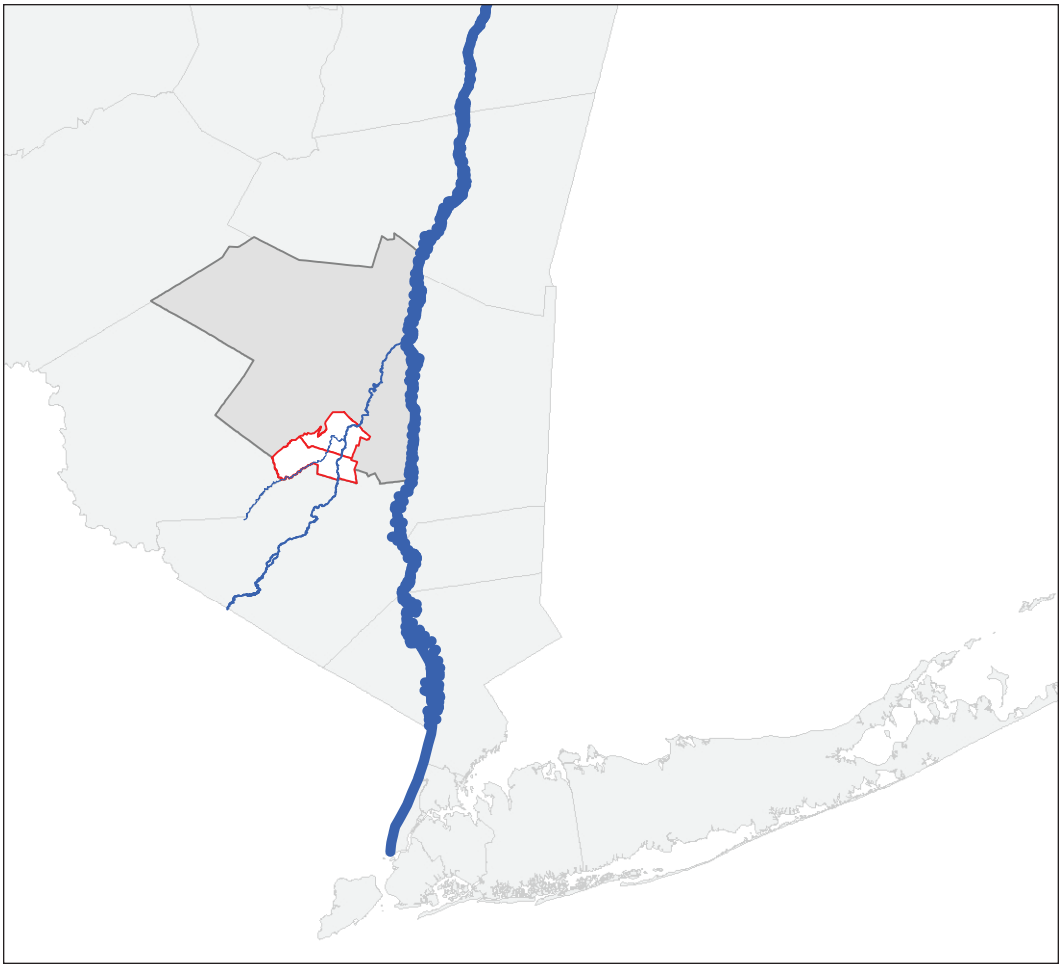
Habitat Map Report
Gardiner and Shawangunk
Ulster County, New York



Report to the Town of Gardiner, the Town of Shawangunk,
and the Hudson River Estuary Program of the New York State DEC

Prepared by Angela Sisson
April, 2014

Acknowledgements

This Project has been funded by a grant from the New York State Environmental Protection Fund through the Hudson River Estuary Program of the New York State Department of Environmental Conservation. For this, we are very grateful.

We are most grateful to Gretchen Stevens from Hudsonia for her invaluable assistance and guidance. Thanks to Laura Heady for being there throughout.
Thanks also to Kelly Farrell and Andrew Meyer of Hudsonia Ltd.

Thanks to the intermunicipal habitat team members for their many hours of volunteer work.
Anne Bienstock
Joe Bridges
Josh Clague
Liana Hoodes
Hatti Langsford
Rob Lathrop
Patty Lee Parmalee
Ashley Sapir
Anne Albright Smith
David Straus
And thanks to earlier Gardiner team members: Al Wegener, Nadine Lemmon and Mercy Ebbert.

Thanks to the Town of Shawangunk and especially John Valk, Jr., Ellen Bistor, Robin Kaufmann, and Kris Pedersen.
Thanks to the Town of Gardiner and especially Carl Zatz, and members of the ECC.

Thanks to property owners who provided access for site visits.
Jay and Polly Armour
Anne Bienstock
Steven Clarke
Susan Eckhardt
Nadine Lemmon
Carol LeFevre
Phillies Bridge Farm
Boria Sax
Seldon Spencer
David Straus
Warren Wiegand

We wish to thank Jill Shaw and Karen Strong of the Hudson River Estuary Program for their guidance and patience.

For providing GIS data, we thank New York State GIS Clearinghouse, Ulster County Information Services, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, Cornell University Geospatial Information Repository, and New York Natural Heritage Program.

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About This Report

This report is the companion to the Habitat Map of Shawangunk and Gardiner. The habitat map was funded by a grant from the New York State Environmental Protection Fund through the Hudson River Estuary Program of the New York State Department of Environmental Conservation

The information provided in this report has been largely adapted from the *Biodiversity Assessment Manual for the Hudson River Estuary Corridor* (Kiviat and Stevens 2001), hereinafter referred to as the Hudsonia Manual. A recent report on Woodstock's habitats—*Significant Habitats in the Town of Woodstock, Ulster County, New York* (Haeckel et al. 2012)—was used as a model for the format and much of the habitat information in this report.

Important Terms

Ecologically Significant Habitats

1. Habitats which are rare or declining in the region.
2. Habitats that support rare species or other species of conservation concern.
3. High quality examples of common habitats. For example, habitats that are very large or isolated from humans, or provide links between high quality habitats.
4. Complexes of connected habitats that have significant biodiversity value by virtue of size or composition.

Species of Conservation Concern

Species of conservation concern are those wildlife species that show evidence of population declines, or appear to be in need of concentrated conservation actions. Species of conservation concern include protected, state & federal listed, and unprotected, including regionally rare, plant and animal species.

Introduction

The towns of Gardiner and Shawangunk lie adjacent to one another in southern Ulster County, New York State. They share many natural and cultural features. Both are bounded on the west by the Shawangunk Mountain ridge (the ridge) with the Hudson River about 10 miles to their east. The ridge includes a vast area of parkland—Minnewaska State Park Preserve, Mohonk Preserve, and Sam's Point Preserve—representing over 32,000 protected acres. (Minnewaska State Park—21,000 acres; Mohonk Preserve—7000 acres; and Sam's Point Preserve--4600 acres)

Just 75 miles north of New York City, the New York State Thruway provides fast access to this rural and exceptionally scenic region, drawing visitors from the city, both weekend residents and vacationers. This proximity and accessibility has over recent years intensified development pressure in both towns. To address and manage this growth, Gardiner adopted an open space plan in 2006. The plan can be found on line at www.townofgardiner.org/Gardiner_Open_Space_Plan.cfm.

Shawangunk adopted an open space inventory in 2004. The inventory can be found on line at www.shawangunk.org/pdf/enviro/Shawangunk-Open-Space-Analysis.pdf.

Biodiversity Assessment Training

As part of their commitment to open space planning, both towns supported projects which helped to identify valuable natural resources when representatives received training in habitat assessment from Hudsonia. (Hudsonia Ltd., located in Annandale, New York, is a not-for-profit institute focused on research, education, and technical assistance in the environmental sciences.) In 2001 a group of volunteers from Shawangunk undertook Hudsonia's first 10-month Biodiversity Assessment Training (BAT) program producing a habitat map and report on an area along the Shawangunk Kill corridor. In 2005 a volunteer group from Gardiner underwent the 10-month BAT program focusing on a 5000-acre area lying east of the Wallkill River in Gardiner. The group completed a draft habitat map with report, presenting both to the town in 2007. The BAT projects were funded by the Hudson River Estuary Program of the New York State DEC.

In 2006 the towns applied for and received a $30,000 intermunicipal grant from the Hudson River Estuary Program to map habitats in both towns. The intermunicipal habitat map is the subject of this report. The grant budget included expenses for GIS (Geographic Information System) map digitizing and GIS software for both towns and required a matching amount from the grant recipient. (The recipient match has been provided by volunteer labor.) In 2007 a habitat team, representing volunteers from both Shawangunk and Gardiner, formed to undertake the intermunicipal project. From 2007 to 2010 the team met and conducted a number of site visits within the towns. Beginning in 2010, habitats from both towns were digitized on a GIS map by a consultant. The digitized habitat map was completed in 2013.

Study Area

The study area, or focus area for this project includes the entire geographic area of both Shawangunk and Gardiner totaling about 100 mi2 or over 64,000 acres (36,000 acres in Shawangunk and 28,000 acres in Gardiner). The towns share natural features such as the ridge and valley landscape, major watersheds and agricultural land along with cultural characteristics such as intensely developed central hamlets. The combined population of the study area per 2010 census is about 20,000 (14,300 in Shawangunk and 5,700 in Gardiner).

The land in the study area slopes from the high elevations of the forested ridge east to the Shawangunk Kill and Wallkill River valleys. The highest elevation in the study area is just over 2100 ft ASL (above sea level) in Shawangunk near Sam's Point. The Gardiner section of the ridge includes elevations near 2000 ft ASL as well. From these cliff-tops the land slopes to the lowest elevation in the study area, 180 ft ASL where the Wallkill River exits Gardiner at the northern boundary. The Hillshade Map illustrates the relationship and orientation of ridge and valley.

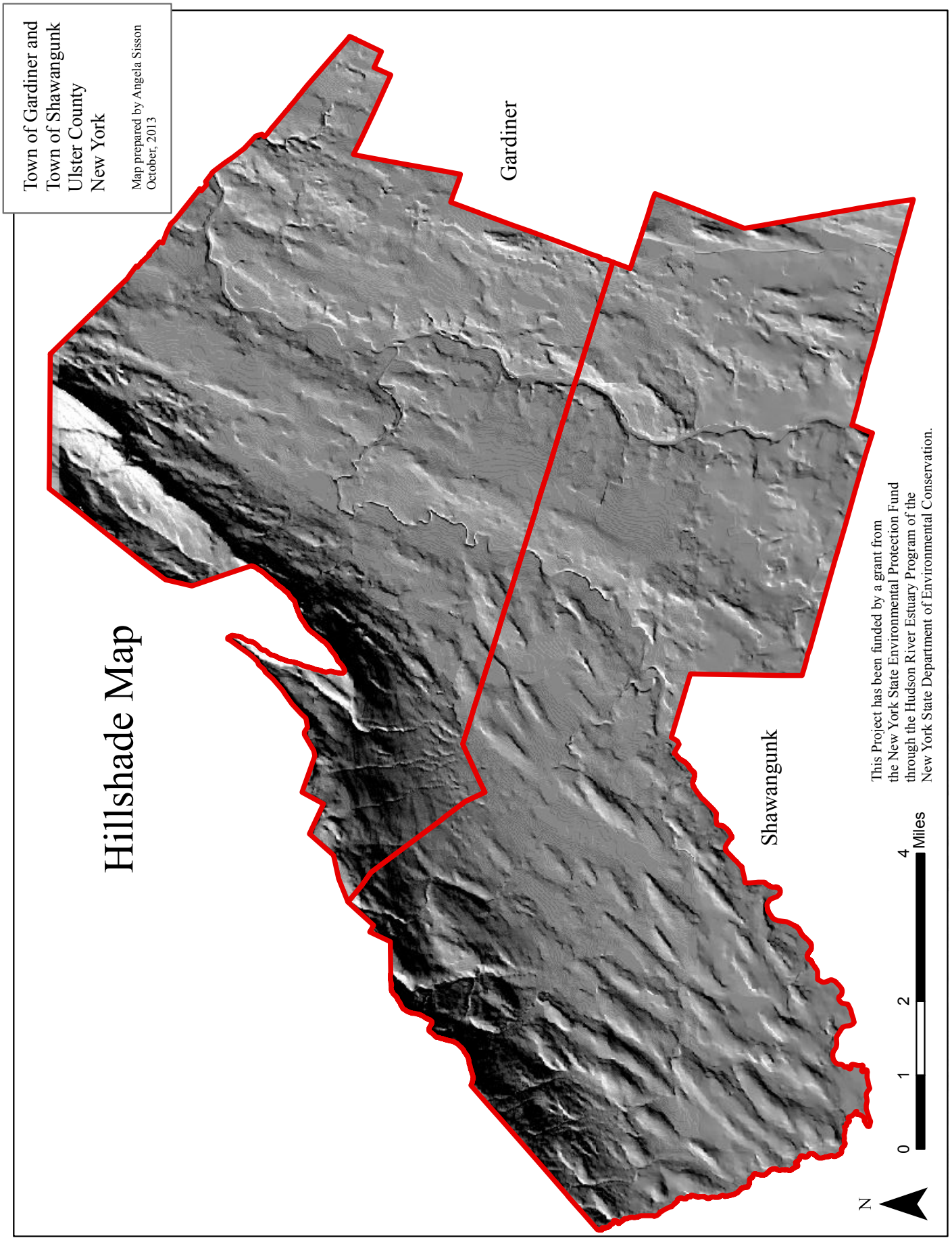
An intricate system of streams and rivers drains the surface water of the study area. The north-flowing Shawangunk Kill drains the western slopes and flows into the Wallkill River just south of the 44-55 bridge. The watershed or basin of the north-flowing Wallkill River includes the entire study area with the exception of the Coxing Kill on the northwest border of Gardiner, which makes its way north to the Hudson River via Rosendale. The stream system is interconnected with a large network of wetlands and water-bodies in the study area.

Though there are many large, privately owned parcels in the study area, the vast majority of parcels are less than 25 acres. Much of the most scenic and biologically fragile land in the study area is protected or immediately adjacent to protected park land. The Protected Lands Map shows the portions of Minnewaska State Park and Mohonk Preserve which fall within Gardiner. (Sam's Point Preserve lies adjacent to Shawangunk just outside the study area.) A number of smaller conservation easements which include private parcels in the study area and the rail trail in Gardiner also restrict development.

Biodiversity

Assessing biodiversity in order to protect it is the focus of this project. Biological diversity or biodiversity as the term is used here, is a concept which includes all of life and all of life's processes. In addition to biological communities of plants, animals and other living organisms (such as bacteria and fungi), biodiversity includes interactions with non-biological or abiotic components such as soil, water, air and sunlight. Protecting biodiversity helps maintain healthy ecosystems, which in turn sustain all of life including human life.

The study area includes two areas which have been recognized by a New York State DEC report, Wildlife and Habitat Conservation Framework (Penhollow et al. 2006). The report identifies the Shawangunk Kill/Shawangunk Grasslands and the Shawangunk Ridge as "Significant Biodiversity Areas." Recommendations for protecting the biodiversity of these regions are provided in the DEC's report, which can be found on their website.


