TOWN OF GARDINER
- Environmental Conservation Commission
- Open Space Commission

Cornell University

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

TOWN OF GARDINER
NATURAL RESOURCES INVENTORY








Town of Gardiner
Natural Resources Inventory

Prepared by the DEC Hudson River Estuary Program and Members of the Town of Gardiner Environmental Conservation Commission, Open Space Commission, and Planning Board

2021

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This project was carried out through a partnership with Cornell University and the New York State Department of Environmental Conservation Hudson River Estuary Program with funding from the New York State Environmental Protection Fund.

Acknowledgments

by Laura Rose, Member, Town of Gardiner Open Space Commission.
Thanksgiving, November 2020

When asked to participate in developing a Natural Resources Inventory (NRI) for Gardiner, as a representative of its Open Space Commission, I was told there would be several entities involved, and meetings over a period of months. The NYS Department of Environmental Conservation would take the lead, and we'd be joined by representatives from Gardiner's Environmental Conservation Commission, Planning Board, Town Board and an intern from SUNY New Paltz.
It sounded like a whole lot of work I wasn't sure I wanted to volunteer for!

I didn't know what an NRI was or how valuable the information could be for focusing preservation efforts. I wasn't aware it could help the Town be proactive in responsible growth and planning.

My first clue that this was a project worth doing came at our first meeting. Ashley Curtis, a SUNY New Paltz geography student and intern, had worked with land use specialists Nate Nardi-Cyrus and Ingrid Haeckel of the DEC to develop an initial 12 maps for the group's review. They were beautiful and full of nuanced information about the Town's natural resources.

We began an editing process that evening and I was impressed with how well Ingrid and Nate listened, and later, by how seamlessly Ashley incorporated the changes that were discussed. Thank you, Ashley!

When the pandemic hit, we switched to on-line meetings. And despite it being harder to work on this remotely, Ingrid was able to lead us through a meaningful editing process.

Much gratitude goes out to the DEC's Hudson River Estuary Program and Cornell University for initiating and sponsoring this project. Through a partnership with the SUNY New Paltz Geography Department internship program, they've been able to bring the expertise needed to create the maps in this report. They are truly its stars, a series of 23 stunning maps that clearly depict Gardiner's resources, including wetlands, streams, rivers, aquifer recharge areas and flood zones, connected forests and priority animal habitats, cultural resources, and more. They will be extremely useful to the Town.

Once the maps were organized, Ingrid and Nate turned their attention to creating the narrative portion of this report. Again, they listened, and updated based on the rest of the group's input.
Thanks to Ingrid and Nate for their expertise, patience, and many hours of work.

The data in the maps and text came from a variety of sources. Nate and Ingrid did research, pulling in existing mapping and a wide variety of reports. They were assisted in this effort by members of the Environmental Conservation Commission, who deserve special acknowledgement for the work they did for this project.

ECC members located relevant data and documents gathering dust in obscure filing cabinets across the County. They fleshed out more readily available information, with information that would otherwise have been forgotten. This has added key information to our NRI. Bill Trifilo's geological expertise has been helpful. Janet Kern's participation has been appreciated.
And the fingerprints of John Sansalone, a long-time member of their group, remain on the work they've brought to the table.

Roberta Clements, the ECC's Chair, deserves special note. Roberta has been an advocate for our Town developing an NRI for a very long time. Her advocacy was key in getting it organized. Once begun, she did research and led public outreach for this project, including sharing information to the Town website and via social media. She ran a safety conscious, physically-distanced public information session. She brings a depth of local knowledge and her passion for conservation to this project.
Special thanks to Roberta and the ECC.

Kay Hoiby, of the Gardiner Open Space Commission, has sorted through a very full cabinet of old files and also contributed to the research portion of the project. Thanks Kay!

Carol Richman, of the Planning Board, contributed research, as well as her time and graphic expertise. Thank you, Carol.

The Preserved in Gardiner map reflects research I completed for the Open Space Commission, so you can blame me for any omissions or mistakes! I had hand drawn the map; I'm really grateful to have had help in getting it digitized and truly honored that it was deemed valuable enough to include in this report.

Jean McGrane, Chair of the Gardiner Open Space Commission, worked closely with Roberta Clements, Nate and Ingrid to get the NRI off the ground. Her depth of professional experience is an asset to our town. I appreciate her for steering Gardiner's Open Space Commission in the right directions, always seeing a larger picture, utilizing our strengths and challenging each of our members to do more and do it better. Her leadership and enthusiastic participation in the NRI, and every effort Gardiner's Open Space Commission has made to date, is appreciated.

Thank you, Town of Gardiner, and Supervisor Marybeth Majestic, for ongoing support for green projects and conservation. The decision of the Town Board to go ahead with this project was the deciding factor in why the DEC invested the resources to get it done, so thank you Town Board. And thank you Laura Walls for attending NRI meetings, being the liaison, and contributing as a participant.

Climate Smart Gardiner members attended most of our meetings. We were really happy to have them there, and appreciate their input and support.

Section 1: Introduction

The Town of Gardiner is a notably scenic and rural small town, located within Ulster County, NY. There is a hamlet business district and a variety of small business enterprises. However, the majority of the Town consists of agricultural land, natural areas, and residential single family homes. Agricultural products include both crops and livestock, primarily beef. The Town shares it borders with Minnewaska State Park and the privately owned Mohonk Preserve. Both are rich in natural and recreational resources. Much of the Town is situated in the Wallkill Valley, a region that has recently been experiencing rapid population growth. Land-use planning is instrumental to balancing future growth and development with protection of natural resources.

Oak Leaves in Gardiner. *Roberta Clements*

Gardiner's forests, meadows, wetlands, and streams are not only habitat for abundant wildlife and fish; they also provide many vital benefits to the people who live near them. These ecosystems help to keep drinking water and air clean, moderate temperature, filter pollutants, absorb floodwaters, and provide for pollination of agricultural crops. They also present opportunities for outdoor recreation and education, and create the scenery and sense of place that is unique to the community. Identifying important natural resources is the first step in proactive environmental planning and informed decision-making.

This Natural Resources Inventory (NRI) identifies and describes the naturally occurring resources located in Gardiner, including topography, geology and soils, water resources, and habitat, as well as recreational and cultural areas, land uses, and climate conditions and projections. This document also serves to aggregate the numerous local natural resource studies, reports and plans that contribute to a nuanced and detailed understanding of the Town. By bringing this information together in one place, the NRI can cultivate a better understanding and appreciation of the community's natural resources and set the stage for a wide range of planning and conservation applications. The NRI provides a foundation for comprehensive and open space planning, zoning updates, identifying critical environmental areas, climate adaptation strategies, and other municipal plans and policies for the Town of Gardiner. The NRI can also inform land stewardship and conservation in the Town. In years past, the community experienced a seemingly unlimited abundance of natural resources, and human activities reflected that attitude of wealth. In present times, we are faced with the limits of our geography and of the capacity of our natural resources to sustain our current way of life. The mere need for the development of a natural

resources inventory indicates a paradigm shift in the way we value our everyday world and the local, state, national, and global efforts to maintain it for future generations.

Data and Methods

Mapping for the Gardiner NRI was completed in December 2020 through technical assistance from the NYS DEC Hudson River Estuary Program and Cornell University. The Estuary Program's Conservation and Land Use Specialist, Ingrid Haeckel, drafted 23 maps with assistance from SUNY New Paltz Geography Intern Ashley Curtis and extensive input from the Town's NRI Project volunteers. The maps display data from federal, state, and county agencies; non-profit organizations including Mohonk Preserve and The Nature Conservancy; and prior planning efforts by the Town. The original source and publication year of data sets are included on each map and are described in the report.

Gardiner NRI Public Meeting held in February 2020. *Nate Nardi-Cyrus*

All maps were produced using ESRI ArcGIS 10.6 Geographic Information Systems (GIS) software and data in the NAD 1983 State Plane New York East FIPS 3101 Feet coordinate system. Information on the maps comes from different sources, produced at different times, at different scales, and for different purposes. Most of the GIS data were collected or developed from remote sensing data (i.e., aerial photographs, satellite imagery) or derived from paper maps. For these reasons, GIS data often contain inaccuracies from the original data, plus any errors made while converting it. Therefore, maps created in GIS are approximate and best used for planning purposes. They should not be substituted for site surveys. Any resource shown on a map should be verified for legal purposes, including environmental review. Information provided by the maps can be enhanced by local knowledge, and the NRI should be updated every 10 years as new data become available.

The NRI report was written based on a template from the Hudson River Estuary Program, with assistance from NRI Project volunteers. It incorporates information from the following documents:

- Gardiner Comprehensive Plan (2004)
- Gardiner Open Space Plan (2006)
- Scenic Resources in the Shawangunk Mountains Region: A Guide for Planning Boards (2012)
- Shawangunk Mountains Scenic Byway Corridor Management Plan (2005)
- Gardiner Habitat Map and Report (2014)
- Appraisal of Ground-Water Resources in Gardiner - *draft* (2001)
- Town of Gardiner Water Resource Summary (1998)
- Preserved in Gardiner Database (2019)

The draft NRI maps were made available for public comment on the Town website during the summer and fall of 2020. Due to physical-distancing guidelines established during the Covid-19 crisis, the draft maps were not available in physical locations, though the NRI project team would have preferred this. Residents of the Town were invited to monthly virtual meetings to review the draft maps and one in-person meeting was held prior to the Covid-19 pandemic. The Town Board received a virtual presentation of the draft maps from the DEC during their July 14th public meeting. In September residents had an opportunity to attend an in-person open house to learn more about the NRI maps and associated narrative report. On October 13th the Planning Board received a training from DEC and NRI project volunteers, to both solicit input on the NRI draft and practice using the report to inform land-use decisions.

