised: June 2016
Data Set Details http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1203

Water Quality Classifications - NYS - *NYS Dept. of Environmental Conservation (DEC)* - This data set provides the water quality classifications of New York State's lakes, rivers, streams and ponds, collectively referred to as water bodies. All water bodies in the state are provided a water quality classification based on existing, or expected best usage, of each water body or water body segment.

Themes: Hydrography, Land Use/Land Cover, Watersheds/Water Supply

Data Set Details https://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1118

Member Inventory https://gis.ny.gov/gisdata/inventories/member.cfm?organizationID=529

Member Details https://gis.ny.gov/co-op/members/membersalpha.cfm?orgID=529

Coverage: New York State

Waterbody Inventory-Priority Waterbodies
NYS Dept. of Environmental Conservation (DEC) - The Waterbody Inventory/Priority Waterbodies List (WI/PWL) is an inventory of the state's surface water quality. The data set provides a summary of general water quality conditions, tracks the degree to which a water body supports its designated uses, and monitors progress toward the identification and resolution of water quality.

Themes: Hydrography, Watersheds/Water Supply, Wetlands

Data Set Details https://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1117

Member Inventory https://gis.ny.gov/gisdata/inventories/member.cfm?organizationID=529

Member Details https://gis.ny.gov/co-op/members/membersalpha.cfm?orgID=529

Coverage: New York State

Water Resources: Dams
This data set is used to show the location of dams in New York State's inventory of dams, and lists selected attributes of each dam. *Revised: December 2015.*

Themes: Facilities, Hydrography, Watersheds/Water Supply

Geology and Soils Map: Soil - Drainage Class
Current SSURGO data downloaded from Web Soil Survey: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Geology and Soils Map: State Geologic Map
The USGS has geology data for New York state in GIS format on the following website: https://pubs.usgs.gov/of/2005/1325/
New York Updated August 2008

The paper state geologic map of New York was originally published by the New York State Geological Survey in five sheets (Niagara, Finger Lakes, Hudson-Mohawk, Adirondack, and Lower Hudson; Fisher and others (1970)) at a scale of 1:250,000.

Geology and Soils Map: Bedrock Geology Surficial Geology
The New York State Museum Geology website has geology data in GIS format for the state of New York: http://www.nysm.nysed.gov/research-collections/geology/gis

In 1999, a digital version of the 1970 paper bedrock map was created by the New York State Museum. Digital products which are available for NY include surficial materials and bedrock geology (as separate files) from http://www.nysm.nysed.gov/gis/. See Lower Hudson shapefile.

Information about products from the New York State Geological Survey can be found at http://www.nysm.nysed.gov/research/geology/.

APPENDIX A

STAFF FOLDER
Requests to access the staff folder may be directed to the Conservation Board or Town Clerk.

Phase 1 Protocol
Phase One Protocols or DEC Reported Sites pre2017 were created by Toxic Targeting, Inc. (2016) for the Conservation Board.

Special Use Overlay: greenCORRIDORS
Constellations of unprotected and protected properties forming green corridors identified by PRLC (2008). Shapefile created by Paul LaBella (2017) for the Conservation Board.

Special Use Overlay: OS_Advisory_ PriorityParcels
Open Space Advisory, priority parcels of unprotected open space identified in 2008. Shapefile created by Paul LaBella (2017) for the Conservation Board.

Special Use Overlay: Priority_parcelsUNION
Priority parcels identified by Opens Space Advisory and Pound Ridge Land Conservancy. Shapefile created by Paul LaBella (2017) for the Conservation Board.

Protected Open Space: Mianus_River_Gorge
Shapefile provided by Mianus River Gorge Preserve (2017) or the preserve to the Conservation Board.

Protected Open Space: Other MRG Easements
Conservation easements provided by Mianus River Gorge (2017) to the Conservation Board.

Protected Open Space: Morgenthau_Preserve
Created by Paul LaBella (2017) for the Conservation Board.

Protected Open Space: PR_boundary_PRO2
Pound Ridge boundary map, created by Paul LaBella (2017) for the Conservation Board.

Protected Open Space: PRLC_Preserves
Pound Ridge Land Conservancy Preserves created by Paul LaBella (2017) for the Conservation Board.

Protected Open Space: Protected_TownPark
Protected town-owned parks created by Paul LaBella (2017) for the Conservation Board.

Protected Open Space: Town house
Town house open space created by Paul LaBella (2017) for the Conservation Board.

Protected Open Space: Unverified Town Easements
Conservation easements held by the Town of Pound Ridge. Verification required. Created by Paul LaBella (2017) for the Conservation Board.

Protected Open Space: Ward_Pound_Ridge_ Reservation
Created by Paul LaBella (2017) for the Conservation Board.

Protected Open Space: WLT_Easements
Upon request ,Westchester Land Trust provided shapefiles of its conservation easements (August 2017).

Protected Open Space: WLT_Preserves
Upon request, Westchester Land Trust provided shapefiles of Westchester Wilderness Walk/Zofnass Preserve (August 2017).

Unprotected Open Space: Zoned Agriculture
Created by Paul LaBella (2017) for the Conservation Board.

Unprotected Open Space: HOA_Final1
Land owned in common by Home Owners Association entities (created by Paul LaBella for the Conservation Board in 2017).