Town of Gardiner and
Town of Shawangunk
Ulster County
New York
Map prepared by Angela Sisson
October, 2013
Hillshade Map
Gardiner
Shawangunk
This Project has been funded by a grant from
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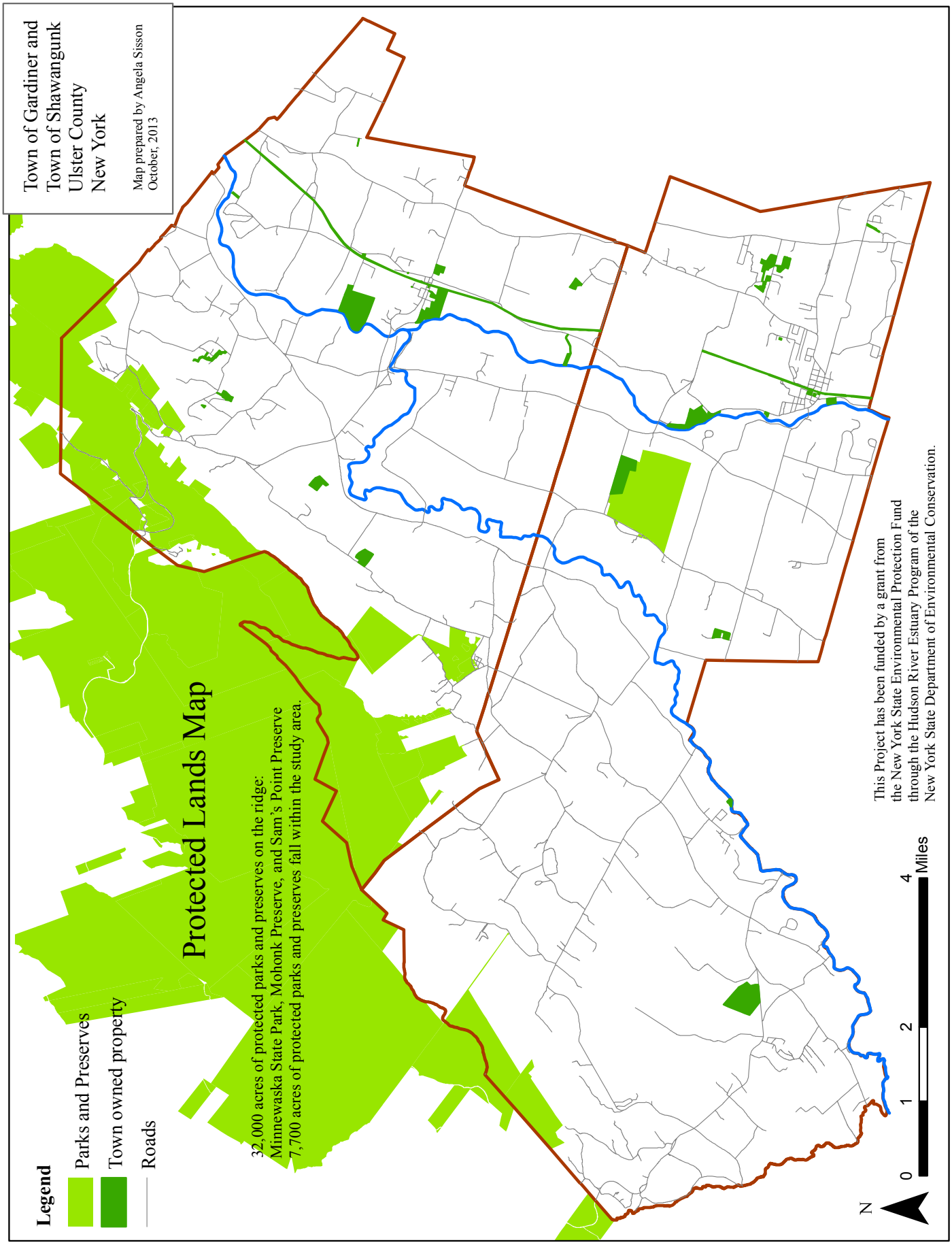
Town of Gardiner and
Town of Shawangunk
Ulster County
New York
Map prepared by Angela Sisson
October, 2013
Protected Lands Map
32,000 acres of protected parks and preserves on the ridge:
Minnewaska State Park, Mohonk Preserve, and Sam's Point Preserve
7,700 acres of protected parks and preserves fall within the study area.
Legend
Parks and Preserves
Town owned property
Roads
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Miles
This Project has been funded by a grant from
the New York State Environmental Protection Fund
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New York State Department of Environmental Conservation.

Methods

The habitat map for this project was created primarily using remote sensing techniques. Some field verification of habitats was conducted by volunteer habitat teams during the early stages of the project. Habitats can be predicted remotely because of their close ties to land features such as soil type, topography, and vegetation. Maps showing this information are used to identify the type of habitat which will occur under those conditions.

Field Verification

In the initial stages of the project, preliminary predictions of habitats were made and outlined on a draft habitat map which was used for field verification by the volunteer habitat team. A number of site visits were then made by the team to both gather specific information on the habitats and to verify the accuracy of the predicted habitats. Over a period of three years (2007 to 2010) approximately 15 site visits were conducted by the team. Two municipal sites on the Wallkill River, the Gardiner land fill (104 acres) and the Shawangunk land fill (29 acres), received extensive site visits and reports. The two reports on the municipal properties are attached in the Appendix.

Map Analysis

The next stage of the mapping, after field verification of predicted habitats, commenced with GIS map overlays. Geographic information system, or GIS, is a computer program which allows the user to create, view, and manipulate multiple layers of map data and attach information—or a database—to the various data layers. (Google Earth is an example of a GIS incorporating map layers that can be turned on and off.) Various kinds of map data such as soils, topography, and hydrology were layered on top of an aerial-photo base map. Then the habitats were manually "digitized" on a computer screen. Digitizing here simply means drawing with a computer mouse onto a map image. The drawing or digitizing created a separate and new habitat map layer.

Because the study area was mapped remotely with limited field verification, the habitat boundaries should be considered approximate.

Digital Resources

The following digital and map resources were employed:

-*GIS Data* The program used was ArcGIS version 10.0 by ESRI (Environmental Systems Research Institute, Inc.). A number of different map layers were used including roads, municipal boundaries, and NYS wetlands obtained from the NYS GIS Clearinghouse website. Floodplain maps were obtained from the FEMA website. NWI (National Wetlands Inventory) map data were obtained from the US Fish and Wildlife Service website. Tax parcel maps containing general information on parcels and public lands were obtained from Ulster County Information Services.

-*USGS (US Geological Survey) topographic maps* (7.5 minutes quadrangles for Clintondale, Ellenville, Gardiner, Mohonk Lake, Napanoch, Pine Bush, Walden, Wurtsboro). The GIS map format was a DRG (digital raster graphic). Topographic maps contain important landscape information such as elevation contours, a few surface water features and cultural features such as roads and structures.

-*DEM (Digital Elevation Model)* (7.5 minutes quadrangles for Clintondale, Ellenville, Gardiner, Kerhonkson, Mohonk Lake, Napanoch, Newburgh, Pine Bush, Rondout Reservoir, Rosendale, Walden, Wurtsboro) obtained from CUGIR (Cornell University Geospatial Information Repository). DEM's are useful for developing watershed, hillshade and other imagery which requires elevation information.

-*Soil Survey of Ulster County, New York* (Tornes 1979). A digital overlay provided by NRCS (Natural Resources Conservation Service of the USDA) was used in the GIS. Information contained in the soil survey such as drainage, depth and pH indicate the type of habitat likely to occur on a site. For example, poorly drained soils usually indicate the presence of a wetland.

-*Orthophotos* high resolution (1 pixel = 1 foot) color infrared taken spring 2001 and high resolution natural color taken spring 2009. Orthophotos were used as the aerial "base map" for digitizing habitat boundaries on the computer. Orthophotos were obtained from the NYS GIS Clearinghouse website.

-*Aerial photographs* 1:40,000 scale, stereoscopic aerial prints from the NAPP (National Aerial Photography Program) series taken in spring 1994 obtained from US Geological Survey. Viewed in pairs with a stereoscope, these prints provide a three-dimensional image of the landscape and are useful in identifying a variety of landscape features.

-*Geospatial database for the northern Shawangunk Mountains* Originally described in: Biasi, F., D. Morse, J. Thompson and M. Batcher 1997; used by the Shawangunk Ridge Biodiversity Partnership 2003 for management guidelines. The database uses *Ecological Communities of New York State* (Edinger et al. 2002) for vegetation types and was useful in verifying many of the habitats on the ridge.

Results – Types of Habitats

The **Habitat Map** included with this report shows a diversity of habitats distributed across the study area. At such a large scale however (report map scale is 1:100,000), small habitats and detail is lost. (Finer detail is shown on the large-format printed maps stored with each town. Higher resolution digital-pdf maps are available from the towns as well.)

About 56,400 acres of the 64,800-acre study area or 87% was mapped as significant habitat. The remaining 13% or 8,400 acres was mapped as developed. In total, 24 habitat types were identified and mapped along with the developed or non-habitat areas.

The majority of mapped habitats were common types such as upland forest and upland meadow. There were, however, noteworthy exceptions as well. The steep slopes and shallow soils of the ridge landscape supports rare habitats such as cool ravine, rocky barren, and crest/ledge/talus along with very large contiguous forests. Though the valleys are more developed they also support rare habitats such as kettle shrub pools and even a cool ravine along with large contiguous meadows. Both large contiguous forests and large contiguous meadows were abundant in the study area. In all, 26% of the study area was forested with patches exceeding 500 acres in size and 4% of the study area supported meadow patches exceeding 100 acres in size. A list of the different habitats along with their distribution and extent is on the **Habitat Table**.

All of the habitats have been altered to varying degrees by human activities. More alteration and disturbance has occurred near developed areas and along habitat edges. Difficult access areas have been more protected from disturbance. Human and now animal disturbance as well has introduced many species of invasive plants which displace native plants and can degrade habitats. Though it is likely that most of the habitats have endured some degree of degradation, the map cannot provide information on quality and condition.

The habitat descriptions in the following pages contain a number of ecological attributes. The codes given with each species name denote its conservation status. Codes include New York State ranks (E, T, R, SC), NY Natural Heritage Program ranks (S1, S2, S3, SH), NYS Species of Greatest Conservation Need (SGCN), and Hudsonia's regional ranks (RG). Bird species rankings are by Partners in Flight which indicate high conservation priorities at the continental (PIF1) and regional (PIF2) level. These ranking systems are explained in the Appendix.

Perennial Stream

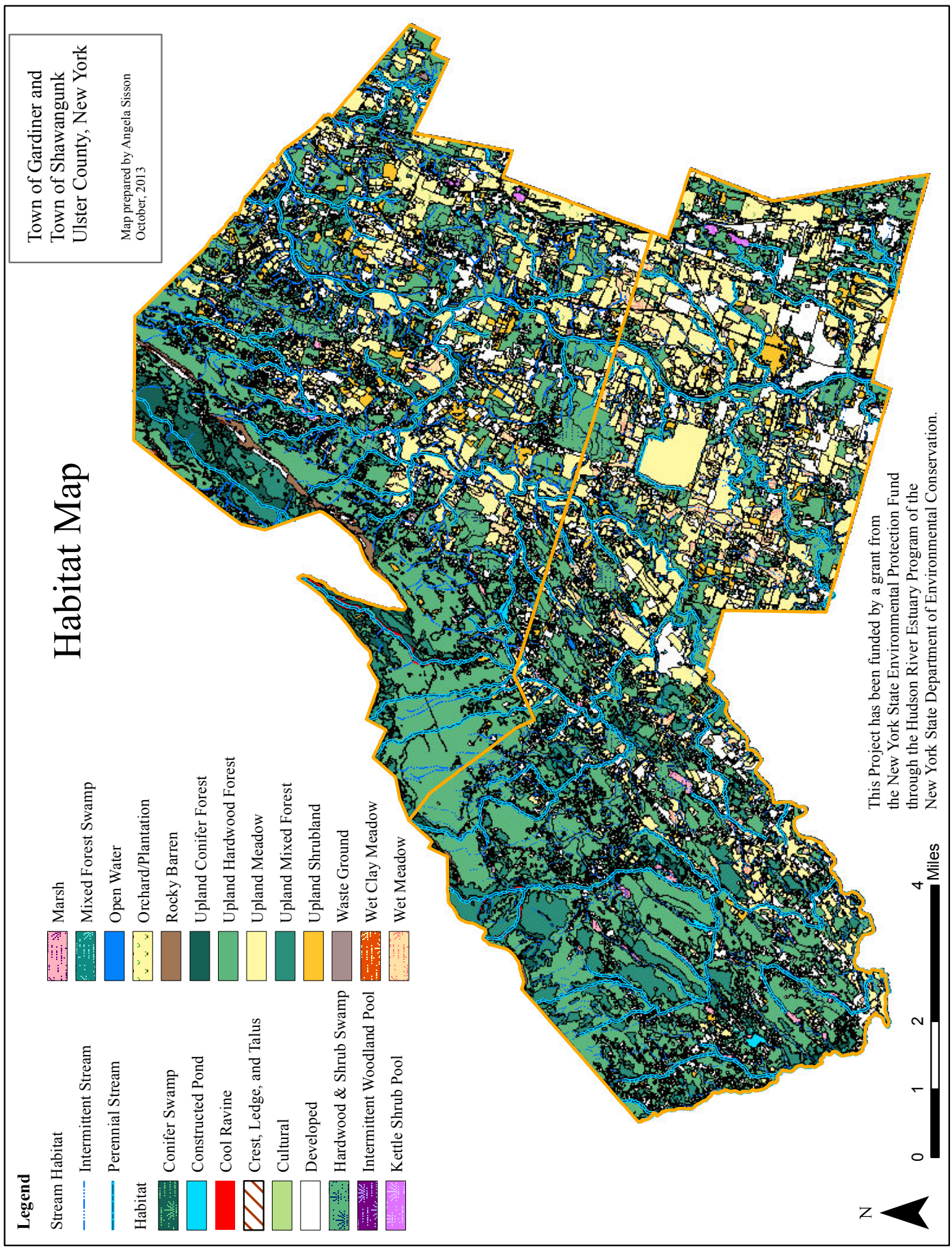
Perennial streams are natural or artificial watercourses (altered or channelized streams and roadside drainage ditches) that flow year-round during years of normal precipitation.

Watershed

Several perennial streams occur in the study area and, except for the Coxing Kill at the northwest edge of Gardiner, all of them flow either directly to the Wallkill River or to the Shawangunk Kill which then flows to the Wallkill River. The Coxing Kill flows north into the Rondout Creek at Rosendale. Though some of the streams shared by the towns flow from Gardiner into Shawangunk (on the western edge), most of the streams flow north, from Shawangunk into Gardiner. The primary streams—Shawangunk Kill and Wallkill River—both flow north from Shawangunk into Gardiner. A few of these streams originate in the study area whereas others originate outside the area and pass through it.