How to Use this Report

The NRI is a valuable land use planning tool as well as an educational resource that documents aspects of the Town's diverse natural and cultural resources. The inventory provides an essential tool for the local Building Department by officially identifying sensitive land, water and cultural/historical resources. The report discusses development considerations for the Planning Board and Zoning Board of Appeals, laying a foundation for evaluating land-use planning and decision-making and zoning considerations. It offers municipal policy guidance, as well as helping to inform environmental conservation efforts. In addition, the NRI provides property owners, developers and their consultants with information they may need in considering the impact their project may have on the Town's natural resources. It can be used to identify natural resources during project planning and design and to help expedite review and approval of their endeavors. It can also be used as a general reference for landowners to understand resources that may occur on their property and to inform stewardship, or care for the land.

It is important to keep in mind that the NRI is best suited for municipal-scale planning but may be used as a screening tool at the site-scale to raise questions or identify the need for additional site assessment. Most of the maps are not intended to provide site-specific accuracy.

The NRI maps are available as PDFs on the Town Website and physical copies are available at the Gardiner Town Hall. The PDF maps allow for ease of navigation with the ability to zoom in to an area of interest. There are two versions of each of the NRI maps, one with and one without tax parcel outlines. Tax parcel data comes from county records and provides a valuable reference for those using the NRI for site-level review. For general use or planning purposes, it is preferable to use the maps without tax parcels. Text highlighted in blue (such as this) throughout this document indicates an associated hyperlink to an online source.

Many of the data sets shown in the NRI maps are available for more detailed viewing through online interactive maps. These include:

- Ulster County Parcel Viewer
- Hudson Valley Natural Resource Mapper
- DECinfo Locator
- Discover GIS Data NY
- National Map
- Web Soil Survey
- TNC Resilient Land Mapping Tool
- Ulster County ReConnect

Base Map (Map 1) and Aerial View (Map 2)

The Base Map (Map 1) is the foundation for the NRI map series. It shows municipal boundaries and roads. The Town of Gardiner is bordered to the north by the Town of New Paltz, to the north and west by the Town of Rochester, to the west by The Town of Wawarsing, to the south by the Town of Shawangunk, and to the east by the Towns of Plattekill and Lloyd. This map displays the major hamlets in the Town of Gardiner, as identified in the Comprehensive Plan:

- Gardiner Hamlet
- Ireland Corners
- Tuthilltown
- Benton Corners
- Mountain Gateway

State Route 44/ 55 is the major transportation corridor through the Town of Gardiner, connecting the Town with locations east of the Hudson River and west of the Shawangunk Ridge in the Town of Wawarsing. Other important roads include north/south running State Route 208 and State Route 32 and east/west State Route 299.

There are many important parks and preserves noted on the base map, including the Mohonk Preserve, Minnewaska State Park, and the Wallkill Valley Rail Trail. These recreational assets support the vibrant local tourism industry as well as quality of life for residents, and are described further under the Preserved Land section (Map 22).

The Base Map also illustrates general natural features such as open bodies of water, streams, rivers and wetlands. Of note, the Wallkill River, Shawangunk Kill, Platte Kill, Mara Kill, Palmaghatt Kill, and Tillson Lake are labeled. General topographic relief is shown using a shaded digital elevation model. These features are shown in more detail on other maps in the inventory.

The Aerial View Map (Map 2) gives a bird's-eye view of the Town, showing .5-ft resolution 4-band digital orthoimagery in natural color taken in 2016 by the NYS Digital Orthoimagery Program. The imagery was accessed through the ESRI (Environmental Systems Research Institute) aerial base layer for 2020.[1] Orthoimagery is aerial imagery that has been georeferenced and digitally corrected to remove geometric distortion due to ground relief and camera position.[2] The resulting imagery is proportionally accurate and can be overlaid onto maps. The aerial imagery was taken in early spring prior to the leaf out of deciduous trees, resulting in a detailed view of vegetation types, land uses, and development. It can serve as a reference for comparison with features shown on other maps in the Natural Resources Inventory.

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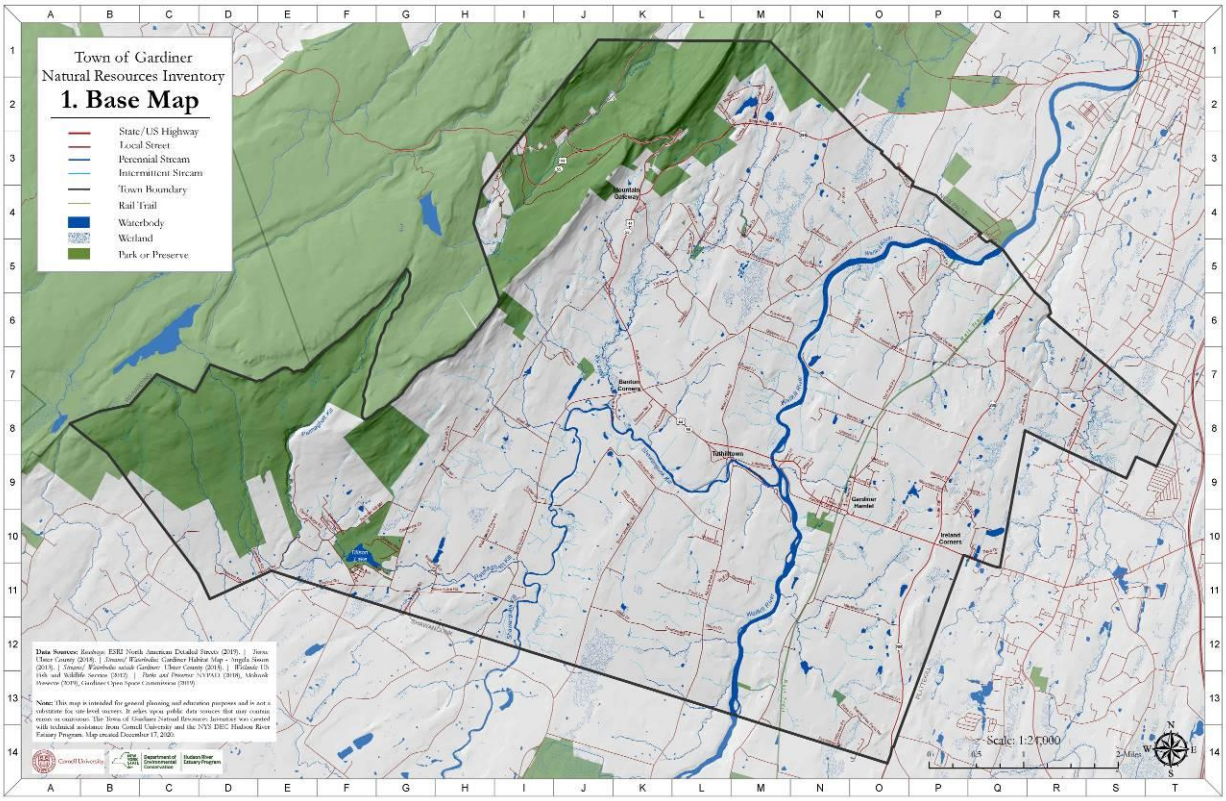
[1] For more detailed, interactive viewing of orthoimagery dating back to 1994, users can visit the Discover GIS Data NY website at https://orthos.dhses.ny.gov/.

[2] "Frequently Asked Questions – Digital Orthoimagery Information." NYS GIS Program Office. http://gis.ny.gov/gateway/mg/faq.htm


Town of Gardiner
Natural Resources Inventory
1. Base Map
State/US Highway
Local Street
Perennial Stream
Intermittent Stream
Town Boundary
Rail Trail
Waterbody
Wetland
Park or Preserve
Mountain Gateway
Boston Corners
Tuthilltown
Gardiner Hamlet
Ireland Corners
Tillson Lake
Scale: 1:27,000
0
0.5
1
2 Miles
N
W
E
S


Town of Gardiner
Natural Resources Inventory
2. Aerial View
Mountain Gateway
Boston Corners
Tuthilltown
Gardiner Hamlet
Ireland Corners
Tillson Lake
Scale: 1:24,000
0
0.5
1
2 Miles
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Section 2: Climate

Climate is the long-term average of weather, typically averaged over a period of 30 years.

Gardiner is already experiencing the effects of rapid climate change. Such as rapidly changing weather patterns, hotter summers, and warmer winters.

The Town of Gardiner lies in the humid continental climate zone with cold winters, mild summers, and no significant precipitation difference between seasons. The Town is in the Northern Glaciated Slate and Shale Valleys ecoregion. An annual average of 42.8 inches of precipitation was recorded at the Gardiner 1 W weather station for the period of 1981-2010.[3] Annual snowfall average for 1956-2001 was 38.3 inches.

Since the 19th century average global temperatures have been rising, largely due to the increasing input of insulating greenhouse gases into the atmosphere. In addition to the direct effects of hotter weather (e.g. heat stress), the resulting warming atmospheric temperature alters the water cycle, leading to more extreme precipitation, short-term drought and severe storms

Local data, including long-term records collected from the Mohonk Mountain House, show steady and rapid changes in the Town of Gardiner's climate that reflect global trends.[4] It is vital for local decision-makers to understand these trends and the related climate hazards facing the region and to plan for future conditions such as flooding and drought, increased overall temperature, and rapidly changing weather patterns. Many of the natural resources described throughout this inventory contribute to the community's safety and ability to adapt to the impacts of climate change. Natural areas like forests and wetlands help to sequester and store carbon, offsetting some of the impacts of local greenhouse gas emissions. This section presents general climate information prepared for Hudson Valley communities by the DEC Hudson River Estuary Program.[5]

Climate Projections

Responding to Climate Change in New York State (the ClimAID Report), written in 2011 and updated in 2014, is the current authoritative source for climate projections for New York State.[6] ClimAID translated Intergovernmental Panel on Climate Change (IPCC) scenarios into more robust regional-scale predictions incorporating local data inputs and expert knowledge. Gardiner is located within the ClimAID Climate Region 2, as seen on Figure 1.