Unprotected Open Space: Public_Inst_
Location of school, church, and library properties (created by Paul LaBella for the Conservation Board in 2017).

Unprotected Open Space: TownOwned_NonPark
Location of Highway Dept and Maintenance properties (Created by Paul LaBella for the Conservation Board 2017).

Unprotected Open Space: Residential_ VacantLand
Created by Paul LaBella (2017) for the Conservation Board.

Unprotected Open Space: RESvacantland___>1ac
Created by Paul LaBella (2017) for the Conservation Board.

Unprotected Open Space: TownOwned_UPOS
Created by Paul LaBella (2017) for the Conservation Board.

DATA SOURCES

Aquarion Water Company
Aquarion Water Company provided seven shapefiles (AWCPoundRidge Watersheds) from which watershed boundaries for Inland Long Island Sound, in the southern portion of Pound Ridge, can be inferred. Upon request (August 2017).

CAI Technology
CAI Technology uploads all data layers under the Property Map heading with the exception of the buildings layer. The Buildings Layer is uploaded by Westchester GIS.

Conservation Board
Dry Fire Hydrants (2017) created by Paul LaBella for the Conservation Board is located under Miscellania. Open Space Inventory maps created by Paul LaBella (2017) for the Conservation Board are located in the Staff Folder. Requests to access the staff folder may be directed to the Conservation Board or Town Clerk.

Hudsonia Ltd.
Habitat study completed 2018.

Mianus River Gorge Preserve (MRGP)
MRG provided shapefiles of its conservation easements. These shapefiles are located in the Staff Folder. Requests to access the staff folder may be directed to the Conservation Board or Town Clerk.

NYS Department of Conservation (DEC)
Several data layers are accessed from DEC. http://gis.ny.gov/gisdata/inventories/member.cfm?organizationID=529

The data layers, under the heading Pound Ridge, NY, include: Dams, Eastern Westchester Biotic Corridor and Extension, Forest Health Survey, Ecological Zones, Water Body Inventory/Priority waterbodies, Water Quality Classifications, Water Wells. See Data: Table of Contents Pound Ridge for more detailed information.

New York State Museum Geology
The New York State Museum Geology website has geology data in GIS format for the state of New York: http://www.nysm.nysed.gov/research-collections/geology/gis

Toxic Targeting, Inc
Phase One Protocols or DEC Reported Sites pre2017 created by Toxic Targeting, Inc. (2016) for the Conservation Board are located in the Staff Folder. Requests to access the staff folder may be directed to the Conservation Board or Town Clerk.

USDA (United States Department of Agriculture): Soil Survey

USGS (United States Geological Survey)
The USGS has geology data for New York state in GIS format on the following website: https://pubs.usgs.gov/of/2005/1325/

Westchester GIS
Provides the majority of our data layers under the headings Westchester County and under Pound Ridge, NY. Westchester GIS accesses data from many sources, e.g. FEMA, National Wetlands Inventory, USGS, etc. Westchester County datasets are available for download. Their Data Warehouse is available at: http://giswww.westchestergov.com/wcgis/DataWarehouse.htm

Westchester Land Trust (WLT)
Under the Pound Ridge heading, Open Space subheading, is a data layer of properties provided by WLT. Additional data layers from WLT (regarding conservation easements) are in the Staff Folder. Requests to access the staff folder may be directed to the Conservation Board or Town Clerk.

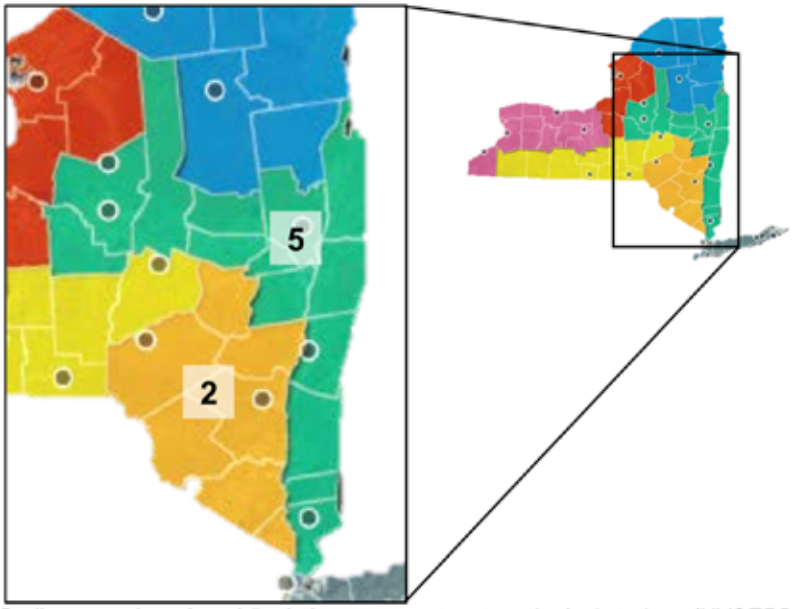
APPENDIX B

CLIMATE PROJECTIONS IN THE HUDSON RIVER ESTUARY

NEW YORK STATE OF OPPORTUNITY. | Hudson River Estuary Program

A fact sheet for the public

This fact sheet provides a one-page summary table of the climate projections for the Hudson River Estuary region. The projections include air temperature, precipitation, heat wave, sea level rise and flood projections from now through year 2100. The projections are taken from *Responding to Climate Change in New York State CimAID Report* written in 2011 and updated in 2014. The report delineates climate projections by region. This fact sheet includes the two Hudson Valley regions: Region 2 (west of the Hudson River) and Region 5 (east of the Hudson River and the Mohawk River region). Region 2 covers Delaware, Greene, Orange, Schoharie, Sullivan, Rockland, and Ulster counties, and Region 5 covers Albany, Columbia, Dutchess, Fulton, Herkimer, Madison, Montgomery, Oneida, Putnam, Rensselaer, Saratoga, Schenectady, Washington, and Westchester counties.