Map Identification

Perennial streams are identified on USGS topographic maps as a solid blue line. Several perennial streams are shown on those USGS quadrangles used to prepare the habitat map.


Habitat Map
Town of Gardiner and
Town of Shawangunk
Ulster County, New York
Map prepared by Angela Sisson
October, 2013
Legend
Stream Habitat
Intermittent Stream
Perennial Stream
Habitat
Conifer Swamp
Constructed Pond
Cool Ravine
Crest, Ledge, and Talus
Cultural
Developed
Hardwood & Shrub Swamp
Intermittent Woodland Pool
Kettle Shrub Pool
Marsh
Mixed Forest Swamp
Open Water
Orchard/Plantation
Rocky Barren
Upland Conifer Forest
Upland Hardwood Forest
Upland Meadow
Upland Mixed Forest
Upland Shrubland
Waste Ground
Wet Clay Meadow
Wet Meadow
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Habitat Table page 1 of 2

Habitat Includes Developed (Non-habitat)	Gardiner approx 28,000 acres	Shawangunk approx 36,000 acres	Entire Study Area approx 64,000 acres
Conifer Swamp	59 acres	77 acres	136 acres
Constructed Pond	182 acres	232 acres	414 acres
Cool Ravine	123 acres	102 acres	225 acres
Crest, Ledge, Talus	169 acres	4 acres	173 acres
Cultural	69 acres	33 acres	102 acres
Developed	3,227 acres	5,151 acres	8,378 acres
Hardwood & Shrub Swamp	3,153 acres	4,656 acres	7,809 acres
Intermittent Woodland Pool[1]	1 acre		--
Kettle Shrub Pool[2]	27 acres	42 acres	69 acres
Marsh	124 acres	301 acres	425 acres
Mixed Forest Swamp	9 acres	357 acres	366 acres
Open Water[3]	379 acres	470 acres	849 acres
Orchard/Plantation	889 acres	295 acres	1,184 acres
Rocky Barren	309 acres	35 acres	344 acres
Upland Conifer Forest	1,014 acres	355 acres	1,369 acres
Upland Hardwood Forest	10,144 acres	11,505 acres	21,649 acres
Upland Meadow	4,108 acres	6,900 acres	11,008 acres
Upland Mixed Forest	2,040 acres	3,077 acres	5,117 acres
Upland Shrubland	1,291 acres	1,143 acres	2,434 acres
Waste Ground	77 acres	79 acres	156 acres
Wet Clay Meadow[4]		2 acres	--
Wet Meadow	1,043 acres	1,516 acres	2,559 acres
Wetland[5]		33 acres	33 acres
Total mapped area	**28,437 acres**	**36,365 acres**	**64,835 acres**
Stream Habitat	**Gardiner (miles)**	**Shawangunk (miles)**	**Combined**
Perennial Stream[6]	67.3 miles	99.2 miles	166.5 miles
Intermittent Stream	140.3 miles	170.2 miles	310.5 miles
Shawangunk Kill	6.9 miles	12.3 miles	19.2 miles
Wallkill River	7.5 miles	4.7 miles	12.2 miles
Contiguous Habitats	**Gardiner**	**Shawangunk**	**Combined**
Contiguous Forest Patches over 500 acres	7,700 acres	9,500 acres	17,200 acres
All forests	16,360 acres	19,950 acres	36,310 acres
Contiguous Meadows Patches over 100 acres	750 acres	2060 acres	2,810 acres
All meadows	5,151 acres	8,416 acres	13,567 acres

Habitat Table page 2 of 2

Wetland Habitats	Gardiner approx. 28,000 acres	Shawangunk approx. 36,000 acres	Entire Study Area approx. 64,000 acres
Conifer Swamp	59 acres	77 acres	136 acres
Constructed Pond	182 acres	232 acres	414 acres
Hardwood & Shrub Swamp	3,153 acres	4,656 acres	7,809 acres
Intermittent Woodland Pool[1]	1 acre	--	--
Kettle Shrub Pool[2]	27 acres	42 acres	69 acres
Marsh	124 acres	301 acres	425 acres
Mixed Forest Swamp	9 acres	357 acres	366 acres
Open Water[3]	379 acres	470 acres	849 acres
Wet Clay Meadow[4]	--	2 acres	--
Wet Meadow	1,043 acres	1,516 acres	2,559 acres
Wetland[5]	--	33 acres	33 acres
Total wetland area	**4,977 acres**	**7,686 acres**	**12,663 acres**
Streams	207.7 miles	269.4 miles	477 miles

Upland Habitats	Gardiner approx 28,000 acres	Shawangunk approx 36,000 acres	Entire Study Area approx 64,000 acres
Cool Ravine	123 acres	102 acres	225 acres
Crest, Ledge, Talus	169 acres	4 acres	173 acres
Cultural	69 acres	33 acres	102 acres
Orchard/Plantation	889 acres	295 acres	1,184 acres
Rocky Barren	309 acres	35 acres	344 acres
Upland Conifer Forest	1,014 acres	355 acres	1,369 acres
Upland Hardwood Forest	10,144 acres	11,505 acres	21,649 acres
Upland Meadow	4,108 acres	6,900 acres	11,008 acres
Upland Mixed Forest	2,040 acres	3,077 acres	5,117 acres
Upland Shrubland	1,291 acres	1,143 acres	2,434 acres
Waste Ground	77 acres	79 acres	156 acres
Total upland area	**20,233 acres**	**23,528 acres**	**43,761 acres**
Total habitat area	**25,210 acres**	**31,214 acres**	**56,424 acres**
Non Habitat			
Developed	3,227 acres	5,151 acres	8,378 acres

1. Intermittent Woodland Pool. A separate map showing these potential sites has been included.
2. Kettle Shrub Pool. These pools require field verification.
3. Open Water. Open water includes naturally occurring water bodies and wider segments of streams.
4. Wet Clay Meadow. A separate map showing potential wet clay meadow sites has been included.
5. Wetland. Wetland is a separate category of potential kettle shrub pools which require field verification.
6. Perennial Stream. The Shawangunk Kill and Wallkill River have been mapped as Perennial Stream.

Study Area

Within the Town of Shawangunk, the following "named" streams appear on the USGS topo map: Shawangunk Kill, Wallkill River, two different Dwaar Kills (one of which drains to the Shawangunk Kill and one to the Wallkill River), Platte Kill (flowing along the western boundary), Beaver Brook, Stony Brook, Tomy Kill, and Verkeerder Kill.

Within the Town of Gardiner, the following named streams appear on the USGS topo map: Shawangunk Kill, Wallkill River, Coxing Kill, Palmaghatt Kill, and Mara Kill. The stream known as the Plattekill Creek which flows through the eastern section of Gardiner (distinct from the Platte Kill in Shawangunk) is not named on the USGS topo map. Perennial streams, including the two rivers, flow over 166 miles within the study area.

Flora

Perennial streams with slow flowing and still water areas may support submerged vegetation such as pondweeds, waterweeds, and coontails. Low profile stream banks may support vegetation similar to that found bordering ponds and in wetlands, such as alder, silky dogwood, buttonbush, purple loosestrife, cattail, rushes, sedges, and ferns. A NYNHP (New York Natural Heritage Program) report lists blunt spikerush (NYS Endangered) on a gravel bar in the Wallkill River in Gardiner, which could occur on other such habitats within the study area. The report also identifies occurrences of Davis' sedge (NYS Threatened) and beakgrass (NYS Endangered) near the study area, plants which could occur on stream terraces of the Wallkill River and other large streams within the study area.

Fauna

Slow-moving perennial streams support a wide variety of species: aquatic reptiles such as painted turtle, snapping turtle (SGCN), wood turtle (NYS Species of Special Concern), and northern watersnake; amphibians such as pickerel frog, green frog, red-spotted newt, bullfrog; many species of fishes, and mammals such as beaver, muskrat, and river otter. The core habitat for wood turtle is a perennial stream with undercut banks and bordered by broad areas of forest and meadow habitats. Birds associated with perennial streams include great blue heron (RG), green heron, belted kingfisher, spotted sandpiper, northern rough-winged swallow, bank swallow (RG) (where exposed, high, steep streambanks are present) and many species of waterfowl.

Sensitivities, Impacts

Streams are vulnerable to activities anywhere in the watershed that either increase the area of impervious surfaces (e.g., roads, driveways, parking lots, buildings), or remove woody vegetation. These activities reduce the groundwater recharge, increase the erosive potential of stormwater runoff, and alter the volume and quality of water entering the stream from surface and groundwater sources. Perennial and intermittent streams are vulnerable to pollution runoff from bordering agricultural fields and lawns. Because some perennial streams in the study area occur near old farm dumps or other disturbed areas, farm debris and other trash may collect in streams and be carried downstream for considerable distances. Invasive plant species such as Japanese knotweed are known to spread along the banks of perennial streams. Stream channels may be exposed to scouring and stream banks to erosion. For information on stream management and protection see the Priority Habitats section.

Intermittent Stream

Intermittent streams are natural or artificial water courses which do not flow year-round. The period of active flow or hydroperiod for intermittent streams varies from year to year, depending upon wet or dry seasonal conditions. Numerous intermittent streams flow over 310 miles within the study area.

Watershed
Virtually all of the streams drain to the Wallkill River either directly as first order tributaries or as second or third order tributaries. Many of the streams drain to the Shawangunk Kill which then flows to the Wallkill River. A few intermittent streams in the northwest of Gardiner drain to the Coxing Kill which flows into the Rondout Creek at Rosendale.
Flora and Fauna
Because intermittent streams are periodically dry they do not reliably support many of the plants and animals associated with perennial streams, but do possess habitat values related to intermittent flows. Certain rare species of invertebrates seem to be associated only with intermittent streams. Occasionally intermittent streams retain small pools during the dry season which provide habitat for aquatic reptiles and invertebrates. Intermittent stream banks of wooded ravines often support mosses and ferns with high moisture requirements even during periods of drought. Northern dusky salamander (RG), two-lined salamander, and spring salamander (RG) inhabit intermittent and small perennial streams. Green frogs and other amphibians may find refuge in cool, moist or wet stream beds.
Identification
A few intermittent streams are identified on USGS topographical maps as a dash-dotted blue line. Unmarked intermittent streams may also occur in swales which are depicted on topographical maps as a series of V-shaped topographic contour lines with their apices or "tips" pointing toward areas of higher elevation.
Substrates
Intermittent streams tend to be smaller than perennial streams. Intermittent stream substrates vary from clay to cobble to bedrock. Eroded intermittent streams may exhibit accumulated silt deposits at various locations along the streambed.
Quality and Impacts
Intermittent streams are a primary water source for large watercourses, ponds, and lakes. The quality and quantity of intermittent stream-water flows, as well as the seasonal flow fluctuations, directly affect the habitat quality of those water bodies. Intermittent streams are vulnerable to the same kinds of pollution and impacts as perennial streams. For information on stream management and protection see the Priority Habitats section.

Constructed Pond
Constructed ponds are excavated depressions or dammed impoundments which contain water year-round or intermittently. The study area has many constructed ponds. Most constructed ponds have an inlet or outlet stream or both. Ponds may be constructed by excavating and damming a stream or marshy area or excavating an upland area. In upland areas ponds are excavated deeply enough to intersect the groundwater table. Also, dammed streams are just as likely to flood previously upland areas. Ponds are fed by streams, springs, groundwater, sheet runoff, or a combination of water sources.

Unlike naturally occurring ponds which are usually found in wooded areas, most constructed ponds in the study area originated in agricultural fields and were probably used as a water supply for livestock or crop irrigation. Retention ponds have been created for subdivision developments to control stormwater runoff and manage drainage. These latter types are more likely to hold water intermittently, remaining dry between rainy spells. There are also ornamental ponds in the study.

Distribution and Extent

Constructed ponds are distributed fairly evenly throughout the study area, with somewhat fewer ponds on the steeper slopes of the ridge. About 330 ponds have been mapped in Gardiner, ranging in size from 1/50th of an acre up to 25 acres (Tillson Lake). About 370 ponds have been mapped in Shawangunk, ranging in size from 1/50th of an acre up to 24 acres (Basil Pond).

Sensitivities, Impacts

Pond bottoms frequently accumulate silt in the runoff from surrounding fields or from inflowing streams and rivulets. Many ponds in the study area can be subject to runoff pollution. Farm and lawn fertilizers and pesticides make their way into ponds by overland runoff or groundwater movement. Nutrients in septic leach fields and other pollutants dispersed in groundwater can also contaminate ponds. Aquatic invasive plants are also a concern and water chestnut (Trapa natans), an aggressive plant often spread by migrating waterfowl, has recently been detected in ponds in the study area.

Although constructed ponds were not formed naturally, those that are not intensively managed can support an abundance of plant and animal species and are an integral part of the natural drainage system (the interconnected ponds, wetlands and streams, which drain the Wallkill River basin).

Flora

Because the landscape has changed considerably since many of the ponds were constructed—some are surrounded by woods which have overtaken abandoned agricultural fields—there is a wide variation in the type of habitat associated with constructed ponds. Vegetation surrounding field or meadow ponds includes common grasses and forbs (broad-leaved herbaceous plants), and woody plants typical of shrubby fields such as sumac, eastern red cedar, gray dogwood, and multiflora rose. Vegetation surrounding ponds in reforested areas includes common upland trees such as red and white oak, sugar maple, shagbark hickory, gray birch, white pine, and eastern red cedar. Wetland trees likely to be found include red maple, slippery elm, and swamp white oak.

Ponds rarely exceed eight feet in depth which enables vegetation to cover the pond bottom. Constructed ponds that remain unmanaged often develop emergent marsh communities, submerged aquatic beds, and other plant communities that provide significant habitat resources for wetland-associated wildlife. At the pond's edge, wetland sedges, forbs, and ferns dominate the shoreline. Emergent plant species (emergent wetland plants are rooted in soil beneath the water's surface but have leaves above water), such as cattail, common reed, purple loosestrife, blue flag, alder, and buttonbush grow in the shallow waters. Submerged plants such as common coontail and common elodea grow below the surface while floating-leaved plants such as pondlilies occur at the surface.

Fauna

Fauna found in constructed ponds include: many common reptiles such as painted turtle and snapping turtle (SGCN); amphibians such as green frog, bullfrog, pickerel frog; and common fish such as carp, sunfish and largemouth bass. Common mammals such as muskrat, bats, raccoon and mink, and migrating waterfowl and other birds including great blue heron, kingfisher and red-wing blackbird also forage in ponds. Constructed ponds large and small are often used by migrating waterfowl for resting and foraging. Because they often retain standing water longer than many natural wetlands, they can provide valuable drought refuge for reptiles, amphibians, and other wildlife.

Rare species may also use constructed ponds. During spring and fall, osprey (SC, SGCN) may forage at local ponds. Spotted turtle (SC, S3, SGCN) and wood turtle (SC, SGCN) are known to use constructed ponds. Certain rare and unusual species are more likely to utilize or occur in constructed ponds if they are strongly acidic or alkaline.