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[3] Western Regional Climate Center, Gardiner 1W Station (303138) weather data, https://wrcc.dri.edu/ (accessed October 29, 2020)

[4] Mohonk Preserve. *Weather Data*. https://www.mohonkpreserve.org/what-we-do/conservation-science/weather-data.html

[5] Zemaitis, L. *Working Toward Climate Resilience: General Climate Information Prepared for Hudson Valley Communities*. DEC Hudson River Estuary Program, 2018. https://wri.cals.cornell.edu/sites/wri.cals.cornell.edu/files/shared/documents/HV%20Climate%20Summary%20General%20MAR2018.pdf

[6] Horton, R., D. Bader, C. Rosenzweig, A. DeGaetano, and W.Solecki. "Climate Change in New York State: Updating the 2011 ClimAID Climate Risk Information." New York State Energy Research and Development Authority (NYSERDA), 2014, Albany, NY. www.nyserda.ny.gov/climaid

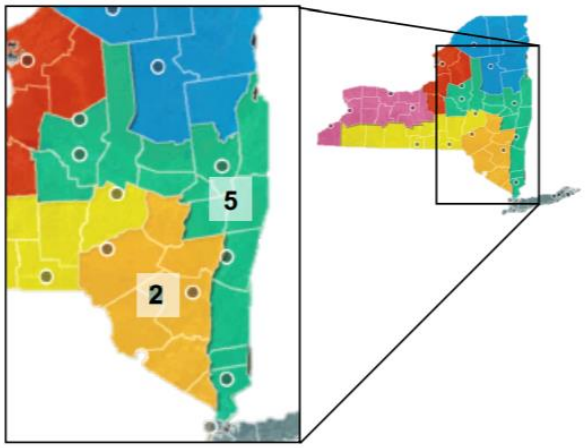


Figure 1. Region 2 and 5 of the ClimAID report include the Hudson and Mohawk River valleys

Looking towards the future there are three prominent climate trends that will likely affect the Town and the region: increasing ambient temperatures, more and longer duration heatwaves, and shifting precipitation patterns (i.e. less frequent but more intense precipitation events, and increased instances of flood and drought).

Temperature. Since 1970, Gardiner has seen a 2°F increase in average annual temperature and a 5°F winter temperature increase. These increases are above both the national and global increases in annual temperature during the same period. Current projections from the 2014 ClimAID report show an additional increase of about 4-6°F in Gardiner's average annual temperature in the coming decades and up to 11°F by 2100.

AIR TEMPERATURE PROJECTIONS FOR REGION 2

	Baseline 1971-2000	2020s	2050s	2080s	2100
Annual average air temperature	48°F	52.2 - 53.1°F	54.2 - 56.1°F	55.4 - 59.6°F	56.2 - 61.2°F
Increase in annual average	-	2.2 - 3.1°F	4.2 - 6.1°F	5.4 - 9.6°F	6.2 - 11.2°F

Increasing annual temperatures will lead to more frequent, intense, and long-lasting heat waves during the summer, posing a serious threat to human health and increased electricity demand from air conditioning. By mid-century, the ClimAID report projects the Town could annually experience five to twelve days above 95 °F, and up to six heat waves (defined as at least three consecutive days with maximum temperatures above 90ºF) that last one to two days longer than average. Increasing temperature not only affects human health and ecosystems but can impact the electrical needs of a community putting strain on both budgets and the grid while creating more challenges in agriculture and other industries.

HEAT WAVE PROJECTIONS FOR REGION 2

	Baseline 1971-2000	2020s	2050s	2080s	2100
# Days per year above 90˚F	12	19 - 25	31 - 47	38 - 77	*
# Days per year above 95˚F	2	2 - 5	5 - 12	7 - 28	*
# Heat waves per year	2	3	4 - 6	5 - 9	*
Average # days of each heat wave	4	5	5 - 6	5 - 7	*
# Days per year ≤ 32˚F	138	108 - 116	86 - 100	65 - 89	*

***Projections not available at this time*

Precipitation. Precipitation in Gardiner has become more variable and extreme, whereas total rainfall has changed only marginally. The amount of precipitation falling in heavy rain events increased 71% from 1958 to 2012 in the Northeast.[7] ClimAID projections indicate total annual precipitation could increase as much as 11% by mid-century and 18% by 2100, with much of that precipitation coming from heavy rain events. Overall, New York State models project more dry periods intermixed with heavy rain and decreased snow cover in winter. However, future precipitation projections are considered more uncertain since it is difficult to model. An increase in heavy precipitation events would elevate flood risk and increase pollution from stormwater runoff.

PRECIPITATION PROJECTIONS FOR REGION 2

	Baseline 1971-2000	2020s	2050s	2080s	2100
Total annual precipitation	48"	48.5" - 52"	49.5" - 53.5"	51" - 54.5"	48.5" - 56.5"
% Increase in annual precipitation	-	1 - 8%	3 - 11%	6 - 14%	1 - 18%
# Days with precipitation > 1"	12	12 - 13	13 - 14	13 - 15	*
# Days with precipitation > 2"	2	2	2 - 3	2 - 3	*

***Projections not available at this time

Gardiner can reduce potential further damage due to increased stormwater runoff by preserving natural areas, implementing green infrastructure strategies, and limiting impervious surfaces where applicable. Conservation of floodplains, stream corridors, wetlands, and forests will help reduce stormwater runoff and risk from flooding, as well as provide opportunities for plants and animals to migrate north and higher in elevation to adapt to warming conditions. Natural areas also act as carbon sinks, sequestering and storing carbon that helps offset local greenhouse gas emissions. Preservation of natural areas providing stormwater and flood control benefits is in most cases cheaper and more effective than engineered alternatives, and should be prioritized wherever feasible.

Special consideration should also be given to forecasts of increased temperature and heatwaves. The Town should plan for increasing temperature by increasing shaded areas in public spaces to offer relief, this can include trees and other structures. Forest areas of all sizes can help moderate local temperatures. The DEC recommends developing or updating a heat emergency plan to provide a course of action

[7] Melillo, J. M., T.C. Richmond, and G. W. Yohe. Climate Change Impacts in the United States: The Third National Climate Assessment. 841 pp. doi:10.7930/J0Z31WJ2, 2014. https://nca2014.globalchange.gov/

during intense heat events.

The above-mentioned changes to Gardiner's climate are expected to negatively impact many of the plant and animal species found in the region. There has already been a documented change in growth zones which are shifting north due to increased atmospheric temperatures.[8] Changes in weather patterns will likely drive the migration of some species, while others might be able to persist because of favorable climate conditions. Map 20, Climate Resilience for Biodiversity, shows the areas within Town that are expected to be important for the conservation of species as the climate changes.

Climate Smart Community Certification

The Climate Smart Communities program is a New York State program that helps local governments take action to reduce greenhouse gas emissions and adapt to a changing climate.[9] The Climate Smart Gardiner Task Force is leading local efforts to engage and educate residents and to reduce carbon emissions and be more prepared for climate change.

[8] Matthews, S.N., L. R. Iverson, M.P. Peters, and A.M. Prasad. *Assessing Potential Climate Change Pressures across the Conterminous United States: Mapping Plant Hardiness Zones, Heat Zones, Growing Degree Days, and Cumulative Drought Severity throughout this Century*, USDA, March 2018, https://www.fs.usda.gov/treesearch/pubs/55870

[9] For more information, visit https://climatesmart.ny.gov

Section 3: Physical Setting

Topography (Map 3)

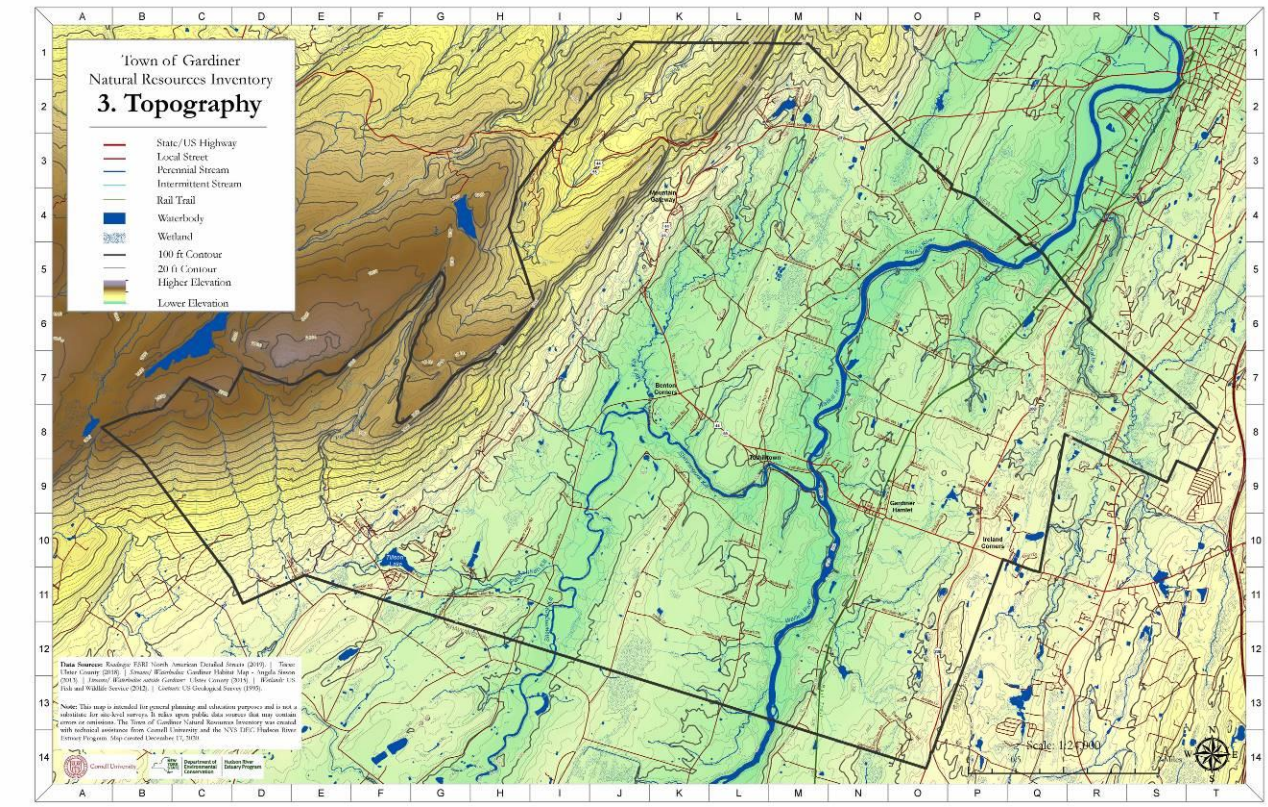
The Town of Gardiner has a tremendous variety of topography from the fertile floodplain of the Wallkill Valley to the sheer cliffs along the Shawangunk Ridge. The variation in the Town's topography reflects differences in the underlying geology and has been an important factor influencing the location of development.