ClimAID climate regions 2 and 5, circles represent meteorological stations (NYSERDA).

CLIMATE PROJECTIONS FOR THE HUDSON VALLEY REGION

AIR TEMPERATURE PROJECTIONS FOR REGION 2

	Baseline 1971-2000	2020s	2050s	2080s	2100
Annual average air temperature	48˚F	52.2 - 53.1˚F	54.2 - 56.1˚F	55.4 - 59.6˚F	56.2 - 61.2˚F
Increase in annual average	-	2.2 - 3.1˚F	4.2 - 6.1˚F	5.4 - 9.6˚F	6.2 - 11.2˚F

AIR TEMPERATURE PROJECTIONS FOR REGION 5

	Baseline 1971-2000	2020s	2050s	2080s	2100
Annual average air temperature	50˚F	52.3 - 53.2˚F	54.5 - 56.2˚F	55.6 - 59.7˚F	56.1 - 61.4˚F
Increase in annual average	-	2.3 - 3.2˚F	4.5 - 6.2˚F	5.6 - 9.7˚F	6.1 - 11.4˚F

PRECIPITATION PROJECTIONS FOR REGION 2

	Baseline 1971-2000	2020s	2050s	2080s	2100
Total annual precipitation	48"	48.5" - 52"	49.5" - 53.5"	51" - 54.5"	48.5" - 56.5"
% Increase in annual precipitation	-	1 - 8%	3 - 11%	6 - 14%	1 - 18%
# Days with precipitation > 1"	12	12 - 13	13 - 14	13 - 15	*
# Days with precipitation > 2"	2	2	2 - 3	2 - 3	*

PRECIPITATION PROJECTIONS FOR REGION 5

	Baseline 1971-2000	2020s	2050s	2080s	2100
Total annual precipitation	51"	52" - 54.5"	53" - 57"	53.5" - 58.5"	53.5" to 61.5"
% Increase in annual precipitation	-	2 - 7%	4 - 12%	5 - 15%	5 - 21%
# Days with precipitation > 1"	10	14 - 15	14 - 16	15 - 17	*
# Days with precipitation > 2"	1	3 - 4	4	4 - 5	*

HEAT WAVE PROJECTIONS FOR REGION 2

	Baseline 1971-2000	2020s	2050s	2080s	2100
# Days per year above 90˚F	12	19 - 25	31 - 47	38 - 77	*
# Days per year above 95˚F	2	2 - 5	5 - 12	7 - 28	*
# Heat waves per year	2	3	4 - 6	5 - 9	*
Average # days of each heat wave	4	5	5 - 6	5 - 7	*
# Days per year ≤ 32˚F	138	108 - 116	86 - 100	65 - 89	*

HEAT WAVE PROJECTIONS FOR REGION 5

	Baseline 1971-2000	2020s	2050s	2080s	2100
# Days per year above 90˚F	10	26 - 31	39 - 52	44 - 76	*
# Days per year above 95˚F	1	2 - 4	3 - 10	6 - 25	*
# Heat waves per year	1	3 - 4	5 - 7	6 - 9	*
Average # days of each heat wave	4	5	5 - 6	5 - 7	*
# Days per year ≤ 32˚F	155	127 - 136	104 - 119	84 - 109	*

SEA LEVEL RISE PROJECTIONS FOR THE HUDSON

	Baseline 1971-2000	2020s	2050s	2080s	2100
Mid-Hudson region	-	1 - 9"	5 - 27"	10 - 54"	11 - 71"
NYC/Lower Hudson region	-	2 - 10"	8 - 30"	13 - 58"	15 - 75"

FLOOD PROJECTIONS FOR COASTAL NY

	Baseline 1971-2000	2020s	2050s	2080s	2100
Increase in probability of 100-year flood	0%	20 - 50%	70 - 190%	140 - 610%	*
Flood height of 100-year flood	15'	15.3 - 15.7'	15.9 - 16.8'	16.5 - 18.3'	*

APPENDIX B

To learn more about climate change in the Hudson Valley and what communities and individuals can do, please visit the following links:

Sign up for our Climate Resilience Newsletter to receive occasional updates on funding, jobs, events and other opportunities in the Hudson River Estuary:

https://goo.gl/P0IIvb

Visit our page on climate change in the Hudson River Estuary:

http://www.dec.ny.gov/lands/39786.html

Download our climate fact sheet for the public for an introduction to climate hazards in the region:

https://goo.gl/yccfOH

Download our climate summary for communities, which provides more detailed information on climate projections and risks to humans and what we can do about it:

https://goo.gl/ePpjZE

Visit our page celebrating climate resilience case studies in Hudson River communities:

http://www.dec.ny.gov/energy/93950.html

Visit our page for more on why our climate is changing:

http://www.dec.ny.gov/energy/63848.html

Visit the New York State Energy Research and Development Authority (NYSERDA) page to download the entire ClimAID report:

http://www.nyserda.ny.gov/climaid

CONTACT INFORMATION

Libby Zemaitis

Climate Outreach Specialist, Hudson River Estuary Program

New York State Department of Environmental Conservation
21 S Putt Corners Road, New Paltz, NY 12561
(845) 256-3153 | libby.zemaitis@dec.ny.gov
www.dec.ny.gov

CLIMATE IMPACTS: ONLINE RESOURCES

To see the impacts of climate change where we live, go to https://www.epa.gov/climatechange

For a platform for visualizing climate and weather datasets, including a daily summary featuring several weather variables relative to a recent climate baseline, go to http://www.cci-reanalyzer.org

For air quality forecasts of our area go to

http://airquality.weather.gov/probe_aq_data.php?latitude=41.2121&longitude=-73.5767

For the official U.S. Drought Monitor go to http://droughtmonitor.unl.edu. The U.S. Drought Monitor is produced through a partnership between the National Drought Mitigation Center at the University of Nebraska-Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration.

For the 2015 Audubon Climate Report, including changes of summer and winter ranges for birds in our area, go to http://climate.audubon.org

National Audubon Society. 2015. Audubon's Birds and Climate Change Report: A Primer for Practitioners. National Audubon Society, New York. Contributors: Gary Langham, Justin Schuetz, Candan Soykan, Chad Wilsey, Tom Auer, Geoff LeBaron, Connie Sanchez, Trish Distler. Version 1.3.

For invasive plants in our area and to report more, go to http://www.imapinvasives.org

For a Forest Health aerial survey of Pound Ridge on the Town GIS, switch from the base map (third tab, upper right corner) on the GIS viewer. The survey is part of the 2011 Forest Health Aerial Survey Report, a narrative for the aerial observations from the 2011 general forest health aerial surveys conducted for New York State, associated ground crew observations, and other forest health related information. The aerial surveys were conducted by the Sketchmapper and region foresters from New York State Department of Environmental Conservation (NYSDEC) in cooperation with the USDA Forest Service. The survey will be more meaningful as data is collected over time.

To see the effect of sea level rise on Westchester County go to a map model from Westchester GIS at http://wcgis.maps.arcgis.com/apps/MapJournal/index.html?ap

To see CLIMATE SMART CERTIFICATION requirements: https://climatesmart.ny.gov/fileadmin/csc/documents/CSCC-ActionChecklist-6-6-2018.pdf

APPENDIX D

LEGEND: SOILS OF POUND RIDGE

Town GIS > Geology and Soil > Soil Map Unit

Legend	Soils of Westchester County
	Ce—Catden muck, 0 to 2 percent slopes
	ChB—Charlton fine sandy loam, 3 to 8 percent slopes
	ChC—Charlton fine sandy loam, 8 to 15 percent slopes
	ChD—Charlton fine sandy loam, 15 to 25 percent slopes
	ChE—Charlton loam, 25 to 35 percent slopes
	ClB—Charlton fine sandy loam, 3 to 8 percent slopes, very stony
	ClC—Charlton fine sandy loam, 8 to 15 percent slopes, very stony
	ClD—Charlton loam, 15 to 25 percent slopes, very stony
	ClE—Charlton loam, 25 to 35 percent slopes, very stony
	ClF—Charlton loam, 35 to 45 percent slopes, very stony
	CrC—Charlton-Chatfield complex, 0 to 15 percent slopes, very rocky
	CsD—Chatfield-Charlton complex, 15 to 35 percent slopes, very rocky
	CtC—Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes
	CuD—Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes
	DAM—Dam
	Ff—Fluvaquents-Udifluvents complex, frequently flooded
	Fr—Fredon silt loam
	HnB—Hinckley loamy sand, 3 to 8 percent slopes
	HnC—Hinckley loamy sand, 8 to 15 percent slopes
	HnD—Hinckley loamy sand, 15 to 25 percent slopes
	HrF—Hollis-Rock outcrop complex, 35 to 60 percent slopes
	Ip—Ipswich mucky peat, 0 to 2 percent slopes, very frequently flooded
	KnB—Knickerbocker fine sandy loam, 2 to 8 percent slopes
	KnC—Knickerbocker fine sandy loam, 8 to 15 percent slopes
	LcA—Leicester loam, 0 to 3 percent slopes, stony
	LcB—Leicester loam, 3 to 8 percent slopes, stony
	LeB—Leicester loam, 2 to 8 percent slopes, very stony
	Pa—Natchaug muck, 0 to 2 percent slopes
	Pc—Natchaug and Catden mucks, ponded, 0 to 2 percent slopes
	PnB—Paxton fine sandy loam, 3 to 8 percent slopes
	PnC—Paxton fine sandy loam, 8 to 15 percent slopes
	PnD—Paxton fine sandy loam, 15 to 25 percent slopes
	PoB—Paxton fine sandy loam, 0 to 8 percent slopes, very stony
	PoC—Paxton fine sandy loam, 8 to 15 percent slopes, very stony
	PoD—Paxton fine sandy loam, 15 to 25 percent slopes, very stony
	Pt—Pits, gravel
	Pv—Pits, quarry