Open Water

The "open water" habitat designation is used as a catch-all to cover all other unvegetated water-bodies. They include ponds which formed naturally (as opposed to man-made) and open water on rivers and perennial streams. Therefore, both still water (ponds) and moving water (streams) are included in this type. All streams (perennial and intermittent) are documented on a separate map layer using continuous lines to show the interconnected waterways. Because many streams cover a somewhat broader area of water between banks, that area of water has been mapped as open water. Generally, those streams which averaged over 20 feet across—from water's edge to water's edge—were mapped as open water on a polygon map layer in addition to the aforementioned line layer. For more information on the mapping process, see Mapping Conventions in the Appendix.

For habitat information on the open water of stream bodies, see perennial streams. For habitat information on the open water of ponds, see constructed ponds.

Upland Forest (Hardwood, Conifer, Mixed)

This collection of habitat types is comprised of non-wetland tree-dominated sites with varying proportions of deciduous and coniferous trees. Tree cover for upland forests is greater than 60% and the tree canopy varies from open to closed. The three kinds of upland forest habitat are defined as the following:

Upland Hardwood Forest

Upland hardwood forest is the dominant type and the most common habitat in the study area. Habitats mapped as upland hardwood forest exhibit more than 75% of the tree canopy cover by hardwood or deciduous trees.

Upland Conifer Forest and Upland Mixed Forest

Upland conifer forest have coniferous tree canopy cover greater than 75%; and upland mixed forest contains an intermediate mix of deciduous and coniferous trees. Within the study area many coniferous trees and shrubs have been planted in developed areas because they provide effective year-round privacy screening from close neighbors. As a result, a large percentage of the upland mixed forest habitat exists as small, fragmented units occurring around buildings and roadways, which limits the habitat value. The small planted "forests" are more likely to contain exotic or non-native tree and shrub species. The steeper slopes of the ridge support larger patches of naturally occurring upland mixed forest containing native species.

Flora

Representative hardwood trees within these forest habitats include oaks (red, black, white, pin, and chestnut oaks); maples (sugar, red, and silver especially along stream banks); and birches (gray, paper, sweet or black, and yellow). Other hardwoods include American beech, shagbark hickory, black cherry, basswood, bigtooth aspen, and white ash. Representative conifers include white pine, eastern red cedar, eastern hemlock, and red pine, especially in plantations (tree plantations are artificially established forests). Pitch pine is largely confined to dry, rocky areas on the ridge. Common understory species found in upland forests include nannyberry viburnum, maple-leaf viburnum, common witch-hazel, serviceberry, hop-hornbeam, striped maple, and mountain laurel.

Fauna

Upland hardwood forests are used by a wide range of common and rare species of plants and animals. Eastern box turtle (NYS Species of Special Concern) spends most of its time in upland forests and meadows, many snake species forage widely in upland forests and other habitats, and small mammals such as chipmunk, white-footed mouse, and shrews provide food for raptors, snakes, and predatory mammals. Upland hardwood forests provide important nesting habitat for a number of raptors and many species of songbirds including warblers, vireos, thrushes, and flycatchers.

Substrates

Upland forest habitat covers both lowland areas with deep variable soils (clay, sand, and silt) and higher terrains of thin rocky soils and exposed bedrock. Those areas with little or no recent disturbance are more likely to have un-compacted, spongy topsoil and leaf litter layers. "Pit-and-mound" features which originated when tree root systems tipped up and decomposed into hills and hollows can indicate very long periods of minimal human disturbance. In his book, Reading the Forested Landscape, Tom Wessels refers to these features as "pillows and cradles" and talks about how they can last for centuries in the landscape.

Quality

Many factors affect the quality of a forest but extent (large, contiguous, unfragmented forests) has the most influence on high quality. For more information on large forests and quality see Large Contiguous Forests in the Priority Habitats section.

Upland Meadow

Upland meadows are non-wetland habitats dominated by herbaceous plants (grasses and forbs, also called wildflowers) where tree and shrub cover is less than 20%. Upland meadows include cropland, pasture, and mowed and unmowed fields on upland soils. Also included are equestrian fields (e.g. Blue Chip Farms) and extensive lawn areas.

Flora and Fauna

Upland meadows provide important habitat for eastern bluebird (RG), which forages for insects on the ground. Although once imperiled, eastern bluebird is making a strong comeback. Prairie warbler (PIF1, SGCN), blue-winged warbler (PIF1, SGCN), common yellowthroat, goldfinch, savannah sparrow (RG), indigo bunting, song sparrow, chipping sparrow, and rufous-sided towhee are some of the many birds attracted to upland meadows.

Many species of butterflies including swallowtails, admirals, satyrs, sulphurs, fritillaries, ladies, azures and mourning cloak utilize upland meadows. Birds that breed in upland meadows include bobolink (RG, SGCN), eastern meadowlark (RG, SGCN), field sparrow and other types of sparrows. Northern harrier (NYS threatened) and American kestrel hunt in upland meadows. Meadows left unmowed can support a vast number and variety of wildflowers. Dozens of flowers both native and naturalized appear in progression from spring to summer in upland meadows, including foxglove beardtongue, wild bergamot, yarrow, and black-eyed Susan. Other animals which use upland meadows in the study area include eastern box turtle (SC), red fox, wild turkey and white-tailed deer.

The Grasslands

The Shawangunk Grasslands National Wildlife Refuge (the Grasslands) is an important breeding area for rare and grassland birds. Birds of conservation concern known to breed or hunt in the Grasslands include the grasshopper sparrow (NYS Species of Special Concern), Henslow's sparrow (NYS Threatened), vesper sparrow (NYS Species of Special Concern), upland sandpiper (NYS Threatened), northern harrier (NYS Threatened), and short-eared owl (NYS Endangered). The rare birds which rely on the Grasslands may use other large meadows in the study area as well.

Contiguous Meadows

Upland meadows are extensive in the study area and many make up a vast network of contiguous meadows. See Large Contiguous Meadows in the Priority Habitats section for further information and recommendations.

Upland Shrubland

Upland shrubland habitats occur on upland soils and are dominated by shrubs whose coverage is greater than 50%. Upland shrublands develop on abandoned cropland, pasture, or previously mowed fields and typically represent an intermediate stage of community development between field or cleared land and young forest. Trees and herbaceous plants (grasses and forbs) are also present but their collective cover is less than 50%.

Succession

Upland shrubland is typically a transitional stage between upland meadow and upland forest, but may also develop on cleared forested land, utility corridors, and other such areas. If left unmanaged, an upland meadow will start to support woody species such as shrubs, vines and sapling trees, and will eventually become a forest. In the study area, many of the upland meadow and upland shrubland habitats transition back and forth. A meadow may be mowed for a number of years, then abandoned to shrubland, and then, before reverting back to forest, mowed back to a meadow.

Flora

Common non-woody plants include goldenrods, asters, bedstraws, and pasture grasses. Young eastern red cedar, staghorn sumac, and gray dogwood are among the native shrubs that often first appear in our upland shrubland. When these woody "pioneer species" are overtaken by forest trees or shade-tolerant plants, the habitat will transition to a young forest. Alien invasive shrubs such as Eurasian honeysuckle, common buckthorn, and multiflora rose also appear early. These invasive species, however, are not likely to be overtaken by trees and often remain prominent in the understory as the habitat transitions to forest.

Fauna

Dense thickets often found in upland shrubland are difficult for humans to access. Consequently, they provide excellent, relatively undisturbed habitat for field sparrow, song sparrow, common yellowthroat, blue-winged warbler (PIF1, SGCN), prairie warbler (PIF1, SGCN), American goldfinch, brown thrasher, and gray catbird. Golden-winged warbler (NYS Species of Special Concern) nests in shrubby habitats. Upland shrubland is also part of the habitat complex of American woodcock (PIF1, SGCN), which uses nearby meadows and openings in shrub thickets to conduct springtime courtship displays. Eastern box turtle (SC) is found in upland shrubland of the study area and coyote can frequently be heard. Meadow voles and other small mammals abound and are hunted by barred owl (RG), red-tailed hawk, and other raptors.

Quality

Large shrublands are often higher quality habitat for upland shrubland birds. Because shrublands are often considered disturbed waste areas, however, their habitat value can be underestimated or overlooked. In these cases, upland shrublands are easily lost to development.

Orchard/Plantation

This habitat includes maintained or recently abandoned fruit orchards, tree farms and plant nurseries. Conifer plantations with mature trees were mapped as upland conifer forest. (Many red pine plantations in the region were planted in the 1930's. These forests are now mature stands.)

Orchard/plantation habitats in the study area are somewhat similar to upland meadows and upland shrublands. Some of the plants and animals found in upland meadows and upland shrubland can be found in orchards, but frequent mowing and pesticide use in fruit orchards may limit the plant and animal species able to utilize orchard/plantation habitat. Therefore, this habitat is considered ecologically significant more for its future values after abandonment than for its current values.

Open Space

Although of limited habitat value, orchard/plantation habitat and agricultural land in general contribute to open space in the study area and is central to the economy of region.

Flora

When orchard/plantations in the study area are taken out of active production, they may support some native woody species found in upland shrubland such as eastern red cedar, staghorn sumac, and gray dogwood. However, should exotic invasive species such as multiflora rose establish, the overgrown orchard may become inaccessible to native plants.

Fauna

Despite these limitations, Christmas tree farms offer potential northern harrier (T, S3B, S3N, SGCN) breeding and hunting habitat, and orchards with old trees can be valuable to cavity-using birds, bats and other animals.

Swamps

A swamp is a wetland dominated by woody vegetation. Three types of swamps were mapped in the study area: hardwood, conifer, and mixed. Swamps are generally embedded within a larger matrix of upland forest, either hardwood or conifer.

Trees growing in swamps tend to have shallow root systems. Blow-downs are frequent, the tipped-up roots becoming mounds with adjacent pits. (See "pit-and-mound" in Upland Forest section.) Downed trees in various stages of decay, pit-and-mound formations, and tussock- and hummock-forming plants all contribute to a complex swamp structure.

Fauna

Swamps are important to a wide variety of animals, especially when swamps are part of a larger wetland or upland forest. Wood turtles (SC, SGCN) use swamps along floodplains. Spotted turtle (SC, SGCN) and box turtle (SC, S3, SGCN) use swamps for foraging, and travel corridors. Red-shouldered hawk (SC, SGCN), barred owl (RG), great blue heron (RG), wood duck (RG, PIF2), and other birds of conservation concern may nest in swamps. Pools within swamps are used by breeding amphibians.

Hardwood & Shrub Swamp

Tree-dominated and shrub-dominated swamps have been combined into a single habitat type because they are difficult to separate without field verification. By definition, habitats mapped as hardwood & shrub swamp exhibit more than 75% cover by hardwood trees or are dominated by shrubs. Hardwood & shrub swamp is the most extensive wetland type in the study area, covering a substantial area: over 4600 acres in Shawangunk and over 3100 acres in Gardiner. Except for the steeper slopes of the ridge, swamps were evenly distributed throughout the study area and tended to occur within or adjacent to upland forests.

Flora

Trees typically found in these swamps include red maple, slippery and American elms, green ash, pin oak, and swamp white oak. Typical shrubs include highbush blueberry, silky dogwood, alder, buttonbush, winterberry, spicebush, and swamp azalea. Herbaceous plants include tussock sedge, jewelweed, clear weed, skunk cabbage, sensitive fern, marsh fern, and cinnamon fern.

Conifer Swamp and Mixed Forest Swamp

Habitats mapped as conifer swamp exhibit more than 75% cover by conifer species. Mixed forest swamp exhibits 25% to 75% cover by conifer species. Conifer swamps are far less extensive than hardwoods in the study area, covering only 59 acres in Gardiner and 77 acres in Shawangunk.

Flora

Trees likely to be found in the conifer and mixed forest swamps include eastern hemlock, white pine, and eastern red cedar. The denser canopy of conifers shades the understory, cooling the microclimate, especially in the higher elevations, and sometimes allowing snow and ice to persist into the early growing season.

Sensitivities and Impacts

Many swamps in the study area have remained undeveloped because they were too wet to build on. Currently, some swamps remain protected by wetland regulations. Generally this protection is not adequate and many swamps are threatened by a variety of land uses which would compromise their high biodiversity value.

Swamps tend to occupy a lower elevation than the surrounding landscape and are vulnerable to polluted runoff. Swamps near agricultural land are often contaminated by chemicals draining into them. Those near roads often receive runoff contaminated by nutrients, sediments, and de-icing chemicals. These pollutants degrade the swamp's water quality and habitat value.

Breeding amphibians and other transient swamp wildlife rely upon the interconnected structure of swamp habitats with nearby uplands. The following section on intermittent woodland pools will address this issue in more detail.

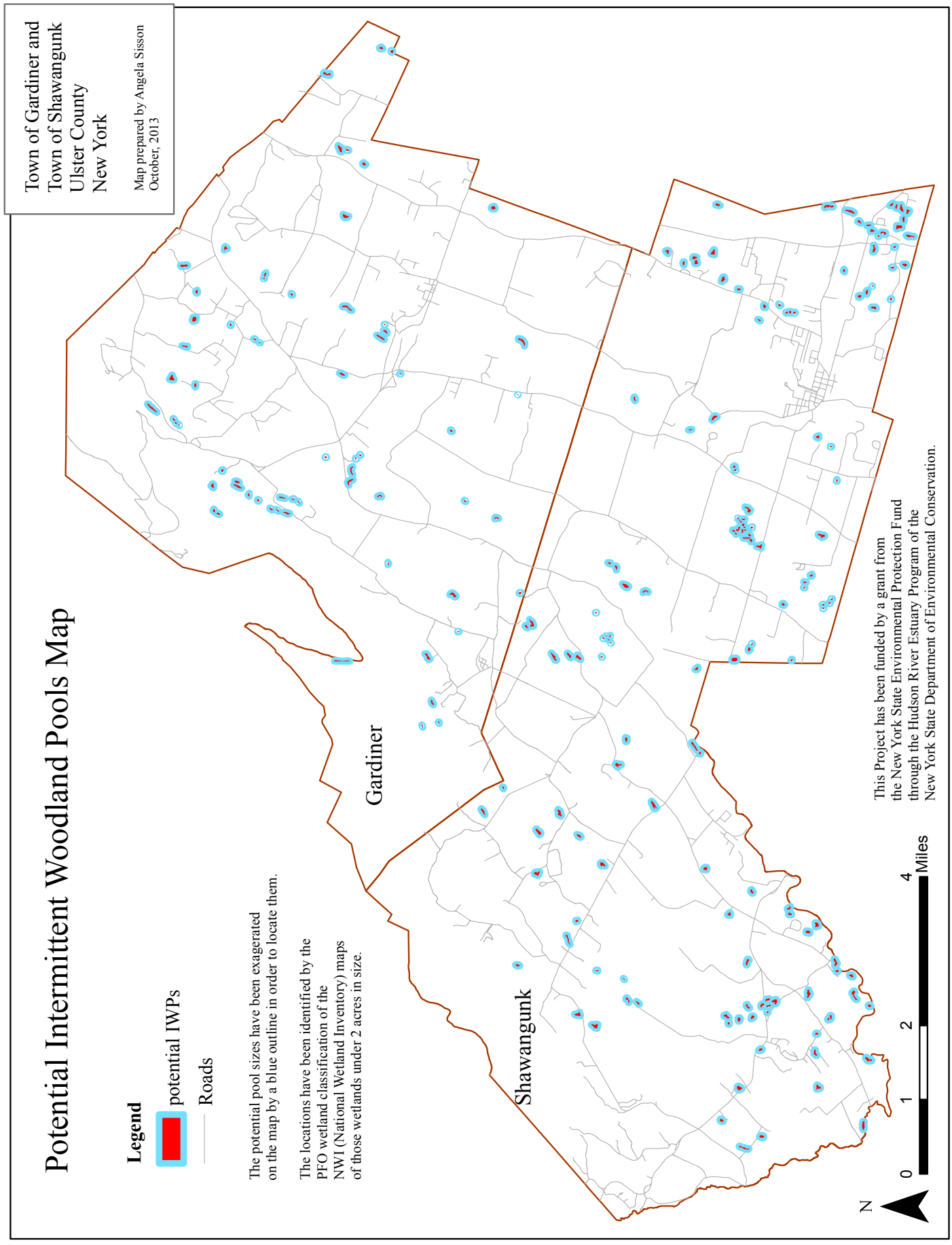
Intermittent Woodland Pool

Often referred to as vernal pools, these habitats have extremely high biodiversity value. Losing one productive intermittent woodland pool can cause a significant reduction in the biomass of the surrounding forest because they are the primary breeding ground for certain forest-dwelling amphibians.