↑High Point - Shawangunk Ridge – 2,043 feet above sea level

↓Low Point - Wallkill River – 180 feet above sea level

Contours are displayed in 20 foot and 100 foot intervals and were derived from 1995 US Geological Survey maps. The elevation gradient is also symbolized using a spectrum of colors, with green representing the lowest elevations and white/brown representing the highest elevations.

The highest areas of Gardiner are located along the Shawangunk Ridge in the western portion of Town, with maximum elevations of around 2,043 feet. The low points are along the Wallkill River in the northern portion of Town, which are closer to 180 feet. These points were determined through 2-foot contours generated from high resolution digital elevation models produced by Ulster County.



The Wallkill River and Shawangunk Kill have created a network of floodplains and terraces within the lowest elevation areas. The landscape gently rises toward the eastern side of the Town but does not exceed 600 feet.

It is critical to understand the topography of a site when designing development and construction projects. Overall elevation affects the layout of stormwater drainage and the developable land on a particular site. Low-lying areas can be prone to flooding, and understanding the absolute elevation as well as elevation change across a site can provide insight into the potential for the existence of floodplains, wetlands, steep slopes and other sensitive environmental features. Development of higher elevation areas can impact surrounding lower-elevation areas unless stormwater is properly managed on site.

The Shawangunk Ridge from the Wallkill Valley. *Roberta Clements*

Steep Slopes (Map 4)

The Town of Gardiner might be best known for its dramatic cliffs along the Shawangunk Ridge. The ridge is a desitination for thousands of rock climbers annually, largely due to the repuation of these cliffs as the best climbing on the east coast of the United States. Whether viewed from a trail within the Mohonk Preserve or from a back porch in the valley, these steep slopes are sensitive to a variety of stressors that can negatively impact their scenic value and unique ecology.

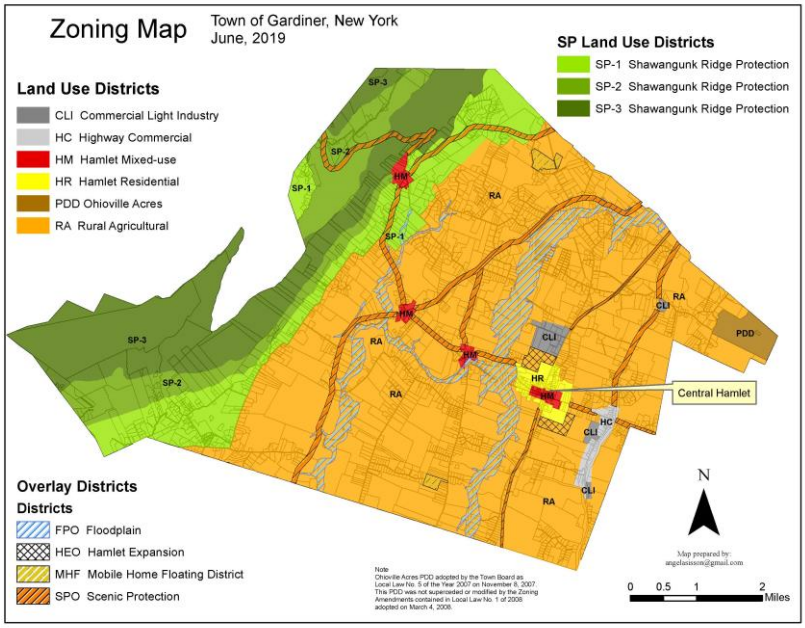
Steep slopes pose significant limitations to development and are among the most sensitive environmental features in the landscape.

Slope is defined as the vertical change in elevation over a given horizontal distance. For example, a 10% slope is one that rises 10 feet over a horizontal distance of 100 feet. The Steep Slopes map is derived from 10-meter resolution digital elevation models based on 1:24,000 contours from the U.S. Geological Survey (1957) and should only be considered an approximate depiction of steeply sloped areas in the Town. Steeper slopes are primarily found along the east-facing side of the Shawangunk Ridge but can also be seen along some tributaries to the Wallkill River and on the larger hills in the valley. These slopes are indicated on the map by shades of green, with darker shades indicating steeper slopes.

The Steep Slopes map includes the following slope classes, based on the national Soil Survey Manual:[10]

- <8% (nearly level to gently sloping)
- 8 – 15% (strongly sloping)
- 15 – 25% (steep)
- Over 25 % (very steep)

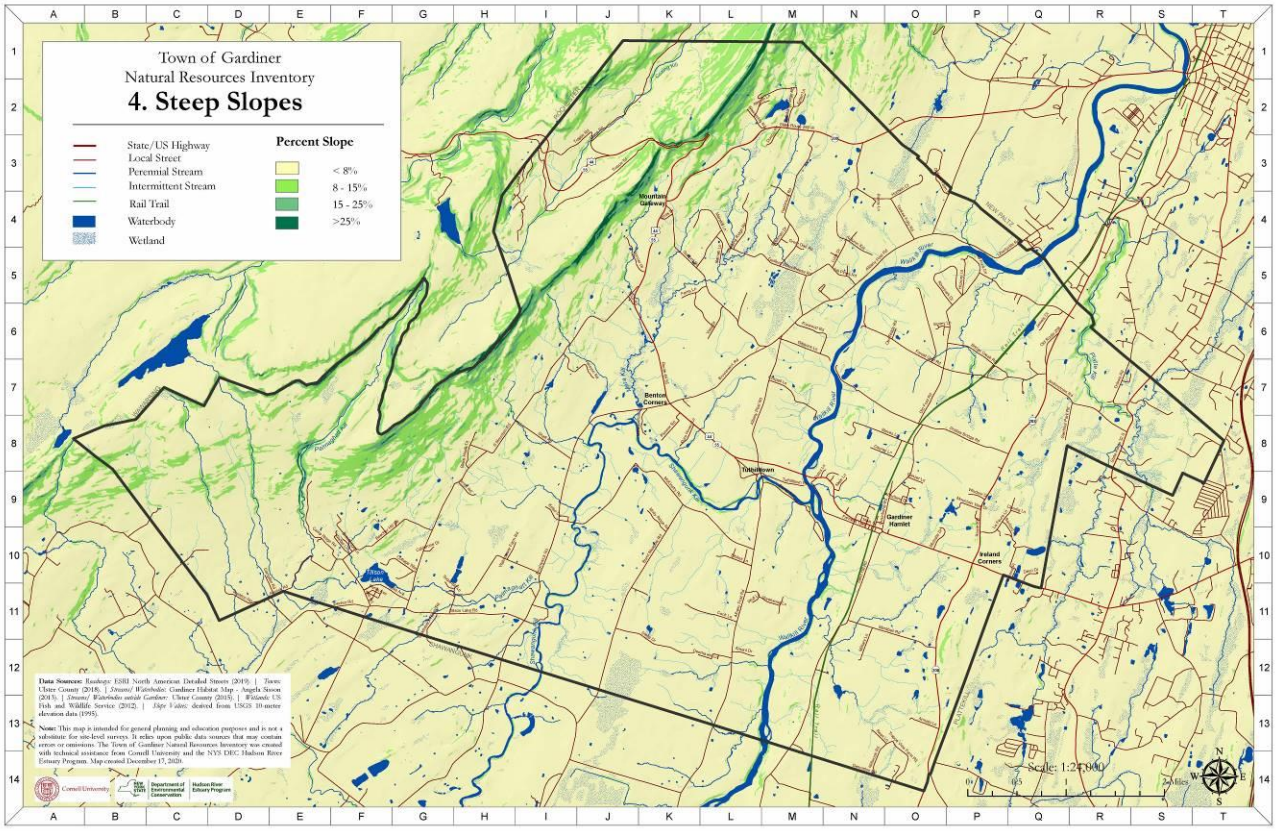
Gardiner's municipal code includes a steep slopes ordinance (§220-36) requiring a permit for activities on slopes greater than 15%. The Shawangunk Ridge Protection (SP) district, which includes a majority of steep slopes in the community, defines additional slope-related restrictions.[11]



Town of Gardiner Zoning Map showing SP Land Use Districts.

[10] Ditzler, C., K. Scheffe, and H.C. Monger (eds.). *Soil Survey Manual.* USDA Handbook 18. Government Printing Office, 2017, Washington, D.C.

[11] Town of Gardiner, Municipal Code. Section 220-36. https://ecode360.com/13868205?highlight=slope,slopes,steep%20slope,steep%20slopes&searchId=17846200926493693#



In general, slopes greater than 15% pose significant limitations to construction and are among the most sensitive environmental features in the landscape. Development of steeply-sloped landscapes can increase the danger of erosion, landslides, and excessive polluted runoff.[12] Steep slope disturbance can introduce sediment and other pollution to streams and waterbodies, affecting downstream water quality. Grading and construction on steep slopes can also be prohibitively expensive, and such sites may not be able to support a properly functioning sewer or septic system.[13]

Gardiner's cliffs and other steep slopes are also exceptional scenic and ecological resources. Views of the Shawangunk Ridge contribute to the local tourism economy by creating a beautiful backdrop for those driving along the Shawangunk Mountains Scenic Byway, local roads, or the Shawangunk Wine Trail. Construction on steep slopes can significantly impact the quality of these scenic views, which has negative implications for the tourism economy.