	Pw—Pompton silt loam, loamy substratum
	Ra—Raynham silt loam
	RdA—Ridgebury loam, 0 to 3 percent slopes
	RdB—Ridgebury loam, 3 to 8 percent slopes
	RgB—Ridgebury loam, 2 to 8 percent slopes, very stony
	RhA—Riverhead loam, 0 to 3 percent slopes
	RhB—Riverhead loam, 3 to 8 percent slopes
	RhC—Riverhead loam, 8 to 15 percent slopes
	RhD—Riverhead loam, 15 to 25 percent slopes
	RhE—Riverhead loam, 25 to 50 percent slopes
	SbB—Stockbridge silt loam, 2 to 8 percent slopes
	Sh—Sun loam
	Sm—Sun loam, extremely stony
	SuA—Sutton loam, 0 to 3 percent slopes
	SuB—Sutton loam, 3 to 8 percent slopes
	Ub—Udorthents, smoothed
	Uc—Udorthents, wet substratum
	UdB—Unadilla silt loam, 2 to 6 percent slopes
	Uf—Urban land
	UhB—Urban land-Charlton complex, 2 to 8 percent slopes
	UhC—Urban land-Charlton complex, 8 to 15 percent slopes
	UhD—Urban land-Charlton complex, 15 to 25 percent slopes
	UlC—Urban land-Charlton-Chatfield complex, rolling, very rocky
	UlD—Urban land-Charlton-Chatfield complex, hilly, very rocky
	UmC—Urban land-Chatfield-Rock outcrop complex, rolling
	UpB—Urban land-Paxton complex, 3 to 8 percent slopes
	UpC—Urban land-Paxton complex, 8 to 15 percent slopes
	UpD—Urban land-Paxton complex, 15 to 25 percent slopes
	UrB—Urban land-Ridgebury complex, 1 to 8 percent slopes
	UvB—Urban land-Riverhead complex, 2 to 8 percent slopes
	UvC—Urban land-Riverhead complex, 8 to 15 percent slopes
	UwB—Urban land-Woodbridge complex, 3 to 8 percent slopes
	W—Water
	WdA—Woodbridge loam, 0 to 3 percent slopes
	WdB—Woodbridge loam, 3 to 8 percent slopes
	WdC—Woodbridge loam, 8 to 15 percent slopes

APPENDIX E

GUIDE TO REFERENCES TO THE WATERSHEDS AND SUBWATERSHEDS OF POUND RIDGE: NYS WATERS INDEX AND PRUP REPORT

WATERSHED CROTON WATERSHED	STATE DOCUMENT NYS WATERS INDEX	OWNER
Cross River	HR-31-P44-35- P109	Watershed 11, p. 185 Honey Hollow, headwaters originate in Ward Pound Ridge and flow to Cross River Reservoir See Watershed 10, p. 175 Ward Pound Ridge Reservation Drainage flows in all directions from Dancing Rock, into Watershed 2, Watershed 1, and Watershed 11
Lake Kitchawan	HR-31-P44-35-P109-6-7	Watershed 1, p. 47 Mostly in Lewisboro: water leaving the lake flows into western canals, into a northward-flowing stream-swamp complex, into Cross River and the Cross River Reservoir See Watershed 10, p. 175 Ward Pound Ridge Reservation Drainage flows in all directions from Dancing Rock, into Watershed 2, Watershed 1, and Watershed 11
Stone Hill River	HR-31-P44-36	Watershed 2, p. 57 Bounded by the south-western ridge of Ward Pound Ridge Reservation See Watershed 10, p. 175 Ward Pound Ridge Reservation Drainage flows in all directions from Dancing Rock, into Watershed 2, Watershed 1, and Watershed 11 See Watershed 3, p. 75 Blue Heron Lake Flows to the pitch swamp of Bedford and to the Stone Hill River

WATERSHED LONG ISLAND WATERSHED	STATE DOCUMENT CT STATE	OWNER
Mianus River	Conn-4	Watershed 5, p. 103 Parallels the Mianus River, includes Twin Lakes, Robin Hood Lake, Highland Lake
East Branch	Conn-5	Watershed 7, p. 127 Shad Roads including White Birch and Rockrimmon Golf Course
Mill River	Conn-6	Watershed 4, p. 87 Originates in Ct and flows through the town's central corridor
Mill River	Conn-7	Watershed 9, p. 163 Barnegat Scotts Corners
Mill River	Conn-8	Watershed 8, p.139 Mill River South The Hamlet, Sarles Corners, part of Indian Hill and Scotts Corners Watershed 9, p. 163 Barnegat Scotts Corners
Mill River	Conn-9	Watershed 6, p. 115 Located in the extreme eastern section of town
Mill River	Conn-10	

Sources:
6 CRR-NY 864.6
6 CRR-NY 936.6
Water and Land Resource Study, Town of Pound Ridge, NY (1979). Environmental Assessment Associates, Inc.