An intermittent woodland pool is a small ephemeral pool—often under an acre—within or adjacent to an upland forest. The pool typically lacks a surface inlet or outlet and dries by mid-summer of a normal year. The drying and hydrological isolation are important because fish cannot establish. Fish in year-round ponds eat the eggs and larvae of amphibians breeding in those ponds. Ephemeral pools are thus protected from fish predation and many forest-dwelling amphibians breed almost exclusively in these pools.

Study Area

Their small size and occurrence within woodlands make these pools difficult to locate using remote sensing techniques. Because it is important to verify their locations, the habitat map lists only those pools which were field-verified during the study for the Geospatial Database for the Northern Shawangunks. The **Potential Intermittent Woodland Pool Map** shows some locations where the pools are likely to be found. See Mapping Conventions in the Appendix for information on potential pool locations.


Potential Intermittent Woodland Pools Map
Town of Gardiner and
Town of Shawangunk
Ulster County
New York
Map prepared by Angela Sisson
October, 2013
Legend
potential IWPs
Roads
The potential pool sizes have been exagerated on the map by a blue outline in order to locate them.
The locations have been identified by the PFO wetland classification of the NWI (National Wetland Inventory) maps of those wetlands under 2 acres in size.
Gardiner
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Miles
This Project has been funded by a grant from the New York State Environmental Protection Fund through the Hudson River Estuary Program of the New York State Department of Environmental Conservation.

Fauna

Amphibians which rely on intermittent woodland pools for breeding (sometimes referred to as vernal pool indicator species, as described in A Field Guide to the Animals of Vernal Pools) include a group called mole salamanders—thus named because they spend most of their lives underground in burrows. Spotted salamander (RG), Jefferson salamander (SC, SGCN), and marbled salamander (SC, SGCN) are included in this group. Like the salamanders, the forest-dwelling wood frog (RG) returns to the pool of birth for breeding. Spotted turtles (SC, SGCN), wood ducks (RG, PIF2), a variety of waterfowl, and many mammals use these pools for foraging.

Sensitivities/Impacts

These habitats are an essential link in the forest ecology and their value cannot be overstated. Unfortunately, they are also one of the most vulnerable, at risk habitats. Intermittent woodland pools tend to be smallish, little noticed depressions in the woodland. Their small size and isolation from other larger wetlands often removes them from the protection of state and federal wetland regulations. Unaware landowners or developers may fill the depressions or excavate them into ornamental and permanent ponds. Occasionally, even if their value is recognized during a site review and the pool is spared, the surrounding forest, which is essential to the pool's ecology, may be destroyed or fragmented. The section on Priority Habitats contains recommendations for preserving this habitat.

Marsh

Marshes are wetlands dominated by herbaceous (non-woody) plants that have standing water for most or all of the growing season.

Study Area

Many marshes of variable sizes were mapped in the study area, totaling 124 acres in Gardiner and 300 acres in Shawangunk. The marshes were rarely isolated, but were typically part of larger wetlands, sometimes bordering wet meadows, but more often embedded within or bordering swamps. Because it was often difficult to distinguish marsh from swamp on aerial imagery, mapped marsh boundaries should be considered approximate.

Flora

Cattails, tussock sedge, common reed, water plantain, and pickerelweed are some typical emergent marsh plants. Deeper water may support floating-leaved plants (such as pond lilies), or submerged plants.

Fauna

Reptiles and amphibians likely to use marshes include snapping turtle (SGCN), spotted turtle (SC, SGCN), green frog, spring peeper, and pickerel frog. Birds likely to use marshes for nesting or foraging include wood duck (RG, PIF2), American black duck (PIF1, SGCN), great blue heron (RG), marsh wren (RG), common moorhen (RG), American bittern (SC, SGCN), and least bittern (T, S3B, S1N, SGCN). Raptors, wading birds and mammals use marshes for foraging.

Sensitivities/Impacts

Marshes are vulnerable to many of the stresses listed under swamp habitats as well as alteration of water levels, which can change an established plant community and facilitate invasion by aliens such as common reed.

Wet Meadow

Wet meadows are wetlands dominated by herbaceous (non-woody) plants, and with inundated or saturated soils for part of the growing season, usually in the spring and sometimes after rainstorms. Unlike marshes, wet meadows lack standing water for much of the growing season. Wet meadows can occur in a variety of settings, such as a slight depression within an upland meadow, or at the edge of a marsh, swamp, or pond, or in an abandoned beaver pond or a drained marsh.

Study Area

Wet meadows were found to be extensive in the study area: over 1000 acres in Gardiner and over 1500 acres in Shawangunk. Wet meadows were generally embedded within the matrix of upland meadows as a component of the contiguous meadows in the study area.

Flora

Some wet meadows were dominated by invasive plants such as common reed, purple loosestrife (though loosestrife is much less dominant since biological controls have started to take effect), and reed canary grass. Wet meadows in less disturbed areas generally exhibited a more diverse mixture of wetland grasses, sedges, and forbs. Woolgrass, fowl mannagrass, soft rush, marsh fern, sensitive fern, blue flag, and Joe-Pye weed along with shrubs such as silky dogwood and alder are among the native species found in these more diverse meadows.

Fauna

Characteristic fauna include meadow vole, red-winged blackbird, goldfinch, garter snake, green frog and pickerel frog. Wet meadows that are within larger patches of contiguous upland meadow can support grassland-breeding birds.

Sensitivities/Impacts

Wet meadows in agricultural areas are frequently farmed or grazed by livestock. Frequent mowing and heavy grazing destroys the surface soil structure, a disturbance which favors aggressive non-native plants over more sensitive native species. Mowing done early in the season when soils are wet, is more damaging than mowing in drier periods. Meadows are often prime sites for development and wet meadows embedded within upland meadows are frequently overlooked during site reviews. See Large Contiguous Meadows in the Priority Habitats section for recommendations.

Wet Clay Meadow

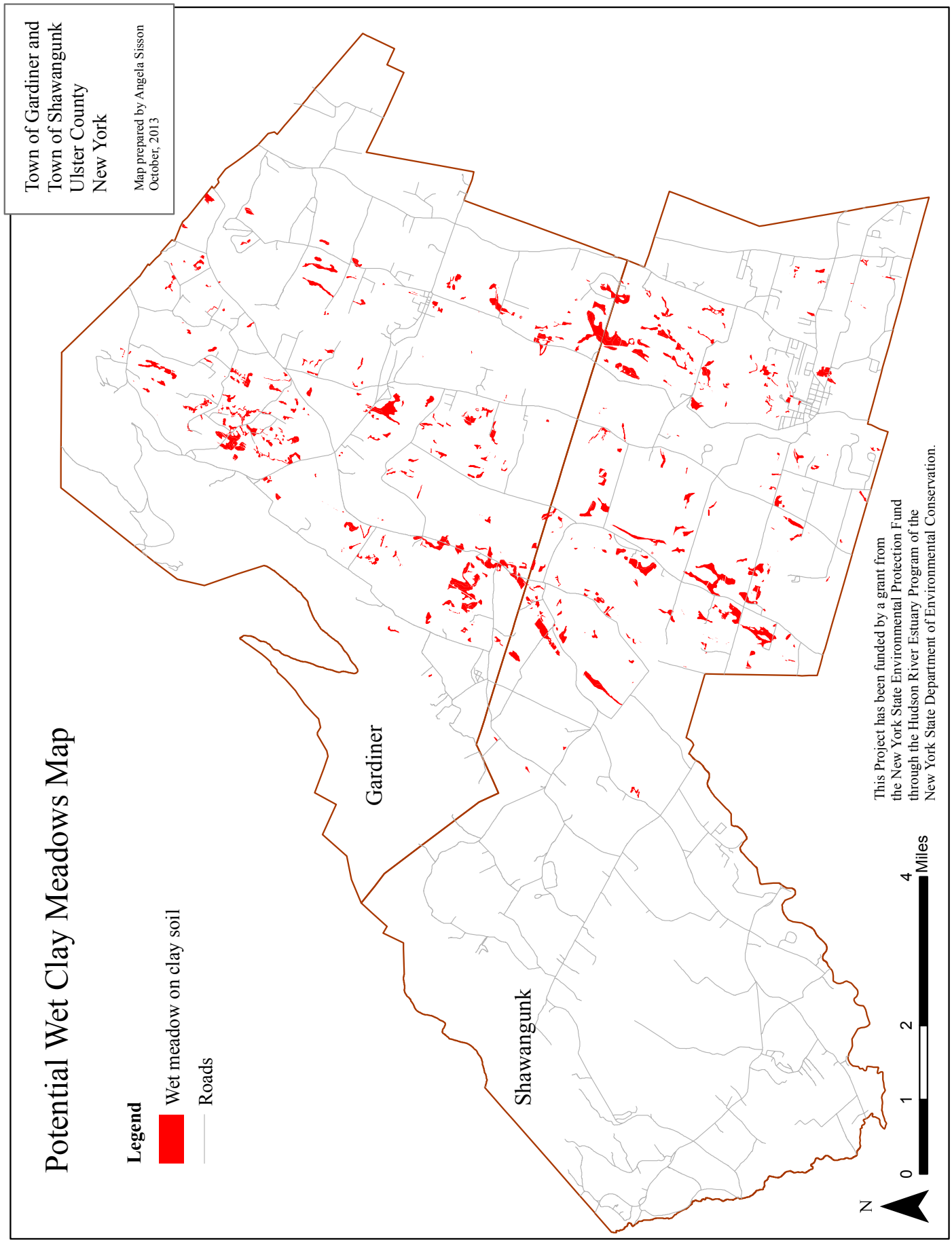
Wet clay meadows have recently been recognized as a subgroup of wet meadow habitats with special biodiversity importance. They are distinguished from wet meadows by the presence of a clay-rich, slowly permeable soil which retains water near the surface, and a distinctive plant community which sometimes includes rare plants.

Substrate

The slowly permeable clayey soils are referred to as having a “perched” water table. The “true” water table is usually located at varying distances below the perched water table. The soils are deep, somewhat calcareous, silty clay loams. Clayey soil types in the study area include Madalin (very poorly drained or hydric soil), Churchville (somewhat poorly drained soil), and Cayuga (well drained or upland soil).

Study Area

The study area has a high percentage of these clayey soil types and is likely to have a number of wet clay meadows. This habitat requires field verification—using indicator plant species—and only the verified wet clay meadows have been identified as such on the habitat map. A **Potential Wet Clay Meadow Map** was produced by overlaying wet meadow habitats on clayey soils and highlighting the area common to both.


Potential Wet Clay Meadows Map
Town of Gardiner and
Town of Shawangunk
Ulster County
New York
Map prepared by Angela Sisson
October, 2013
Legend
Wet meadow on clay soil
Roads
Gardiner
Shawangunk
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Miles
This Project has been funded by a grant from
the New York State Environmental Protection Fund
through the Hudson River Estuary Program of the
New York State Department of Environmental Conservation.

Flora
Indicator plant species used during field verification to distinguish this habitat from wet meadows include foxglove beardtongue (often found flowering in great abundance during early summer), small-flowered agrimony, fox sedge, and Bush's sedge (S3). In addition to the indicator species, plants common to other kinds of wet meadows are found in wet clay meadows. Rare plants which may be found in this habitat include Frank's sedge (E, S1), fringed gentian (RG), winged monkey-flower (R, S3), and spiny coontail (T, S3).
Fauna
Wood turtle (SC, SGCN) and spotted salamander (RG) can use this habitat and American woodcock (PIF1, SGCN) uses this and other wet and upland meadows for courtship displays. The feminine clam shrimp (globally rare) has been found in wet clay meadows and other unshaded wet clayey habitats in Ulster and Dutchess counties.
Sensitivities/Impacts
Wet clay meadows are subject to the same impacts as other kinds of wet meadows. The **Potential Wet Clay Meadow Map** should be consulted during site review and followed up with field verification.

Kettle Shrub Pool
A kettle shrub pool is a seasonally-flooded shrub swamp in a glacial kettle. Kettles are distinctive glacial landforms created when a stranded block of ice became submerged in the glaciers' meltwater, which carries coarse sands and gravels, leaving behind a depression after the ice-block melted. The kettle shrub pool habitat is a subgroup of hardwood & shrub swamp and, due to seasonal drying, serves many of the same ecological functions as an intermittent woodland pool.
Indicators and Identification
Due to their distinctive origins, kettle shrub pools can initially be located using remote sensing techniques with the soil map. Deep organic soil (typically Palms muck) surrounded by or adjoining a glacial outwash soil (typically Hoosic) indicates a likely kettle pool. A site visit will be required to verify the habitat. Shrubs, especially buttonbush but also highbush blueberry and swamp azalea, along with seasonal or permanent water, will help to confirm positive identification of this habitat.
Study Area
The study area has a few verified kettle shrub pools and a few possible ones. Those identified in Gardiner cover 27 acres and in Shawangunk cover 42 acres. An additional 33 acres in Shawangunk—identified simply as "wetland" to distinguish it from other types of wetland such as swamp or wet meadow—requires field verification.
Flora
The typical kettle shrub pool has a dense stand of shrubs—usually buttonbush, highbush blueberry, or swamp azalea, or some combination of these—that is partially or entirely surrounded by an open-water moat several meters wide. Some pools have patches of deciduous swamp. Hardwood trees typically form a fringe around the pool.
Fauna
Animals which likely use this habitat include spotted salamander (RG), green frog, pickerel frog, painted turtle, snapping turtle (SGCN), spotted turtle (SC, SGCN), gray catbird, and red-winged blackbird. American black duck (PIF1, SGCN), wood duck (RG, PIF2) and other waterfowl may use the pools for foraging and nursery habitat. Kettle shrub pools are critical habitat for Blanding's turtle (T, S2) in Dutchess County but the species is not yet known to occur west of the Hudson in southeastern New York.