13868205

[12] *Steep Slopes and Land Use Decisions*. Southern Tier Central Regional Planning and Development Board, February 2012. www.stcplanning.org/usr/Program_Areas/Flood_Mitigation/SCAP_steepslopes 2010_02_21_CR.pdf.

[13] Chemung County Environmental Management Council. *Chemung County Natural Resources Inventory.* 2008. https://www.chemungcountyny.gov/chemung_county_executive_s_advisory_commission_on_natural_energy_solutions/natural_resources_inventory.php.

Several significant habitats are associated with steep slopes, as well. Thinly soiled steep slopes may support rocky ledges and talus, which various wildlife species use for denning, shelter, foraging, and basking.[14] These habitats and their associated species of conservation concern are described further in the Habitats and Wildlife section of this report.

Cliffs in the Mohonk Preserve. *Nate Nardi-Cyrus*

[14] Kiviat, E. and G. Stevens. *Biodiversity Assessment Manual for the Hudson River Estuary Corridor.* New York State Department of Environmental Conservation, 2001.

Bedrock Geology (Map 5)

Bedrock is the solid rock that lies beneath the soil and subsoil.[15] The geology of the Shawangunks and Wallkill Valley has profoundly influenced the topography, soils, water resources, ecological communities, and economy of Gardiner and the surrounding region. The New York State Museum has mapped general bedrock geology for New York State at a 1:250,000 scale.[16] Most of the bedrock geology consists of shale. Table 1 describes the geology units shown on the Bedrock Geology Map.

Geology is the study of the Earth, the materials of which it is made, the structure of those materials, and the processes acting upon them. Geology influences many environmental factors, including topography, groundwater and mineral resources, and the establishment of natural communities.

Table 1. Bedrock Geology Units in the Town of Gardiner.

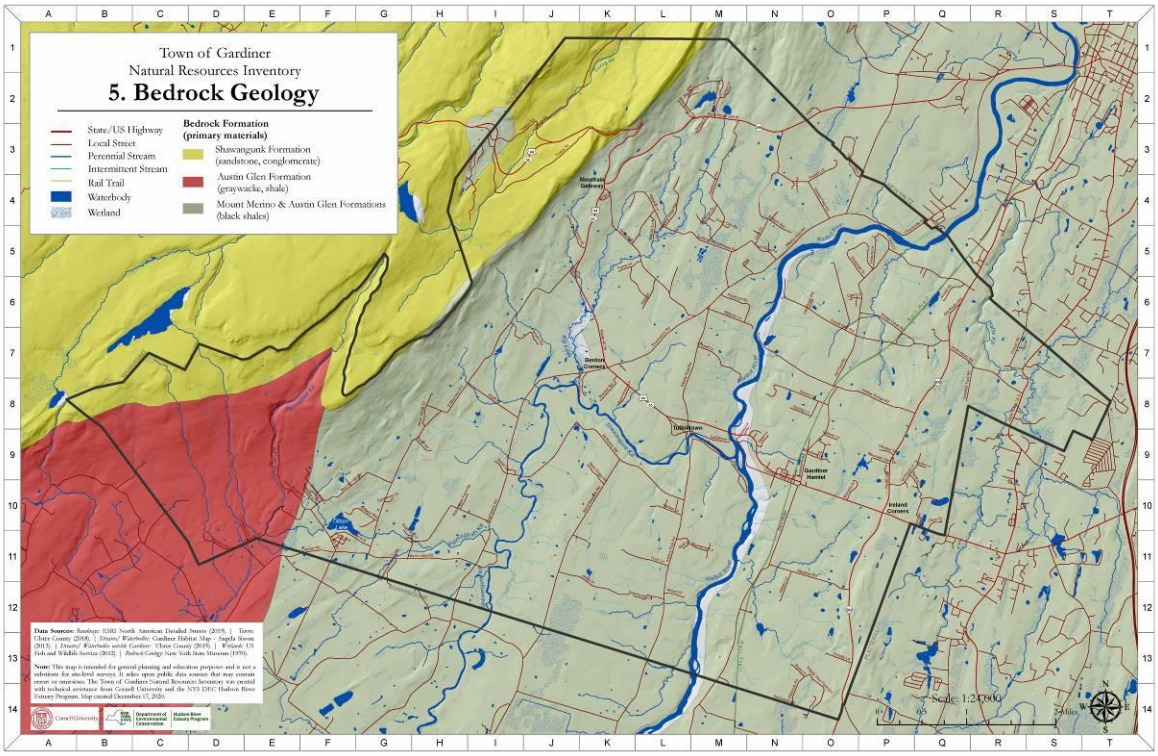
Code	Formation	Bedrock Unit	Primary Materials	Geologic Age
Ss	Shawangunk Formation		conglomerate, sandstone	Silurian
Oag	Austin Glen Formation	Normanskill	greywacke, shale	Middle Ordovician
On	Mount Merino and Austin Glen Formation		black shale	Middle to Upper Ordovician

The oldest bedrock in the Town is part of the **Austin Glen Formation**, which contains greywacke and shales formed during the Middle Ordovician Period, million years ago, 470-458 million years ago. The **Mount Merino** Formation is closely associated and contains chert and black shales dating to the Upper Ordovician Period, 458-443 million years ago. The bedrock in both units was deposited in a deep marine setting. During the Taconic orogeny (a mountain building episode of complex tectonic activity resulting in formation of the Appalachian Mountains), these formations underwent uplift and folding.

The **Shawangunk Formation** was deposited on top of these older rocks during the Silurian Period, approximately 443-419 million years ago. At that time, streams and rivers drained into a shallow sea which covered the southeastern part of New York State. The bottoms of these streams were layered with pieces of abraded quartz. The consistent flow of water eroded the chunks of quartz into pebbles that were eventually bonded together by silica-rich cement, which was supplied by percolating ground water. The name of the sedimentary rock formed by this process is conglomerate. The Shawangunk Mountains

[15] "Bedrock." *Wikipedia, The Free Encyclopedia*. Wikipedia, The Free Encyclopedia, 14 Sep. 2018. Web. 2 Oct. 2018.

[16] Fisher, Donald W., Yngvar W. Isachsen, and V. Lawrence Rickard. *Geologic Map of New York: Hudson-Mohawk Sheet*. New York State Museum and Science Service, Map and Chart Series No. 15, 1970. Available online at http://www.nysm.nysed.gov/research-collections/geology/gis.



extend to the southwest into New Jersey and to the northeast in Rosendale, NY. The Shawangunk Formation ranges in thickness from 733m (2,200 ft) near Ellenville, to the southwest, to <1m (about 1 foot) to the northeast.[17]

Geology influences many environmental factors, including topography, groundwater resources, migration of pollutants, and mineral resources.[18] Geologic properties also strongly influence soil properties, as well as groundwater and surface water chemistry, which in turn influence the establishment of ecological communities that support life on Earth. Calcium-rich bedrock including limestone and certain shales often support rare plants and uncommon habitats. Shales associated with the Austin Glen formation are considered to be potentially calcareous (containing calcium carbonate) and should be surveyed for rare species.[19] The Shawangunk Ridge is an especially unique geologic feature. The cliff and talus complex in Gardiner is thought to be the largest of its type east of the Mississippi, and should be protected for its rarity.[20]

[17] *New York State Geological Association 81st Annual Meeting Field Trip Guidebook,* 2009. https://www2.newpaltz.edu/~vollmerf/papers/NYSGA_2009.pdf

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

[19] Kiviat, E. and G. Stevens. *Biodiversity Assessment Manual for the Hudson River Estuary Corridor.* New York State Department of Environmental Conservation, 2001.

[20] Gardiner Open Space Plan, 2007, pg. 20. https://www.townofgardiner.org/open-space-plan.

Surficial Geology and Glacial Deposits (Map 6)

Surficial geology refers to unconsolidated sediments lying above the bedrock (i.e., rocks on the surface). The weathering of both bedrock and surficial geology deposits along with organic matter, water, and air is responsible for the slow process of soil formation. The properties of these "parent materials" strongly influence resulting soil chemistry, nutrients, and texture on which farmers and gardeners rely.

Surficial deposits are unconsolidated sediments primarily resulting from deposits left behind as glaciers retreated at the end of the last ice age. They are important sources of sand, gravel, and crushed stone.

The surficial geology of Gardiner largely reflects the retreat of glaciers following the last Ice Age. A giant ice sheet blanketed the area during the Wisconsin Stage of the Pleistocene Epoch, reaching a maximum extent about 21,000 years ago. Glacial ice, as much as 5,000 feet thick, scoured the landscape and deposited boulders, sand, and gravel in its path. Glacial meltwater turned parts of the Hudson Valley into vast Lake Albany, and left behind beaches, deltas, and deposits of silt and clay.