Land Use Through Ecology: A Case Study of Pound Ridge, New York (1979). Jerzy E. Glowczewski SARP, AIA Assoc. sponsored by Pound Ridge United for Planning (PRUP) Trust.

Connecticut Watersheds
http://www.arcgis.com/home/item.html?id=f23e5ff1a03e4374be5db9257bae63b0

APPENDIX F

MUNICIPAL PROFILES IN WESTCHESTER COUNTY, NY.
American Community Survey, 2005-2009

POUND RIDGE

POPULATION DATA

Total Population:	**4,920**

Area and density:

Square miles:	23.1
Persons per square mile*:	212.9

Population by race and Hispanic origin

White:	4,565	98.2%
Black:	27	0.5%
American Indian:	0	0.0%
Asian :	41	0.8%
Other:	168	3.4%
Two or more races:	119	2.4%
Hispanic (may be of any race):	365	7.4%

Age

Under 5:	391	7.9%
5-17:	1,070	21.7%
18-34:	321	6.5%
35-64:	2,474	50.3%
65-84:	620	12.6%
85 and over:	44	0.9%

Place of birth and citizenship

Native:	**4,469**	**90.8%**
Born in New York State:	2,915	59.2%
Born in Different State:	1,525	31.0%
US Citizen Not Born in US:	29	0.6%
Foreign Born:	**451**	**9.2%**
Naturalized Citizen:	218	4.4%
Not a Citizen:	233	4.7%

Top countries of origin

Italian	557
English	534
Irish	508
Russian	376
German	316

Ability to speak English

	People in language group	People who cannot speak English well	% of language group
Spanish Speaking:	113	0	0.0%
Other Indo-European:	167	0	0.0%
Asian Speaking:	11	0	0.0%

HOUSEHOLD DATA

Total Household:	**1,701**
Average household size:	2.82

Family Households (families):	1,456
Children under 18 in Family Households:	1,248
Married-couple families:	1,309
Married-couples with children under 18:	630
Female-headed households:	119
Children in Female-headed households:	155
Non-family households:	289
Householder living alone:	201
Householder 65+ living alone:	79

Children under 18 living in single-parent households:	155

HOUSING DATA

Total housing units:	**1,830**

Housing occupancy and tenure

Occupied housing units:	1,701	93.0%
Vacant units:	129	7.0%
Owner-occupied:	1,611	94.7%
Renter-occupied:	90	5.3%

Housing units in structure

Single-family:	1,802
2 to 9 units:	29
10 to 19 units:	0
20 to 49 units:	0
50 or more units:	0
Mobile home / other:	0

Year housing built

Median Year Built:	1,966
2000 or later:	171
1990 to 2000:	124
1980 to 1989:	317
1970 to 1979:	256
1960 to 1969:	224
1950 to 1959:	308
1949 or earlier:	430

Monthly renter costs

Average rent:	$1,606	
Housing Units by Range in Rent		
Total specified renter units:	90	100.0%
<$500:	0	0.0%
$500— 800:	0	0.0%
$800— 1,249:	13	14.4%
$1,250— 2,000:	17	18.9%
$2,000 or more:	29	32..2%
No cash rent	31	34.4%

Cost-burdened households

Total specified households:	1,289
Cost-burdened Renters:	22
Cost-burdened Owners w/ mortgage:	327

Overcrowded housing units

Total occupied housing units:	1,701	100.0%
Persons per room		
1 or less:	1,694	99.6%
1 to 1 1/2:	7	0. 4%
1 1/2 to 2:	0	0.0%
2 or more:	0	0.0%

EDUCATION DATA

Educational attainment

Total persons 25 and over:	3,304	100.0%
No HS Diploma:	77	2.3%
High School Graduate:	178	5.4%
Some College:	312	9.4%
Associate's:	143	4.3%
Bachelor's:	1,033	31.3%
Graduate Degree or Higher:	1,561	47.2%

School enrollment

Total persons 3 and over enrolled in school:	1,353
Preschool / kindergarten:	135
Elementary:	787
High School:	232
College:	139
Graduate or Professional School:	60

EMPLOYMENT DATA

Employment

Total civilian labor force:	2,352

Occupation of residents

Total employed residents:	2,277	100.0%
Management:	1,622	71.2%
Services:	61	2.7%
Sales and office:	412	18.1%
Construction:	55	2.4%
Production and transport:	127	5.6%
Farming:	0	0.0%

Residents commuting to work

Average travel time to work:	42 minutes	
Total commuters 16 and over:	**1,941**	**88.6%**
Drove to work alone:	1,352	69.7%
Carpooled:	112	5.8%
Public transportation:	288	14.8%
Other means:	189	9.7%
Worked at home:	**250**	**11.4%**

INCOME DATA

Household Income

Per capita:	$126,309
Average household:	$193,624
Average family:	$229,791
Households by Income Range	
Total households:	1,701
Less than $15,000:	23
$15,000 to $29,999:	72
$30,000 to $44,999:	51
$45,000 to $59,999:	79
$60,000 to $74,999:	56
$75,000 to $99,999:	109
$100,000 to $149,999:	211
$150,000 or more:	1,100

Poverty status

Total poverty universe**:	4,920	100.0%
Total persons in poverty:	129	2.6%

Prepared by:
Westchester County Department of Planning
148 Martine Avenue
White Plains, New York 10601
(914) 995-4400

Source:
U.S. Census Bureau American Community Survey (ACS) 2005-2009. Note that this data is based on a sample, and contains a margin of error which can be obtained through the Census Bureau's American FactFinder website. For information on the difference between the ACS and the Decennial Census, see:
http://planning.westchestergov.com/census-and-statistics

*Square mileage represents land area and inland water-bodies, but does not include Hudson River or Long Island Sound areas and their inlets within a municipality.