Sensitivities/Impacts
Draining or damming the pools and/or removal of the tree fringe can degrade the habitat for sensitive animals. Building near the pool would cut off safe access to nearby habitats, and could introduce silt-laden and contaminant-laden runoff to the pool and thus have adverse effects on pool species, especially turtles, which nest on the adjacent upland and move overland to other habitats for foraging.

Cool Ravine
A "cool ravine" is a special kind of ravine habitat with steep rocky walls narrowly flanking and extending at least fifteen feet above a perennial (usually) or intermittent stream. The walls are typically forested with a hardwood/conifer mix usually including hemlock. The very cool microclimate of these unusual ravines sometimes supports plants and animals of more northern latitudes or higher elevations. The steep rocky slopes restrict access which has often protected these ravines over time from logging and other disturbance. Remnant old growth forest may be found in cool ravines.
Study Area
There is extensive cool ravine habitat in both towns occurring mostly on the steep upper slopes of the ridge. 123 acres were mapped in Gardiner's two large ravines. The larger of these is the 97-acre Palmaghatt Ravine. The Plattekill Gorge in eastern Gardiner marks a sharp contrast with the adjoining agricultural landscape rising on either side of it. 102 acres were mapped in seven ravines in Shawangunk. One of these is along the Dwaarkill near its confluence with the Shawangunk Kill in the valley of central Shawangunk. All others are on the upper slopes of the ridge.
Flora
The steep walls of cool ravines typically support a hemlock-hardwood forest. Ericaceous shrubs such as blueberries, mountain laurel, azaleas and rhododendron, and other shrubs such as mountain maple and hobblebush may be present. Mosses, lichens and ferns are likely to be abundant.
Fauna
The fauna of cool ravines is not well known, but stream salamanders such as northern dusky and northern two-lined salamander are likely to use cool ravine habitats. Slimy salamander and other terrestrial-breeding salamanders may be abundant on the moist, rocky ravine walls and in the surrounding forest. Uncommon birds such as winter wren, Acadian flycatcher (S3), Blackburnian warbler (RG, PIF2), and black-throated green warbler (RG), often nest in these habitats. Small-footed bat (SC, S2, SGCN) may roost in talus in cool ravines.
Sensitivities/Impacts
Though difficult access has often protected cool ravines from most types of human disturbance, their very wild nature makes them attractive to hikers which may result in trampling, littering, erosion and alien plant invasion. Any shrub or tree removal would elevate temperatures on the slope and in the streambed. A change in the cool, moist microclimate would make the ravine unsuitable for some of the more sensitive plants and animals.

Rocky Barren

Rocky barren habitat is a subset of the more general crest/ledge/talus habitats (described below) but has been defined separately because 1) no talus is visible (on aerial imagery) and 2) rocky barren habitats support continuous though often scrubby vegetation. Rocky barrens are found on hilltops and steep slopes with shallow, often acidic soils and exposed bedrock, extensive exposed bedrock being the unifying feature. The barrens ecosystems are often fire-adapted, and support plant species such as pitch pine and scrub oak which readily regenerate under these conditions. Rocky barrens communities are exposed to wind and sun and ice. The exposure causes more extreme microclimates than surrounding forest habitat—warmer in summer and colder in winter.

Study Area

The study area has a number of mapped rocky barrens—309 acres in Gardiner and 35 acres in Shawangunk. It is likely that this habitat is more extensive than mapped because the aerial imagery does not always reveal the exposed conditions and many rocky barrens may appear to be upland forest. Exact boundaries and locations would require field-verification.

Flora

The habitat supports plants and animals that have adapted to the harsher conditions of temperature extremes and dry exposure. Common trees include pitch pine, chestnut oak, and red oak. Shrubs are likely to include scrub oak, blueberries, huckleberry and sweetfern. The herb layer may include poverty grass, little bluestem, wavy hairgrass, and Pennsylvania sedge and ferns such as bracken fern, rock polypody, and marginal fern. Certain rare plants have developed special adaptations to tolerate these harsher environments and do not compete well outside them. These include bearberry (RG), three-toothed cinquefoil (RG), rusty woodsia (RG), mountain spleenwort (T, S2S3), and clustered sedge (T, S2S3).

Fauna

A number of rare animals can inhabit rocky barrens. Deep fissures provide shelter and den for northern copperhead (RG, SGCN), eastern racer (RG, SGCN), eastern ratsnake (RG, SGCN), and eastern hognose snake (SC, S3S4, SGCN). Rocky barrens with southern exposure (southeastern exposure occurs on the ridge) may provide denning and basking habitat for timber rattlesnake (T, S3, SGCN). Rare butterflies that use the scrubby and heath plants as a food source include Edward's hairstreak (S3S4), cobweb skipper (RG), and Leonard's skipper (RG). Birds using this habitat include common yellowthroat, Nashville warbler, prairie warbler (PIF1, SGCN), field sparrow (PIF2), eastern towhee (PIF2), and whip-poor-will (SC, PIF2, SGCN).

Fauna-raptors

The peregrine falcon (E, S3, SGCN) is known to nest on the cliffs of the Shawangunk ridge. Other raptors which have been sighted on the ridge, primarily during migration season include: Cooper's hawk (SC, S4, SGCN), northern goshawk (SC, S3, SGCN), merlin, red-shouldered hawk (SC, S4, SGCN), northern harrier (T, S3, SGCN), sharp-shinned hawk (SC, S4, SGCN), bald eagle (T, S2, SGCN), and golden eagle (E, S1, SGCN).

Sensitivities/Impacts

Most of the rocky barrens occur in park lands and those are protected from logging and development disturbance. In those areas recreational activities such as hiking and climbing pose a threat to this fragile habitat. Trampling, soil compaction and erosion can damage rare plants and encourage alien plant invasions. Roads can fragment migration corridors for reptiles and butterflies, isolating populations and reducing their chances for long-term survival. Rare snakes are also susceptible to killing, harassment, or collecting.

Crest/Ledge/Talus

Crest, ledge, and talus are three kinds of rocky habitats that often occur together in the landscape. Crests are exposed bedrock areas on hilltops, knoll tops or hillside benches, and ledges are steep bedrock outcrops, including cliffs. The term "talus" is used to describe a collection of broken rock fragments under a cliff or steep ledge that have accumulated through rock falls. Glacial erratics (boulders deposited by glaciers) are included as talus.

Study Area

Crest, ledge, and talus habitats were found to be extensive in Gardiner at 169 acres, though not in Shawangunk. The ridge in Gardiner is distinguished from Shawangunk by long stretches of cliff which have shed the talus deposits. Crest/ledge/talus often encompasses rocky barren habitat.

Flora and Fauna

The plants and animals likely to inhabit rocky barrens can also be found on crest/ledge/talus habitat. Rare birds likely to use crest habitat include golden-winged warbler (SC, PIF1, SGCN), Blackburnian warbler (RG, PIF2), worm-eating warbler (RG, PIF1), and cerulean warbler (SC, PIF1, SGCN). High-elevation ledges are used by bobcat (RG) and fisher (RG) for hunting. Talus and ledges are used by porcupine (RG) and bobcat for denning. Talus is used by eastern small-footed bat (SC, S2, SGCN) for roosting.

Sensitivities/Impacts

Crest, ledge, and talus habitats are vulnerable to all the same impacts listed for rocky barren habitat.

Cultural

"Cultural" habitat as defined for this study area is somewhat similar to upland meadow but with more intensive management resulting in a more degraded environment for animals. Despite this, many animals are likely to use the trails and roads of cultural habitats as travel corridors. These trails can also help link patches of undeveloped habitat together.

Study Area

The rail trail and rail bed along with carriage roads on the ridge—69 acres in Gardiner and 33 acres in Shawangunk—have been mapped as cultural.

Waste Ground

Waste ground encompasses areas highly altered by human activities and usually lacking topsoil or altered in other ways such as excavating, filling, or grading. This category encompasses a variety of highly impacted areas such as active and abandoned gravel mines, rock quarries, mine tailings, dumps, construction sites, and abandoned lots. Vegetation is often sparse, weedy and dominated by non-native plants.

Study Area

Waste ground habitats in the study area were primarily gravel and sand mines—some recently abandoned—along with ongoing construction sites. 77 acres in Gardiner and 79 acres in Shawangunk were mapped as waste ground. An old mine shaft of the aqueduct (mapped at 3 acres) located northwest of the intersection at Old Ford and Forest Glen Roads provides nesting habitat for eastern box turtles (SC, S3, SGCN) (Anne Smith, personal communication).

Flora and Fauna

Though waste ground often has low habitat value, there are notable exceptions. Several rare plant species are known to inhabit waste ground environments. Snake and turtle species of conservation concern, including eastern hognose snake (SC, S3S4, SGCN) and wood turtle (SC, SGCN), may use the open areas of gravel mines for burrowing, foraging, or nesting habitat. Bank swallow (RG) and belted kingfisher sometimes nest in the walls of soil mines. Bare, gravelly, or otherwise open areas provide nesting grounds for spotted sandpiper and killdeer.

Developed

Developed areas are not ecologically significant habitats because they do not meet the criteria to support wildlife. However, some developed areas, especially those without permanent structures or paved roads, have the potential to return to habitat. For example, a manicured lawn adjacent to buildings could be changed into a meadow which would again support wildlife.

Study Area

Developed areas mapped in the study area show a change between older and newer patterns of development. Older patterns often show structures close to main roads, with short driveways and smaller lawns. Newer subdivisions often show a sprawling, less efficient use of the landscape. Developed areas in the towns' hamlets show a dense, efficient use of the landscape. Developed areas are extensive in the study area—over 3200 acres in Gardiner and over 5100 acres in Shawangunk.

Priority Habitats

"Priority habitats" for conservation are those that are rare, support rare species, or are otherwise important to biodiversity. Priority habitats which have already been described in the Results section include:

Rocky barrens/CLT (Crest/Ledge/Talus)
Cool ravine
Kettle shrub pool
Wet clay meadow

Certain other priority habitats are further discussed below:

Large contiguous forests
Large contiguous meadows
Intermittent woodland pool
Streams and riparian corridors

Large Contiguous Forests

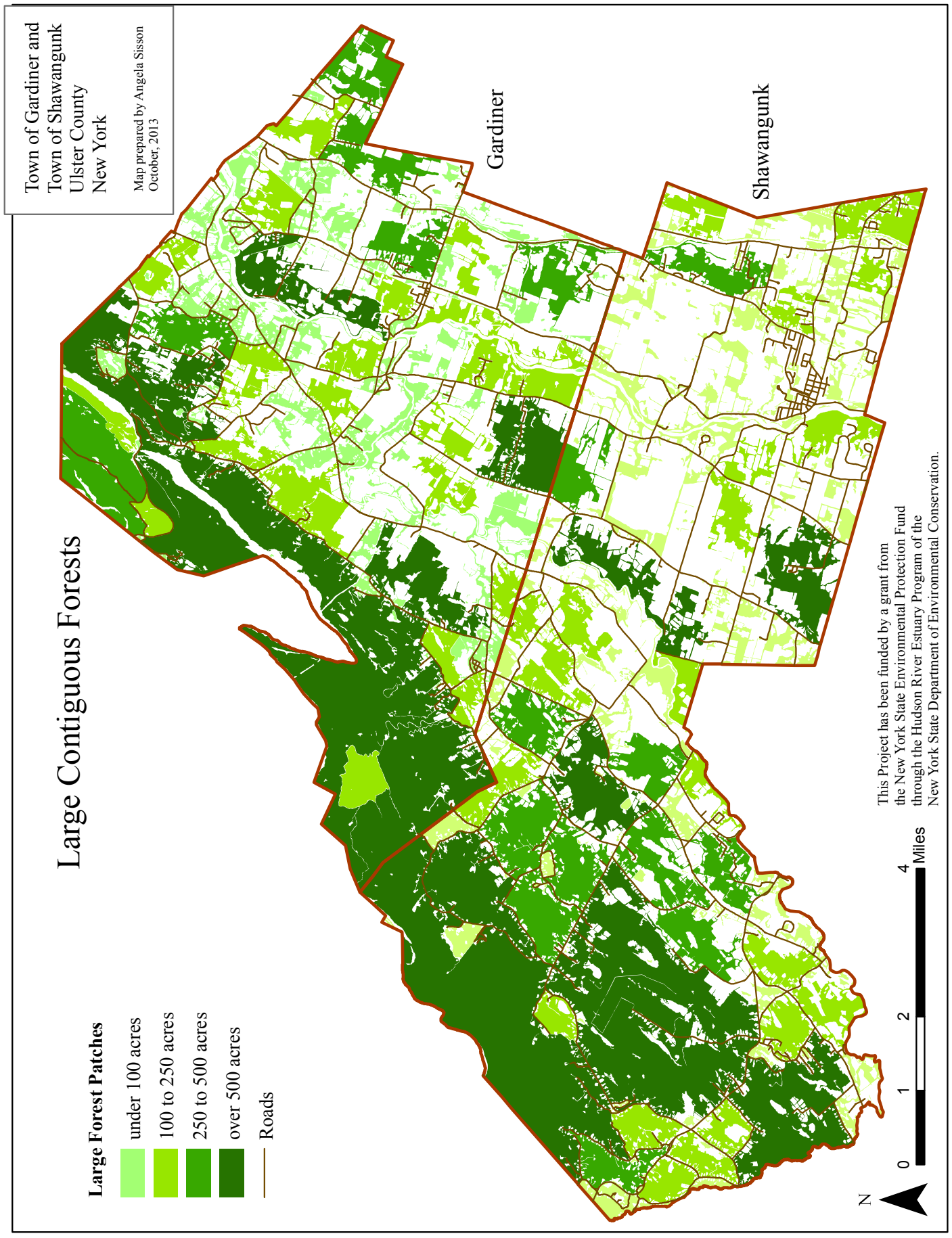
Forests of any size can provide valuable habitat for wildlife but, in general, large, mature, relatively undisturbed forest tracts have the highest conservation value. Smaller forest patches that can provide connections between large patches are also valuable as wildlife corridors.

Remote sensing techniques cannot determine the maturity of forests; however, the extent and shape of forests are easily discernible. Hardwood forest cover (both wetland and upland) in the study area is extensive, especially on the ridge. The large area of protected parkland forest beyond the study area boundary increases the value of the adjacent large forest patches within the study area. Much of the 17,200 acres of forest patches larger than 500 acres is contiguous with the 32,000 acres of protected parkland forest on the ridge. See the **Large Contiguous Forests Map** and **Large Contiguous Forests with Protected Lands Map**. (The **Habitat Table** shows the breakdown in acreage of all the various habitats including the large contiguous forests and meadows.)