The Surficial Geology Map displays information from statewide maps produced by the New York State Geological Survey.[21] This map, like the one for bedrock geology, was developed at a scale of 1:250,000 and is best used as a general reference. There are six types of surficial materials mapped in Gardiner:

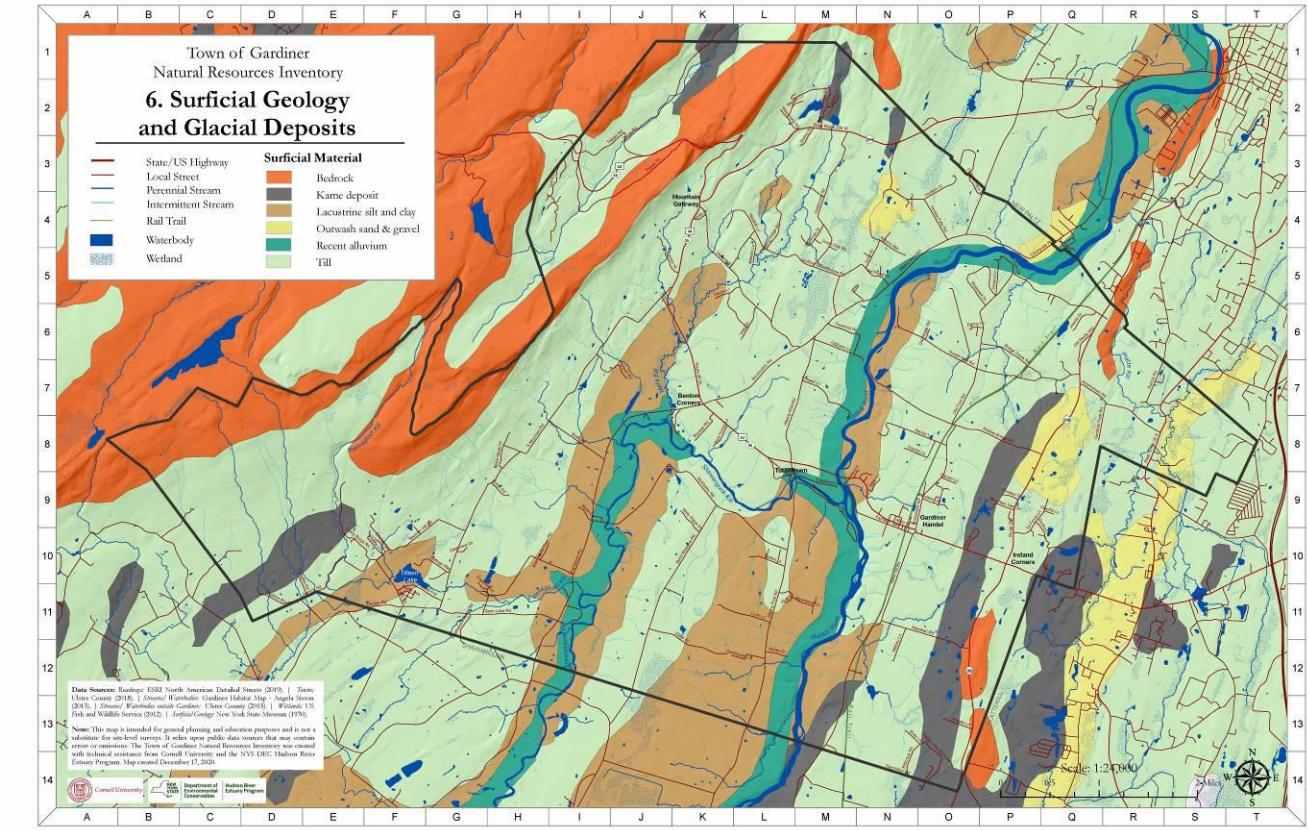
- Bedrock (exposed bedrock, typically within 1 meter of the soil surface)
- Kame Deposit (mound-like hill of poorly sorted drift, mostly sand and gravel, deposited at or near the terminus of a glacier)
- Lacustrine Silt and Clay (fine-grained deposits deposited in glacial lakes)
- Outwash Sand and Gravel (sand and gravel deposits from glacial meltwater streams)
- Recent Alluvium (modern stream deposits)
- Till (dense, unsorted clay, silt, sand, gravel, boulders)

Glacial Till makes up the majority of Gardiner's surficial geology, with deposits in both the Wallkill River valley and on the Shawangunk Ridge where exposed bedrock can also be found on the steep east-facing slopes. Kame deposits are sparse and mainly located South East of Gardiner along with outwash sand and gravel deposits. Recent alluvium deposits are found adjacent to the Wallkill River, Shawangunk Kill, and Palmaghatt Kill. Lacustrine silt and clay deposits are typically found surrounding the alluvium deposits along major stream corridors.

Outwash sand and gravel and kame deposits are associated with some of Gardiner's aquifers (see Aquifer Recharge Areas, Map 8) and may be an important source of sand, gravel, and crushed stone for building and road construction. However, consideration must be given to the potential effect of any

[21] Caldwell, D. H., and R. J. Dineen. *Surficial Geologic Map of New York, Hudson-Mohawk Sheet.* New York State Geological Survey, 1987.

proposed mining operations on the level, turbidity, flow, and temperature of groundwater, especially considering Gardiner residents draw all of their drinking water from wells.[22]



[22] Green, J.A. and J.A. Pavlish, R.G. Merritt, and J.L. Leete, *Hydraulic Impacts of Quarries and Gravel Pits.* Minnesota Department of Natural Resources, Division of Waters, for the Legislative Commission on Minnesota Resources funded by the Minnesota Environment and Natural Resources Trust Fund, 2005.

Soils (Map 7)

Soils determine the suitability of an area for particular land uses and are the foundation for the establishment of natural communities of plants and animals.

Soils are the foundation for the establishment of natural communities of plants and animals as well as for critical ecological processes from decomposition and nutrient cycling to the water cycle, which supports life on Earth. Soil characteristics including reaction (acidity or alkalinity), drainage, soil texture, depth to bedrock, and slope determine the natural habitats that will establish in a particular area.[23] Soils also play a fundamental role in determining suitability for land uses. Soil characteristics determine potential for agricultural production as well as vulnerability to flooding, soil erosion or instability, and efficiency at filtering pollutants and wastes. Farmland soils are important to maintaining the Town of Gardiner's farming economy and are discussed further in relation to Map 21, Agricultural Resources. Consideration of soil properties is important for planning and designing drainage systems, siting of structures, evaluating the potential for septic systems, assessing requirements for constructing foundations, basements, and roads, and determining the feasibility of excavation, among other uses.[24]

The Soil Survey of Ulster County, New York[25]includes detailed soil maps for the entire county along with descriptions of soil types and tables of chemical, hydrologic, and structural characteristics of the soils, and their relationships to various human uses. It is important to note that county soil maps are only approximate; any soil unit may contain "inclusions" of up to 2 acres of soil types different from the mapped unit. The soil data may also be viewed online using the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey. [26] The soil survey report is available for download in PDF format on the NRCS website. Table 2 lists soil types found in Gardiner along with selected soil characteristics, such as soil code, soil unit name, drainage class, depth to bedrock, and soil reaction, based on tabular information provided in the county soil survey.

The Soils Map shows the soil units from the county *Soil Survey* symbolized by natural drainage class. Refer to Table 2 for additional characteristics associated with each soil unit. It includes information on the agricultural value of each soil type.

Soil drainage class indicates the possible presence of wetlands, and is a particularly important factor to consider in the evaluation of proposed development. Somewhat poorly drained soils are good indicators of possible wetland areas and poorly drained and very poorly drained soils are indicators of probable

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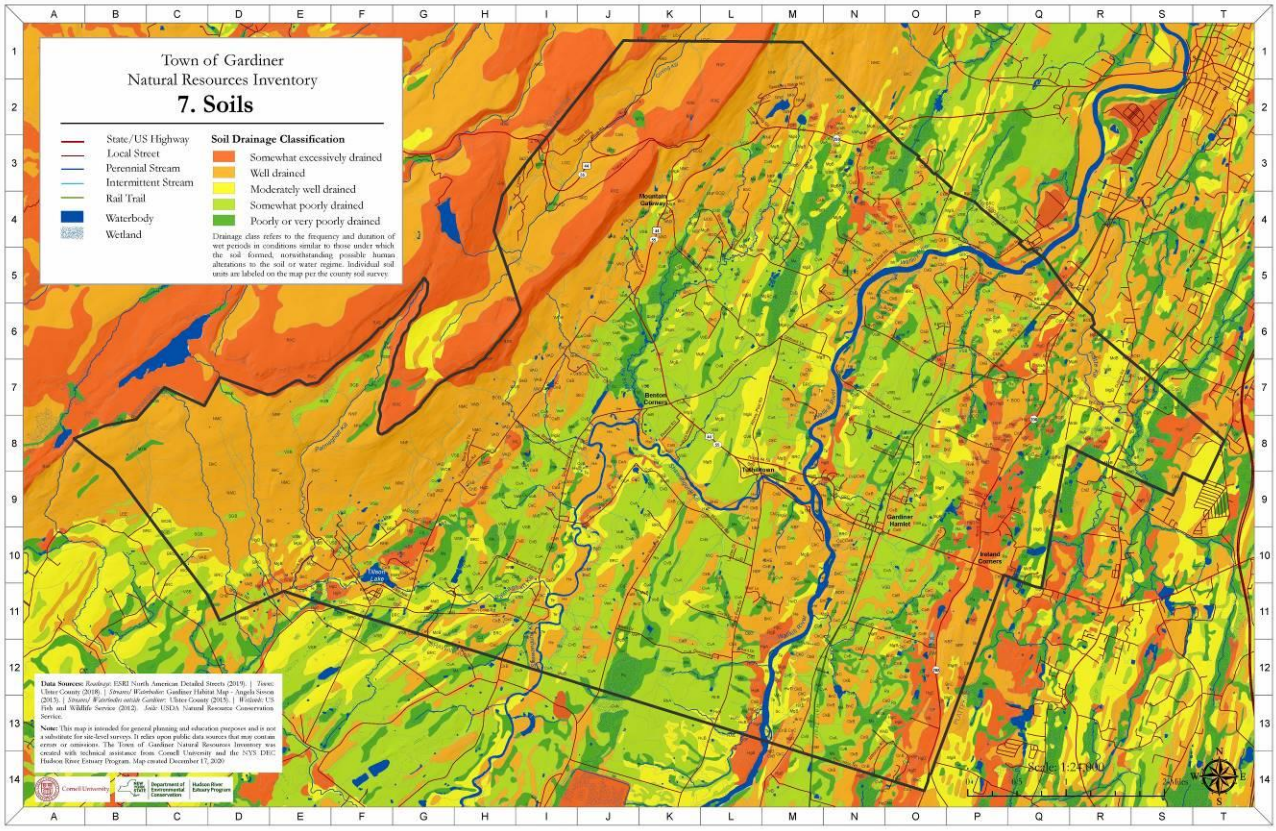
[23] Heady, L., and G. Stevens. *Biodiversity Assessment Guidebook*, Hudsonia Ltd, 2018.

[24] Haeckel, I., and L. Heady. 2014. Creating a Natural Resources Inventory: A Guide for Communities in the Hudson River Estuary Watershed. *New York State Department of Environmental Conservation and Cornell University*, 2014.