**The Total Poverty Universe number differs from the Total Population number because not all people included in the American Community Survey sample reported on their income. For more information visit the American FactFinder on the U.S. Census Bureau website.

OPEN SPACE: ONLINE RESOURCES

DESIGNYOURTOWN.ORG

This online resource brings together practical design solutions and implementation tools that link best practice designs to best practice implementation strategies for comprehensive community planning. The tools included are targeted to be used by citizen planners and advocates dedicated to good community design, sustainable economic development, and smart growth. The material also informs prospective developers on best practices, and professional planners can use this as a training tool in their client communities.

The website covers these essential aspects of comprehensive community planning:

Places – Where to Grow
Preferred patterns are explained in detail for each of several prototypical places: downtowns, edges of downtowns, corridors, crossroads, new neighborhoods, rural places.

Details – What to do
Best practice details are explained for nature (green infrastructure), links (connectivity) and communities (mixed-use).

Tools and Actions – How to do it
Implementation is explained in terms of planning, regulation and administration.

CLIMATE SMART COMMUNITY TOOLKIT

http://nyslandusetoolkit.us/?c=60&t=2097

The Climate Smart Communities Toolkit allows New York communities to find recommended practices that will help to reduce greenhouse gas emissions specifically in the areas of land use, transportation policy, green building, infrastructure investment, green infrastructure, and housing policy. The toolkit is designed to provide results based on local characteristics and priorities.

At this time the toolkit does not contain a database of each community's existing codes, practices, or ordinances.

HUDSON VALLEY NATURAL RESOURCE MAPPER

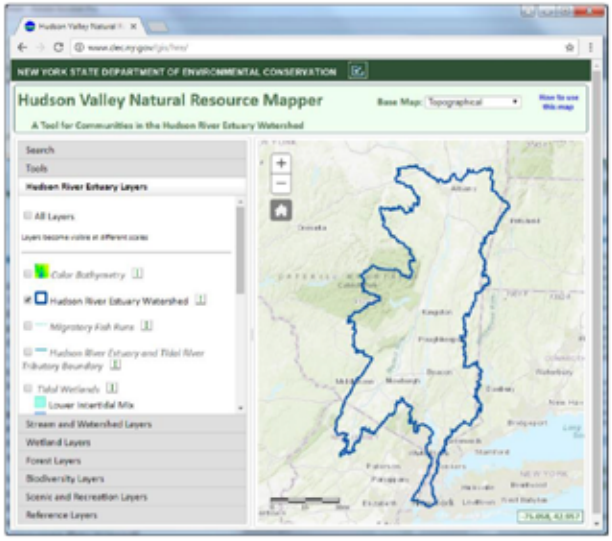
NEW YORK STATE OF OPPORTUNITY. | Hudson River Estuary Program

A Tool for Communities in the Hudson River Estuary Watershed

The Hudson Valley Natural Resource Mapper is an online, interactive tool to assist local land-use decision-makers with identifying and understanding important habitat and water resources, the connections between them, and their broader regional context. By having information about natural features such as stream habitat, floodplains, wetlands, and large forests, communities can begin to identify conservation priorities and strategies that can be incorporated into land-use planning. Ultimately, this process will help ensure that future generations continue to enjoy the numerous benefits of the Hudson Valley's significant natural systems.

The mapper also highlights Hudson River recreation sites and other areas where residents and visitors can access and enjoy the region's natural beauty. Use the mapper to learn about places to visit and the environmental resources they support!

Link: http://www.dec.ny.gov/lands/112137.html



NATURAL RESOURCE MAPPER INFORMATION LAYERS

Estuary
- Hudson River Bathymetry
- Migratory Fish Runs
- Hudson River Estuary and Tidal River Tributary Boundary
- Submerged Aquatic Vegetation
- Tidal Wetlands
- NYS Department of State Significant Coastal Fish and Wildlife Habitats

Streams and Watersheds
- Watershed Boundaries
- Riparian Buffer Areas
- DEC Biomonitoring Data
- Dams and Priority Road-Stream Crossings
- DEC Priority Waterbodies
- DEC Waterbody Classifications and Trout Status
- FEMA Flood Hazard Areas

Wetlands
- National Wetlands Inventory
- DEC Freshwater Wetlands and Check Zones
- Wetland Soils

Forests
- Large Forests
- Matrix Forest Blocks
- Forest Linkage Zones

Biodiversity
- Known Important Areas for Rare Animals
- Known Important Areas for Rare Plants
- Significant Natural Communities
- Audubon Important Bird Areas
- Significant Biodiversity Areas in the Hudson Valley

Scenic and Recreation
- Hudson River Fishing and/or Boat Launch Access
- NYS Parks and Historic Sites
- DEC Lands
- Scenic Areas of Statewide Significance