The interior parts of large forests are less likely to be exposed to human disturbance such as logging, removal of dead wood, and roads and trails which compact soil, and they have less edge exposure (reducing the likelihood of introduced plant species and access for nest predators and nest parasites). High quality forests exhibit a high diversity of species, which is less likely in human-disturbed forests and more likely in large, limited-access forest tracts. Forests that occur nearer human-settled areas have more edge exposure, attracting common species such as white-tailed deer, raccoon, striped skunk, and other overabundant animals. Overconsumption of acorns limits food available to other wildlife and overbrowsing of foliage and seedlings by deer prevents regeneration of certain forest tree species. In these ways large populations of deer can dramatically alter the forest ecology.

Fragmentation

Fragmentation of forests and other important habitat areas is a major cause of declines and local extinctions of area-sensitive wildlife species throughout the U.S. and the world. Acadian flycatcher (S3), cerulean warbler (SC, PIF1, SGCN), Kentucky warbler (S2, PIF1, SGCN), and scarlet tanager (PIF2, SGCN) are some of the birds that require large unfragmented or contiguous forests to nest successfully. Large mammals such as black bear (RG), bobcat (RG), and fisher (RG) also require large expanses of forest. Migrating amphibians are particularly vulnerable as they cross roads when traveling to and from their birth pools for breeding.


Town of Gardiner and
Town of Shawangunk
Ulster County
New York
Map prepared by Angela Sisson
October, 2013
Large Contiguous Forests
Gardiner
Shawangunk
Large Forest Patches
under 100 acres
100 to 250 acres
250 to 500 acres
over 500 acres
Roads
N
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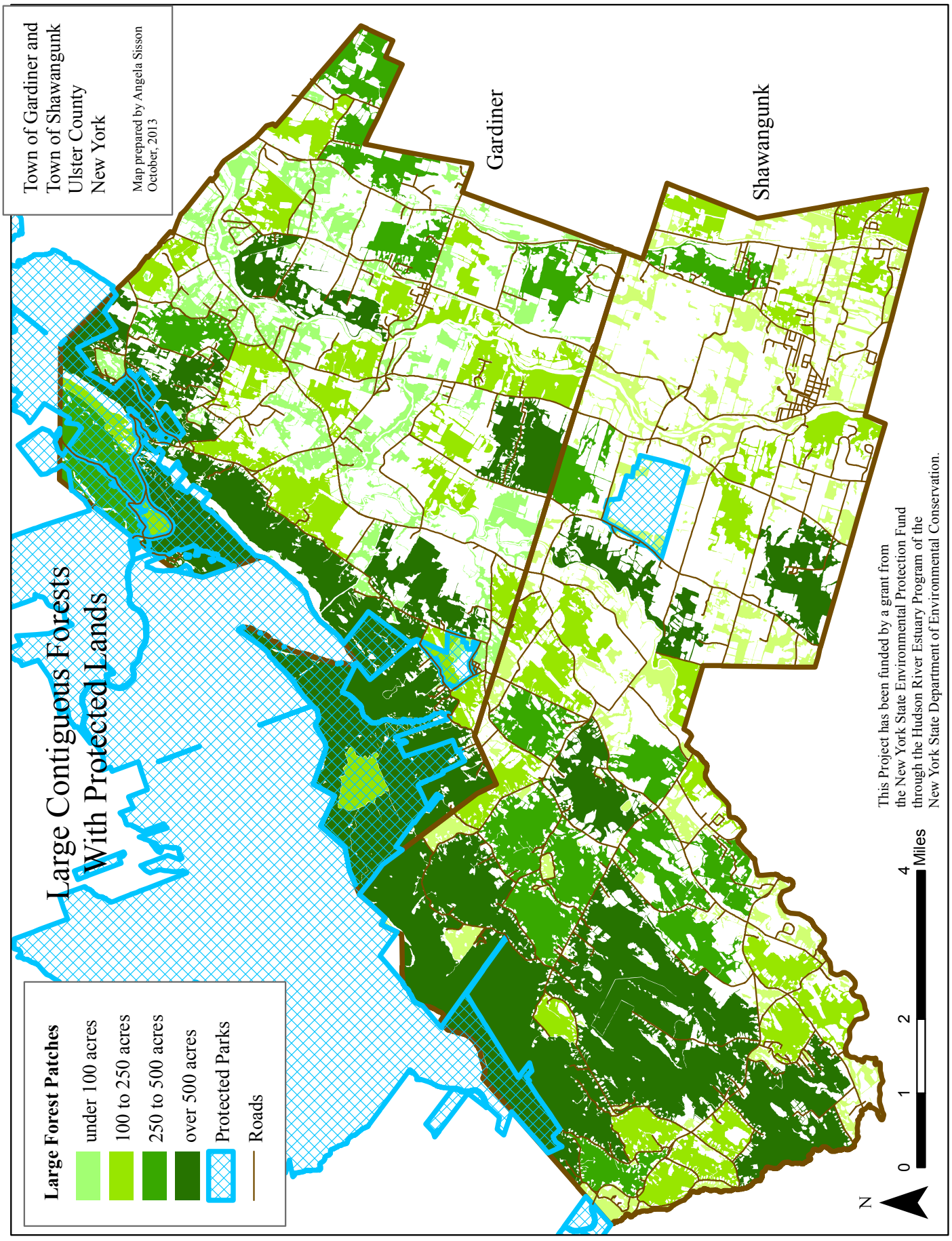
Miles
This Project has been funded by a grant from
the New York State Environmental Protection Fund
through the Hudson River Estuary Program of the
New York State Department of Environmental Conservation.


Town of Gardiner and
Town of Shawangunk
Ulster County
New York
Map prepared by Angela Sisson
October, 2013
Large Contiguous Forests
With Protected Lands
Gardiner
Shawangunk
Large Forest Patches
under 100 acres
100 to 250 acres
250 to 500 acres
over 500 acres
Protected Parks
Roads
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Miles
This Project has been funded by a grant from
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New York State Department of Environmental Conservation.

Invasive species—both plant and animal—find their way in through fragmented edges. Hemlock woolly adelgid, an insect devastating to the region's hemlocks, has been detected in the extensive hemlock forests of the ridge. If a recently released biological control is successful, many of the hemlocks, especially the less affected in isolated areas, can be saved.

Watershed Protection

Forests are the protectors of our water resources. Forests regulate rainwater by means of several mechanisms and processes. Their leafy canopy intercepts rain and snow, and a certain volume evaporates and returns to the atmosphere. Rain and snow that reach the forest floor are absorbed into the organic duff and near-surface soil layers where the moisture is taken up by forest trees, shrubs, and herbs, and used by invertebrates and other organisms of the forest soil. The volume that is not evaporated or used by forest plants and animals is stored in the soil or moves downward to help recharge the groundwater. Intact forest soils act like a sponge and absorb precipitation before releasing it to streams and recharging groundwater. Trees, other plants, and forest soils are also good at filtering pollutants—nutrients and contaminants—from the water. Trees typically use nutrients for growth and store contaminants in the wood.

Carbon Sequestration and Climate Change

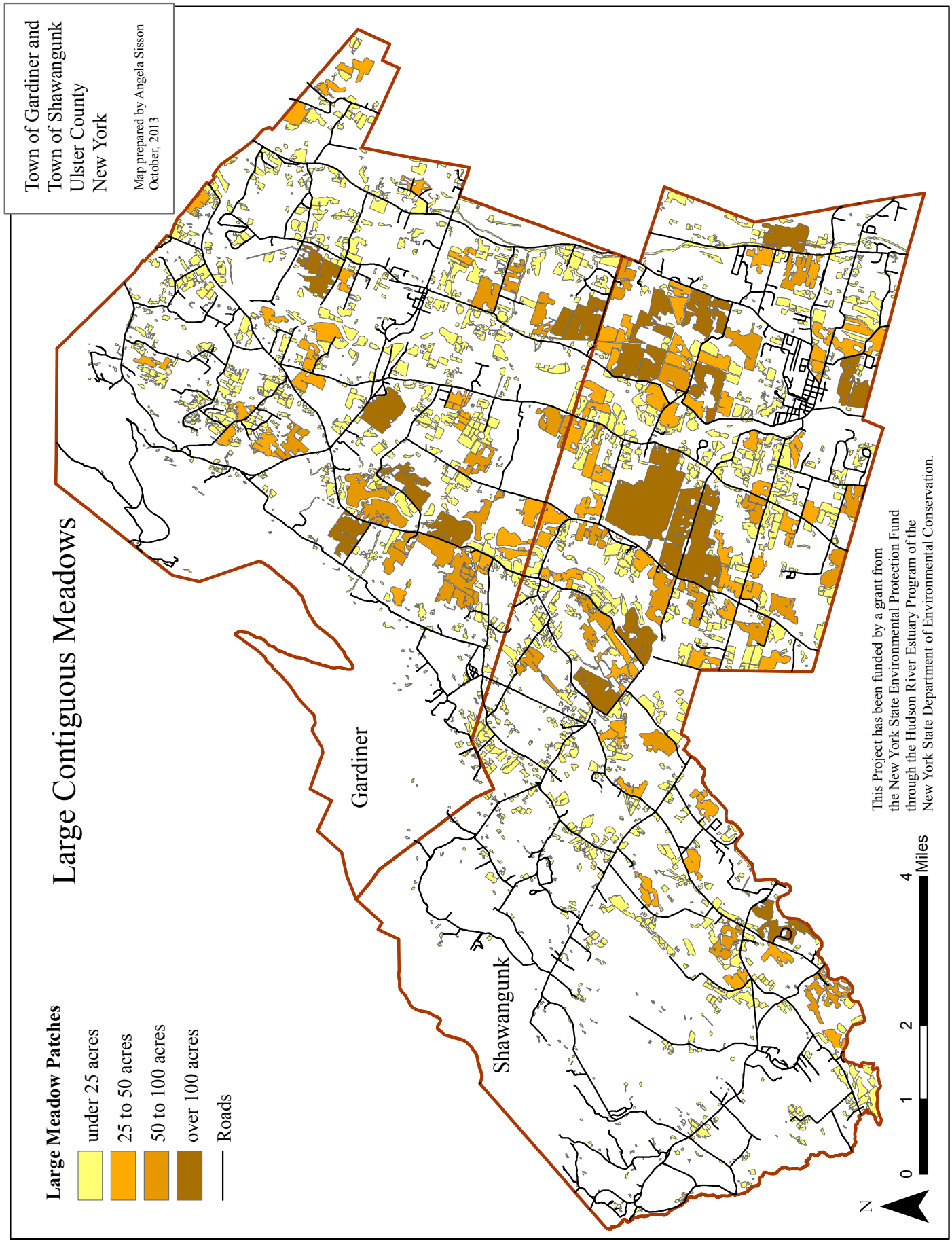
Forests can play a major role in slowing climate change and mitigating its effects through carbon sequestration, the process of pulling carbon from the atmosphere and storing it elsewhere. During photosynthesis, trees and all plants convert carbon dioxide from the atmosphere into sugars. Trees are able to lock up large amounts of carbon in their above-ground and below-ground biomass, and continue to store additional carbon as they grow. Forests and especially large forests are able to store enormous reservoirs of carbon. The New York State DEC identifies a number of strategies on using forests for carbon sequestration, ranging from active forest management to forest preservation. (Trees: The Carbon Storage Experts, http://www.dec.ny.gov/lands/47481.html.)

Recommendations

Forest dwelling birds such as wood thrush (PIF1, SGCN) require forest patches of at least 200 acres to maintain breeding populations in the long term (Rosenberg et al, 2003). Therefore the largest patches should receive the most protection. If new development cannot be avoided in forested areas, it should be concentrated near the forest edges to preserve the unfragmented forest areas.

Large Contiguous Meadows

Large upland meadows integrated with wetland meadows are extensive in the study area and make up a vast network of large contiguous meadows. See the Large Contiguous Meadows Map. Many of the most imperiled grassland breeding bird species require very large areas of contiguous meadow, unfragmented by hedgerows, roads, or developed uses. (See the Grasslands description under upland meadow.) Reducing the size of large meadows reduces the suitability of upland meadows for grassland breeding birds. Upland meadows in particular are among the habitats most likely to be developed by large-scale residential developers, and even by farmers facing economic challenges.


Town of Gardiner and
Town of Shawangunk
Ulster County
New York
Map prepared by Angela Sisson
October, 2013
Large Contiguous Meadows
Large Meadow Patches
under 25 acres
25 to 50 acres
50 to 100 acres
over 100 acres
Roads
Gardiner
Shawangunk
0
1
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Miles
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This Project has been funded by a grant from
the New York State Environmental Protection Fund
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New York State Department of Environmental Conservation.

Agricultural Land

With the exception of the Shawangunk Grasslands, most large meadow patches in the study area are farm fields. Apart from ecological values including wildlife habitat, agricultural land is important to the region for economic and cultural functions. Keeping land in agriculture keeps food production local and supports local economies. Farming also adds to the rural character and the scenery of the landscape which supports tourism.

Management Recommendations

Management may be necessary to maintain conditions for rare species. Mowing prevents meadows from being overtaken by shrubs and trees. Delayed mowing until late summer or early fall allows the ground-nesting birds to nest and fledge their young successfully. Mowing in late summer (early-to-mid September) can also control the invasive Japanese stilt grass. A prescribed burn (late summer/early fall) on alternate mowing years will favor native plant species, allowing them to outcompete some of the alien species. Burning may also promote conditions suitable for certain birds and butterflies. (Such burn projects should be designed and carried out only by experts.)

Intermittent Woodland Pools

Intermittent woodland pools are a critical resource and the Potential Intermittent Woodland Pool Map indicates there are many potential pools in the study area. When identified in the field, these pools and their associated upland forest habitat should receive appropriate protection to ensure their continued success.

Recommendations for protection of intermittent woodland pools

The following recommendations are adapted from Calhoun and Klemens, 2002.

1. Protect pool depression (zone—0 feet)
   - Habitat value: Breeding pool, egg attachment sites.
   - Desired outcome: Good water quality; undisturbed basin and marginal vegetation.
   - Guidelines: No disturbance
2. Protect pool envelope (zone—100 feet)
   - Habitat value: Shade and organic inputs; upland staging for juvenile amphibians.
   - Desired outcome: Maintain forest envelope and water quality; avoid barriers to amphibians.
   - Guidelines: No development.
3. Protect terrestrial habitat (zone—750 feet)
   - Habitat value: Upland habitat for adult amphibians (foraging, dispersing, hibernation)
   - Desired outcome: Partially shaded forest floor; uncompacted litter; abundant woody debris
   - Guidelines: Less than 25% developed area

Streams and Riparian Corridors

The study area has a large number of perennial and intermittent streams. Many of the streams are high quality headwaters flowing from the ridge to feed the Shawangunk Kill and Wallkill River. All of the study area with the exception of the Coxing Kill watershed falls within the Wallkill River watershed or basin. The biodiversity, water quality, and volumes and patterns of stream flows can best be protected by protecting their watersheds. See Watershed Protection under Large Contiguous Forests.