[25] Tornes, L.A. *Soil Survey of Ulster County, New York*. USDA Soil Conservation Service in cooperation with Cornell University Agricultural Experiment Station, Ithaca, 1979. https://www.blogs.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/new_york/ulsterNY1979/ulster.pdf

[26] NRCS Web Soil Survey is available online at https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm



wetland areas.[27] Wetlands are vital to maintaining water quality and biological and ecological diversity. They are also shown on Map 13A (Wetlands and Wetland Soils). Conversely, well drained and somewhat excessively drained soils, especially those that are shallow or sandy, might indicate uncommon habitats such as crests, ledge, and talus, or sand plains. In Gardiner, well-drained soils generally occur on the Shawangunk Ridge and along the Town's eastern boundary, while the soils in the valley are usually more poorly drained. Significant areas of well drained soils can also be found on alluvial deposits immediately adjacent to the Wallkill River and Shawangunk Kill.

Hydric soils form under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Soils classified as hydric are commonly referred to as wetland soils, and largely correspond to poorly and very poorly drained soil classes.

Depth to bedrock is another important soil characteristic to consider in land use planning. Soil depth influences suitability for septic and other wastewater treatment systems, as well as the siting of buildings and roads. Shallow soils (<20 inches to bedrock) are often associated with steep slopes, increasing susceptibility to erosion. Shallow soils are also less capable of filtering pollutants draining to surface and groundwater supplies.

[27] Kiviat, E. and G. Stevens. *Biodiversity Assessment Manual for the Hudson River Estuary Corridor.* New York State Department of Environmental Conservation, 2001.

Soil reaction refers to the acidity or alkalinity of the soil, expressed in pH values.[28] Soil chemistry exerts a strong influence on plant and animal communities, and can be a useful predictor for certain habitats, from acidic bogs to calcareous wet meadows. Soils developing over calcium-rich bedrock such as limestone often support disproportionately high numbers of rare plants, animals, and natural communities.

Table 2. Soils in the Town of Gardiner

Code*	Soil Unit Name	Drainage Class	Hydric Class	Depth to Bedrock (inches)	Erosion Hazard	Farmland Class	pH	Reaction
AA	Alluvial land	Poorly drained	partially hydric	>60	Slight	Not prime farmland	6.5	slightly acidic
AcB	Arnot channery silt loam	Somewhat excessively drained	nonhydric	<20	Slight	Farmland of statewide importance	5.2	strongly acidic
ARD	Arnot-Lordstown-Rock outcrop complex	Well drained	nonhydric	<20	Moderate	Not prime farmland	4.8	very strongly acidic
At	Atherton silt loam	Poorly drained	predominantly hydric	>60	Slight	Farmland of statewide importance	6.6	neutral
BgC, BgD	Bath gravelly silt loam	Well drained	nonhydric	>60	Slight	Farmland of statewide importance	5.6	moderately acidic
BHE	Bath very stony soils	Well drained	nonhydric	>60	Moderate	Not prime farmland	5.6	moderately acidic
BnC	Bath-Nassau complex	Well drained	nonhydric	40-60	Moderate	Not prime farmland	5.4	strongly acidic
BOD	Bath-Nassau-Rock outcrop complex	Well drained	nonhydric	40-60	Moderate	Not prime farmland	5.4	strongly acidic
BRC	Bath and Mardin soils, very stony	Moderately well drained	nonhydric	>60	Slight	Not prime farmland	5.6	moderately acidic
CaB, CaC	Cambridge gravelly silt loam	Well drained	nonhydric	>60	Slight	All areas are prime farmland	6.8	neutral
Cc, Cd	Canandaigua silt loam	Very poorly drained	predominantly hydric	>60	Slight	Farmland of statewide importance	7.3	neutral
CF	Cut and fill land	Somewhat excessively drained	predominantly nonhydric	>60	Slight	Not prime farmland	6.5	slightly acidic
CgA, CgA	Castile gravelly silt loam	Moderately well	nonhydric	>60	Slight	All areas are prime farmland	5.9	moderately acidic

[28] Heady, L., and G. Stevens. *Biodiversity Assessment Guidebook*, Hudsonia Ltd, 2018.

Code*	Soil Unit Name	Drainage Class	Hydric Class	Depth to Bedrock (inches)	Erosion Hazard	Farmland Class	pH	Reaction
		drained						
CkB, CkC	Cayuga silt loam	Well drained	nonhydric	>60	Slight	All areas are prime farmland	7.1	neutral
CnA, CnB	Chenango gravelly silt loam	Well drained	nonhydric	>60	Slight	All areas are prime farmland	6.0	moderately acidic
CnC	Chenango gravelly silt loam	Somewhat excessively drained	nonhydric	>60	Slight	Farmland of statewide importance	6.0	moderately acidic
CvA, CvB	Churchville silt loam	Somewhat poorly drained	predominantly nonhydric	>60	Slight	Prime farmland if drained	7.2	neutral
FW	Fresh water marsh	Very poorly drained	hydric	>60	Slight	Not prime farmland	0.0	
GP	Gravel pit	Somewhat excessively drained	predominantly nonhydric	>60	Not rated	Not prime farmland	0.0	
Ha	Hamlin silt loam	Well drained	nonhydric	>60	Slight	All areas are prime farmland	6.4	slightly acidic
He	Haven loam	Well drained	nonhydric	>60	Slight	All areas are prime farmland	5.3	strongly acidic
HgA, HgB, HgC, HgD	Hoosic gravelly loam	Somewhat excessively drained	nonhydric	>60	Slight	Farmland of statewide importance	5.2	strongly acidic
HSF	Hoosic soils	Somewhat excessively drained	nonhydric	>60	Severe	Not prime farmland	5.2	strongly acidic
HuB, HuC	Hudson silt loam	Moderately well drained	nonhydric	>60	Slight	All areas are prime farmland	6.8	neutral
HwD, HXE	Hudson and Schoharie soils	Moderately well drained	nonhydric	>60	Moderate	Not prime farmland	6.9	neutral
LEE	Lackawanna and Swartswood soils, extremely bouldery	Well drained	nonhydric	>60	Moderate	Not prime farmland	5.1	strongly acidic
Lm	Lamson fine sandy loam	Very poorly drained	predominantly hydric	>60	Slight	Not prime farmland	7.2	neutral
LOC	Lordstown-Arnot-Rock outcrop complex	Well drained	nonhydric	20-40	Slight	Not prime farmland	5.3	strongly acidic

Code*	Soil Unit Name	Drainage Class	Hydric Class	Depth to Bedrock (inches)	Erosion Hazard	Farmland Class	pH	Reaction
LY	Lyons-Atherton complex, very stony	Very poorly drained	hydric	>60	Slight	Not prime farmland	7.5	mildly alkaline
Ma	Madalin silty clay loam	Very poorly drained	predominantly hydric	>60	Slight	Farmland of statewide importance	7.0	neutral
MdB	Mardin gravelly silt loam	Moderately well drained	nonhydric	>60	Slight	Farmland of statewide importance	5.4	strongly acidic
MgB	Mardin-Nassau complex	Moderately well drained	nonhydric	>60	Slight	Farmland of statewide importance	5.4	strongly acidic
ML	Made land	Somewhat excessively drained	predominantly nonhydric	>60	Slight	Not prime farmland	6.5	slightly acidic
Mr	Middlebury silt loam	Moderately well drained	nonhydric	>60	Slight	All areas are prime farmland	6.4	slightly acidic
MTB	Morris-Tuller complex, very bouldery	Poorly drained	predominantly nonhydric	>60	Slight	Not prime farmland	5.4	strongly acidic
NBF	Nassau-Bath-Rock outcrop complex	Well drained	nonhydric	<20	Not rated	Not prime farmland	5.0	very strongly acidic
NMC	Nassau-Manlius shaly silt loams	Well drained	nonhydric	<20	Slight	Farmland of statewide importance	5.0	very strongly acidic
NNF	Nassau-Manlius complex	Well drained	nonhydric	<20	Severe	Not prime farmland	5.0	very strongly acidic
NOD	Nassau-Rock outcrop complex	Somewhat excessively drained	nonhydric	<20	Moderate	Not prime farmland	5.0	very strongly acidic
Pa	Palms muck	Very poorly drained	hydric	>60	Slight	Not prime farmland	7.3	neutral
Ra	Raynham silt loam	Somewhat poorly drained	predominantly nonhydric	>60	Slight	Prime farmland if drained	6.4	slightly acidic
Re	Red Hook gravelly silt loam	Somewhat poorly drained	predominantly nonhydric	>60	Slight	Prime farmland if drained	6.5	slightly acidic
RhA, RhB	Rhinebeck silt loam	Somewhat poorly drained	predominantly nonhydric	>60	Slight	Prime farmland if drained	6.7	neutral

Code*	Soil Unit Name	Drainage Class	Hydric Class	Depth to Bedrock (inches)	Erosion Hazard	Farmland Class	pH	Reaction
RvB	Riverhead fine sandy loam	Well drained	nonhydric	>60	Slight	All areas are prime farmland	5.2	strongly acidic
RXC, RXE, RXF	Rock outcrop-Arnot complex	Somewhat excessively drained	nonhydric	>60	Slight	Not prime farmland	0.0	
Sc	Scio silt loam	Moderately well drained	nonhydric	>60	Slight	All areas are prime farmland	5.5	strongly acidic
SGB	Scriba and Morris soils, extremely bouldery	Somewhat poorly drained	predominantly nonhydric	>60	Slight	Not prime farmland	6.2	slightly acidic
SwB	Swartswood stony fine sandy loam	Well drained	nonhydric	>60	Slight	Farmland of statewide importance	4.6	very strongly acidic
Te	Teel silt loam	Moderately well drained	nonhydric	>60	Slight	All areas are prime farmland	6.3	slightly acidic
Un	Unadilla silt loam	Well drained	nonhydric	>60	Slight	All areas are prime farmland	5.7	moderately acidic
VAB, VAD	Valois very bouldery soils	Well drained	nonhydric	>60	Slight	Not prime farmland	5.2	strongly acidic
VoA, VoB, VoC	Volusia gravelly silt loam	Somewhat poorly drained	predominantly nonhydric	>60	Slight	Farmland of statewide importance	6.3	slightly acidic
VSB	Volusia channery silt loam, very stony	Somewhat poorly drained	predominantly nonhydric	>60	Slight	Not prime farmland	5.8	moderately acidic
W	Water		nonhydric	>60	Not rated	Not prime farmland	0.0	
Wb	Wayland soils complex, non-calcareous substratum, frequently flooded	Very poorly drained	predominantly hydric	>60	Slight	Not prime farmland	5.7	moderately acidic
Wc	Wayland mucky silt loam	Very poorly drained	hydric	>60	Slight	Not prime farmland	6.9	neutral
WLB, WOB	Wellsboro and Wurtsboro soils, very bouldery	Moderately well drained	nonhydric	>60	Slight	Not prime farmland	5.3	strongly acidic
WsA, WsB	Williamson silt loam	Moderately well drained	nonhydric	>60	Slight	All areas are prime farmland	5.5	strongly acidic

* The final letter in each soil unit code (i.e., the “A” in “CaA”) refers to slope. Slopes are given letter codes A-F, with “A” signifying the gentlest slopes and “F” the steepest. The absence of a final uppercase letter indicates more-or-less flat terrain.