Reference
- Town, City, Village, and County Boundaries
- Tax Parcels
- NY Protected Areas

Using the Natural Resource Mapper

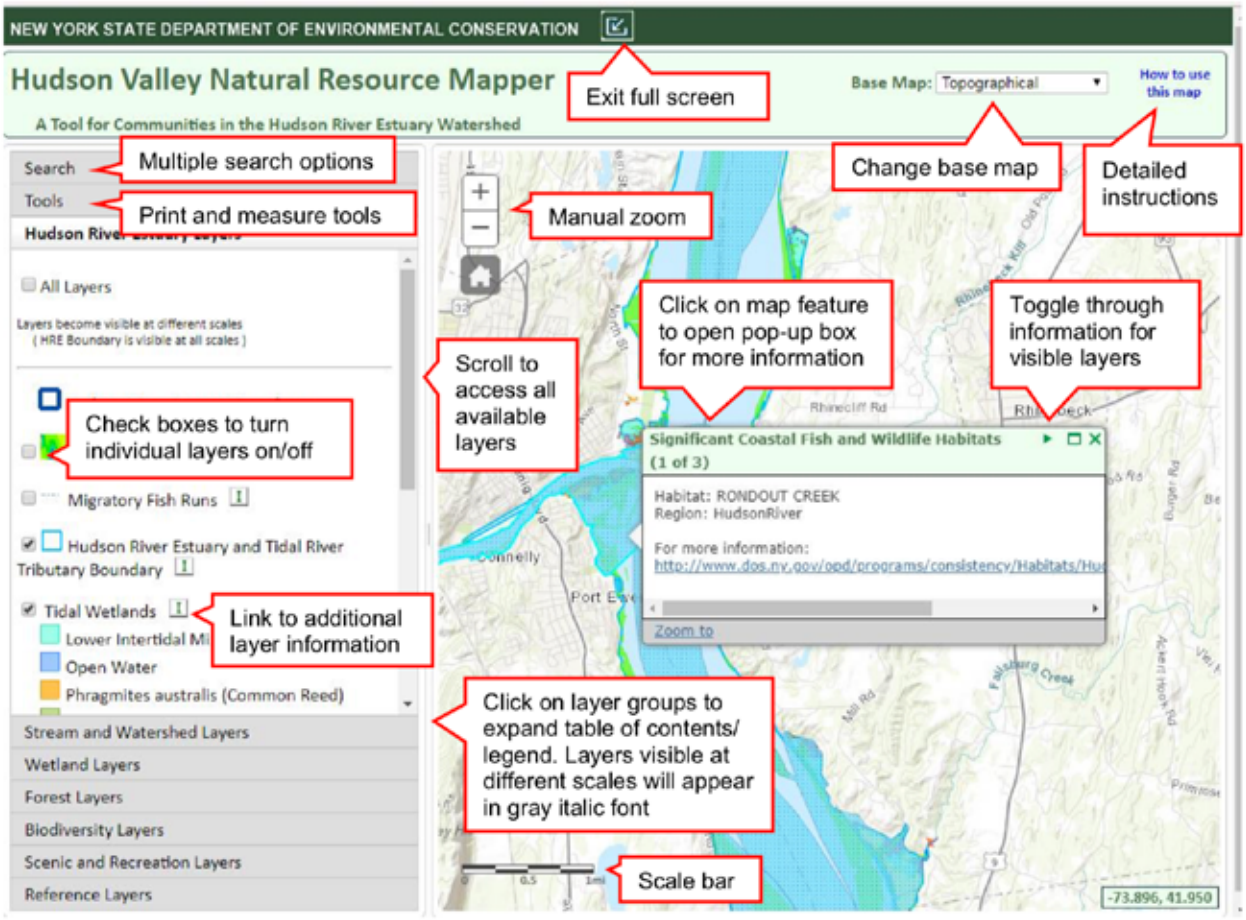
The mapper can help to visualize an area's resources—where they occur and how they relate to each other, their context, and existing development—and provide a foundation for land-use planning and decision-making. Use the mapper to inform:

- Public education and outreach
- Preliminary site analysis for environmental review
- Identification of conservation priorities
- Natural resources inventories
- Comprehensive planning and zoning updates
- Watershed assessment and planning
- Open space planning and land acquisition

IMPORTANT NOTE:

This tool is intended for general information and planning purposes and does not indicate the extent of DEC regulatory authority. It contains data compiled from numerous sources and may not be complete or accurate. Any resource shown on a map should be verified for legal purposes, including environmental review. Contact your DEC regional office for assistance with regulatory questions. Hudson River Estuary Program staff can assist with interpreting and using the data provided.

Quick Tour of the Natural Resource Mapper



CONTACT INFORMATION

Ingrid Haeckel
Conservation and Land Use Specialist
845-256-3829 | ingrid.haeckel@dec.ny.gov
www.hudson.dnr.cals.cornell.edu

New York State Department of Environmental Conservation
21 South Putt Corners Road
New Paltz, NY 12561
www.dec.ny.gov/lands/5094.html

A special note of gratitute t o Fog Design,
Pound Ridge, NY for generously donating
enormous amounts of time and talent
to this effort.


Pound Ridge
Conservation Board
PROTECTING OUR ENVIRONMENTAL
HEALTH AND NATURAL RESOURCES