Stream protection principles

Stream quality can be protected by taking measures to:

-maintain broad undeveloped forested riparian zones;
-minimize impervious surfaces throughout the watershed;
-minimize vegetation removal throughout the watershed;
-minimize disturbance to soils throughout the watershed;
-prevent pollution from point and non-point sources (e.g., from roads, lawns, and agriculture); and
-prevent erosion of stream channel and banks.

Conservation Thresholds for Land Use Planners (Environmental Law Institute 2003) provides detailed study data on riparian buffers for different purposes along with the following useful guideline:

"Land use planners should strive to establish 100-meter wide riparian buffers to enhance water quality and wildlife protection."

More specific goals can be achieved with the following buffers:

Function	**Buffer Needed**
Shade, water temperature	33 feet -- 100 feet
Nutrient reduction, fecal coliform reduction	66 feet -- > 100 feet
Protect fish (general), aquatic invertebrates, amphibians	> 100 feet
Stream stabilization & sediment control	> 125 feet
Protect trout	> 200 feet
Protect bird species	130 feet -- > 600 feet

Adapted from Conservation Thresholds for Land Use Planners (Environmental Law Institute 2003.)

Using the Habitat Map

In the long term the habitat map and this report can be used in conjunction with other documents (e.g., open space plan or inventory) to provide a big-picture perspective and help establish or refine conservation goals.

In the short term the map can be used for reviewing site-specific development proposals. The map can provide habitat information about a particular site under review along with the surrounding area or the context in which a development is proposed.

When a development is under consideration, landowners, developers and reviewers should take the following steps:

1. Consult the large format printed map showing the habitats. High resolution digital (pdf) versions of maps in this report should also be available on town websites. Check to see what types of habitats are on and near the proposed development and check to see if any habitats are listed in the Priority Habitats section of this report.

2. Read about the habitats in this report and note any recommendations.

3. Consider whether the proposed development can be modified to minimize impacts to habitats. Some suggested modifications include:

- -Minimize intrusion into large contiguous forests, large meadows, and wetland complexes;
- -Locate disturbance areas as far from sensitive habitats as possible;
- -Locate built features in such a way as to maintain connectivity between habitats;
- -Direct stormwater runoff into detention basins instead of directly into ditches, streams, ponds or wetlands; and
- -Minimize clearing of vegetation during construction and restore cleared areas with native plantings wherever possible.

The habitat map has been prepared using remote sensing techniques and has received limited field-checking. Therefore it should be used as a general guide for land use planning, and field verification of habitats should be included in any site review process.

Conclusion

The towns of Shawangunk and Gardiner, New York have an abundance of ecologically significant habitats as evidenced by the habitat map. Of special note are habitats identified in the Priority Habitats section, in particular the large contiguous forests and meadows. Forest patches which exceed 500 acres cover over 17,200 acres or 26% of the total study area. Large meadow patches in excess of 100 acres cover over 2800 acres or 4% of the total study area. Stream systems with high quality headwaters interconnect extensive water resources including significant habitats such as wet clay meadows, kettle shrub pools, marshes, swamps and ponds.

The habitat map provides a broad overview of the study area showing the connections between water resources, contiguous forest or meadow patches, and travel corridors. Smaller, individual habitats are identified within the context of this regional landscape. The map is useful in illustrating land use patterns such as the fragmentation to habitat caused by roads. Development patterns which have evolved over time become obvious on a regional habitat map; from earlier homes concentrated near main roads to current suburban style tracts often including large lawns covering former agricultural lands.

Of the almost 65,000 acres in the study area, 56,400 acres have been mapped as habitat and 8,300 acres as developed. A fair amount of the towns' habitat, 7,700 acres, mostly on the ridge, is owned and protected by public and private preserves. The remaining 48,700 acres of habitat is privately owned and unprotected with the exception of a few conservation easements. Of the unprotected acreage, there are a number of very large properties exceeding 150 acres in size—about 8150 acres (2480 acres in Gardiner and 5670 in Shawangunk). It is safe to assume that at some point in the near—or far—future these very large properties will be candidates for development. The habitat map can help landowners and developers plan their projects to minimize impacts to habitats and protect the most sensitive environments. During site reviews, the habitat map can be a useful resource providing an independent body of information which will help alert reviewers to important habitats which might be overlooked. Because the map was prepared using remote sensing techniques, field verification of habitat map information will be necessary, especially with respect to habitat boundaries and changes that have occurred since the 2009 aerial imagery was used. Site reviews with field verification can also provide an opportunity for the towns to update and/or refine the habitat map's database with their GIS software.

Conserving habitats is one of the best ways to protect biodiversity. Using this approach during the planning process integrates the needs of both the human and natural communities.

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Appendix—Mapping Consistency and Conventions

In order to maintain consistency throughout the mapping process a digitizing scale of 1:1000 was established. At this scale the high resolution ortho-imagery used as a base map can reveal individual trees and other relatively small features such as automobiles or stone walls. More homogenous areas were digitized at a scale of 1:2000. The following mapping conventions or rules specific to certain habitats were used to delineate their boundaries.

Streams

Streams were depicted in the GIS as a continuous line overlain on the other habitats and running through water bodies such as ponds and wetlands. Larger streams such as rivers with open water, have been shown as both open water (polygons or shapes) and a continuous line. Where streams have been diverted underground (road culverts, etc.) and emerge again, the line continues over the likely location of the underground flow. Those streams visible either in aerial imagery and/or indicated by contour lines as drainage swales on topographic maps have been mapped. The courses of small headwater streams are difficult to map remotely and may require field verification. Perennial streams (which flow year round) were distinguished from intermittent streams using the perennial stream designation of the USGS topographic maps; except in those cases where aerial imagery showed changes from the (decades old) topographic maps. The Soil Survey of Ulster County was also useful in verifying many (intermittent) streams not shown on the topographic maps. Channelized streams or ditches were also mapped where possible because they provide hydrologic functions.

Open water and constructed ponds

Most water bodies in the study area are constructed ponds which were created by damming and/or excavation. A constructed pond can usually be distinguished from a natural water body by its shape—a dammed edge appears straight—and/or position in the landscape—sometimes perched in a field. If a body of open water does not appear to be a constructed pond, it has been mapped as "open water." To map bodies of open water, a digitizing scale of 1:1000 was used. Assuming they have not been obscured by vegetation or other obstruction, ponds as small as 800 square feet or 1/50th of an acre were visible and mapped.

Intermittent woodland pool

Often called vernal pools, these seasonal water bodies are especially important because they are used by a special group of pool-breeding amphibians for reproduction and should be given top priority when making conservation decisions. However, because they are often small or otherwise hidden on aerial imagery, they can be difficult to identify using remote sensing or map interpretation techniques. Therefore, efforts should be made to identify them through field observation during any site review process.

Certain wetland classifications (such as PFO1E—Palustrine Forested Deciduous Seasonally-saturated) on the NWI (National Wetland Inventory) maps can help identify potential locations of these pools. This process is described in *Best Development Practices for Pool-breeding Amphibians in Commercial and Residential Developments* (Calhoun and Klemens 2002).

A separate map showing these potential sites has been included. Field verification should occur in the spring when the pools are most likely to contain water and amphibian eggs and/or developing amphibians. Though the study area likely includes many intermittent woodland pools, only a few verified locations have been shown on the habitat map.

Wetlands

Several types of wetland habitats were identified and mapped including but not limited to hardwood and shrub swamp, conifer swamp, wet meadow, and marsh. Aerial imagery, soil data and topographic maps were used to remotely identify the wetlands. The presence of hydric soil (classified as poorly or very poorly drained) was relied upon as the primary indicator of wetlands when combined with aerial imagery and topography. Though hydric soils are reliable wetland indicators, in some cases wet farm fields were drained after the soils had been mapped which explains why areas mapped as "hydric soil" are actually now dry. (In those cases the habitat was mapped as upland meadow.) Additionally, soils that are classified as somewhat poorly drained often include some wetlands or a mix of wetland and upland. Though habitats on somewhat poorly drained soils have been scrutinized carefully, they are more likely to contain mapping errors than the habitats on hydric soils. In any event, field verification, except for a limited number of site visits, was not performed to confirm the presence of wetlands. Therefore, the mapping of wetland habitats should not be used for jurisdictional purposes and the boundaries should be treated as approximations.

Upland forests

Three types of upland forest have been mapped: hardwood, mixed, and conifer. Hardwood and coniferous trees are distinguishable on aerial imagery taken in the spring during "leaf-off." Other factors which affect the relative quality of a forest include tree community (species including invasive species), extent (scale), maturity and size of trees, degree of disturbance, forest structure (understory layers), soil drainage and texture. With the exception of extent, these factors cannot be distinguished using remote sensing techniques and would require field assessment. With respect to extent however, bigger is usually better (from a biodiversity and wildlife habitat standpoint) and the study area has many large and many unfragmented forests. Because fragmentation increases "edge" effects, intrusions into forests such as wood roads and trails—where visible on the aerial imagery—have been identified and mapped.

Upland meadows and shrubland

Upland meadows divided by hedgerows were mapped as separate units. Because of the successional process of change that occurs when a meadow is left unmowed—from meadow to shrubland and from shrubland to forest—the distinction between a meadow with some shrubs and an early stage shrubland can be somewhat arbitrary. Therefore shrubland were defined as those habitats with at least 25% woody cover. The 2001 and 2009 aerial imagery reveals that meadows and shrubland have transitioned back and forth over time—some meadows returned to shrubland after mowing ceased and some meadows were recovered from shrubland after brush-hogging.

Contiguous forests and meadows

In the figures depicting large contiguous forests, all forests have been combined: upland hardwood and coniferous along with hardwood and coniferous swamps. After the different types of forest were combined into one database, all contiguous units—those that share a boundary—were merged into a single unit. Though some of the individual units have long, convoluted edges due to development fragmentation, we considered the forest "contiguous" if there was no break or separation within the unit. We used the same process for contiguous meadows. In some cases open water habitat of perennial streams was included with contiguous forests to show that the streams were not fragmenting the forest.

Crest/Ledge/Talus and Rocky Barren
Crest/ledge/talus habitat and rocky barren habitat share many features, including some of the plants and animals likely to inhabit them. Areas where extensive exposed bedrock was visible through a tree or shrub canopy on aerial imagery were mapped as rocky barren habitat. Areas of large rock fragments (talus) without a cover of vegetation were mapped as crest/ledge/talus. Additional bedrock exposures and talus deposits were likely to exist outside the mapped boundaries; therefore specific habitat units and boundaries should be identified and verified in the field.

Cultural
The "cultural" habitat designation was used in the study area for the rail trail through Gardiner and rail trail and remaining rail bed through Shawangunk along with carriage roads and wood roads on the ridge in Gardiner.

Developed
Developed areas include buildings, roads, driveways, pavement, and adjacent lawns. Lawns are depicted as developed because of their limited ability to support wildlife or provide other ecological services such as prevention of stormwater runoff. Outer portions of large lawns and areas not immediately adjacent to buildings which have not been intensively managed are more likely to support wildlife. These outlying lawn areas have been mapped as upland meadow. On aerial imagery it is often difficult to distinguish between intensively managed lawn areas and less managed meadows. Therefore, some lawns may have been mapped as upland meadow and vice versa. Wetland and/or wooded habitats which occur within developed areas are mapped accordingly. Though the quality of those habitats occurring within developed areas would be diminished, they can still provide refuge to animals and serve valuable ecosystem services.

Appendix – Explanation of Rarity Ranks

Species of conservation concern (rare or declining species) listed in the Results section received a rarity ranking. The rarity rankings are described below.

Explanations of New York Legal Status and New York State Ranks are from the New York Natural Heritage Program website (http://www.acris.nynhp.org/ranks.php) Accessed October, 2013.

New York State Legal Status—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.

E - Endangered Species: any species which meet one of the following criteria:

Any native species in imminent danger of extirpation or extinction in New York.

Any species listed as endangered by the United States Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

T - Threatened Species: any species which meet one of the following criteria:

Any native species likely to become an endangered species within the foreseeable future in New York.

Any species listed as threatened by the U.S. Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

SC - Special Concern Species: those species which are not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York.

New York State Legal Status—Plants

The following categories are defined in regulation 6NYCRR part 193.3 and apply to NYS Environmental Conservation Law section 9- 1503.

E - Endangered Species: listed species are those with:

5 or fewer extant sites, or

fewer than 1,000 individuals, or

restricted to fewer than 4 U.S.G.S. 7 ½ minute topographical maps, or

species listed as endangered by U.S. Department of Interior, as enumera¬ted in Code of Federal Regulations 50 CFR 17.11.

T - Threatened: listed species are those with:

6 to fewer than 20 extant sites, or

1,000 to fewer than 3,000 individuals, or

restricted to not less than 4 or more than 7 U.S.G.S. 7 and ½ minute topographical maps, or

listed as threatened by U.S. Department of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11.

R - Rare: listed species have:

20 to 35 extant sites, or

3,000 to 5,000 individuals statewide.

New York State Rank (of New York Natural Heritage Program)
These ranks carry no legal status. The state rank reflects the rarity within New York State.

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 to 20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.
S3: Typically 21 to 100 occurrences, limited acreage, or miles of stream in New York State.
S4: Apparently secure in New York State.
S5: Demonstrably secure in New York State.

Species of Greatest Conservation Need—**SGCN**
From the New York State DEC website
(http://www.dec.ny.gov/animals/9406.html.) Accessed October, 2013.
Species are chosen as SGCN using the following criteria:

- Species on the current federal list of endangered or threatened species that occur in New York
- Species that are currently State-listed as endangered, threatened or 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

Regional Status (Hudson Valley)—**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). Hudsonia uses ranking criteria similar to those used by the NYNHP, but applies those criteria to the Hudson Valley below the Troy Dam. The 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 more information about species occurrences in the region becomes available. In this report, all regional ranks (rare, scarce, declining, vulnerable) are denoted with a single code (RG). Species with New York State Legal Status or New York State Rank 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.

Partners In Flight Priority Species Lists—Birds

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, and deteriorating habitats throughout their entire range. The most recent WatchList was updated in July 2008.

PIF1 High continental priority (Tier IA and IB species)
PIF2 High regional priority (Tier IIA, IIB, and IIC species)

Appendix - Reports on Municipal Land Fill Sites

Two municipal sites on the Wallkill River, the Gardiner land fill (104 acres) and the Shawangunk land fill (29 acres), received extensive site visits and reports. The reports on the municipal properties are attached.

Assessment of Biodiversity and Potential Public Use
Town of Shawangunk Transfer Station Property
Habitat Assessment Team. 2009.

Assessment of Biodiversity and Potential Public Use
Town of Gardiner Transfer Station Property
Habitat Assessment Team. 2009