Section 4: Water Resources

Aquifer Recharge Areas (Map 8)

The Aquifer Recharge Areas map shows features that are important to the Town's water supply. The undeveloped areas of Gardiner recharge the groundwater supplying wells for drinking water to the Town's residents and businesses. The map shows areas that are important for supplying a sufficient quantity of water for private and commercial use and surface water hydrology including streams and wetlands, which in some cases are connected to aquifer recharge. Maintaining the rural character of the community helps provide natural filtration that improves water quality.

All Gardiner residents rely on water in private wells supplied by unconsolidated aquifers and other groundwater stored in the cracks and fractures of bedrock. Unconsolidated deposits of sand and gravel can store large quantities of water as aquifers but are vulnerable to contamination from the overlying land use. They may also provide important base flow to streams during dry periods of the year. Confined aquifers have layers of impermeable material above and below the aquifer and are under pressure so water will rise when punctured by a well.[29]

Unconsolidated Aquifers are deposits of sand and gravel that are capable of storing large quantities of water.

In 1998, the Chazen Companies produced a map and accompanying report titled the *Town of Gardiner Water Resource Summary* that identifies the most important areas for aquifer recharge in the Town and recommends municipal actions to protect these resources.[30] The data from this report were incorporated into Map 8 to highlight important areas for groundwater recharge.

Primary Recharge Areas supply water to the aquifers most vulnerable to contamination and should be afforded the highest levels of municipal protection possible**.**

Seasonal Recharge Areas include some wetlands that accumulate water in the fall and spring, when vegetation is not actively transpiring water, allowing this water to percolate into subsurface aquifers. Wetlands can be sources of filtration and purification for underlying aquifers, though in other cases they may be sources of groundwater discharge to the surface. Further study would be necessary to determine wetlands providing aquifer recharge function. Natural buffer areas surrounding a wetland are essential to wetland ecological value and function, which may diminish when a wetland is surrounded by development.

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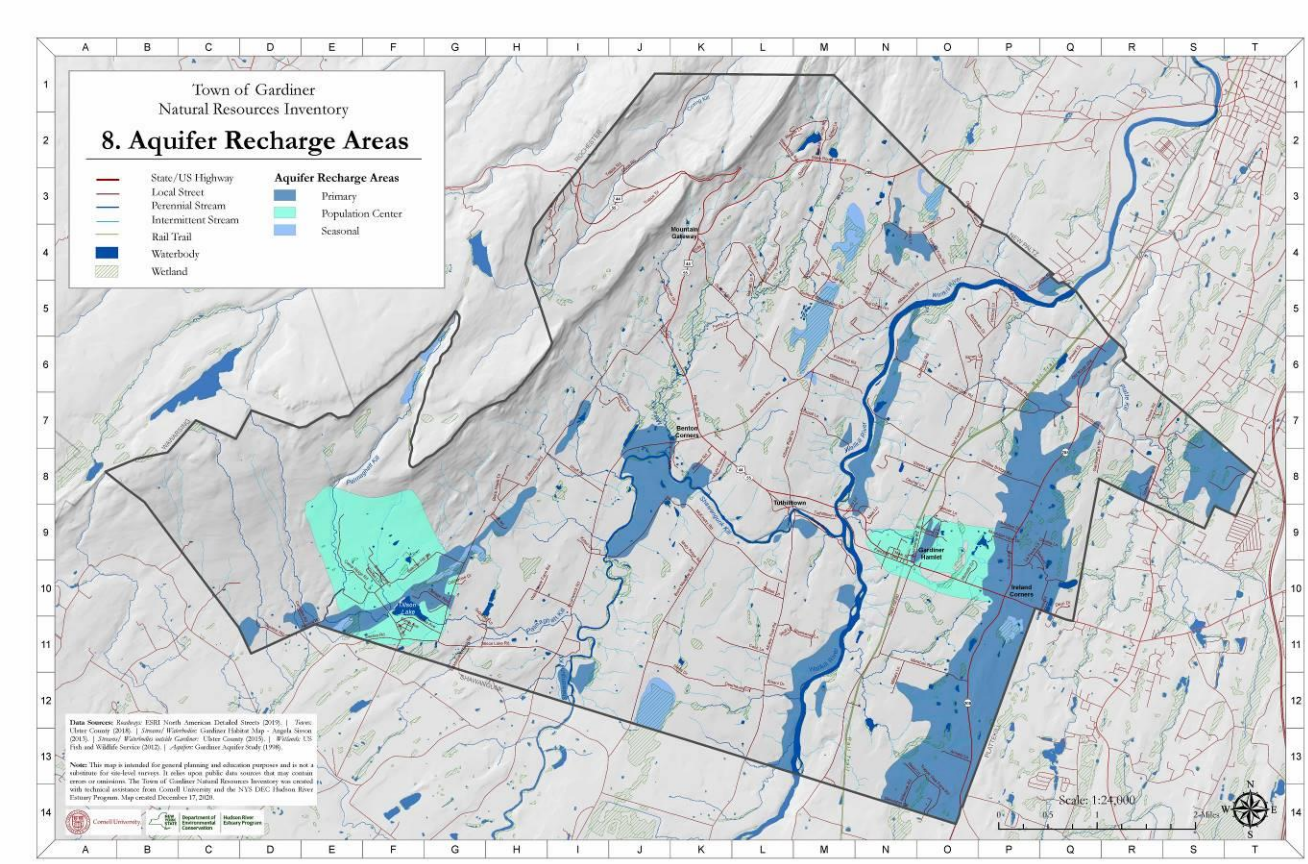
[29] "What is the difference between a confined and an unconfined aquifer?" United States Geological Survey, 2018. https://www.usgs.gov/faqs/what-difference-between-a-confined-and-unconfined-water-table-aquifer?qt-news_science_products=0#qt-news_science_products.

[30] Town of Gardiner Water Resource Summary. Chazen Companies, 1998.



Population Center Recharge Areas are associated with select hamlets and neighborhoods in the Town where higher residential density is present.

The Chazen report indicates that Primary Recharge areas and Population Centers should be the top priority for municipal protection efforts in Gardiner. The map and report were subsequently used by the Gardiner Environmental Conservation Commission to draft an aquifer protection overlay district, but it has yet to be formally adopted by the Town. In the 2006 Gardiner Open Space Plan the aquifer recharge area data was used to prioritize the conservation of important natural areas in the Town.

The sand and gravel aquifer that roughly follows Route 208 is the largest identified aquifer in Gardiner, with the proportionate recharge area displayed on Map 8. On the Wallkill State Prison property, which is just south of the Town, 29-35 foot deep wells yield 41-55 gallons per minute. There is a rather large aquifer associated with the area around Tillson Lake. More information is needed to determine the extent of this aquifer but the highest yields are suspected to be associated with the Palmaghatt Kill and its adjacent alluvial gravels.[31]

[31] Appraisal of Ground-Water Resources in Gardiner. Allan D. Randall, 2001.

Private Well Maintenance

Whereas public water wells are routinely monitored according to state regulations, private well owners are responsible for the safety of their water. Homeowners with private wells should test their water on a regular basis. There are three certified drinking water laboratories in Ulster County: Kingston Water Department Lab Inc. (Kingston), Environmental Labworks, Inc. (Marlboro) and Gentech Environmental Services (Stone Ridge).

The U.S. Environmental Protection Agency (EPA) has identified common conditions or nearby activities that well owners should be aware of and the substance(s) that should be tested for to ensure well safety.[32] If you suspect your drinking water well may have been contaminated after a flood or another natural disaster, contact the Ulster County Health Department or New York State Department of Environmental Conservation for additional advice on inspecting and testing your well.

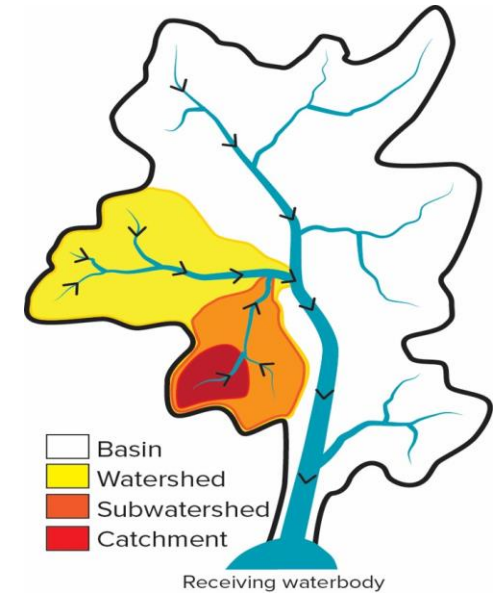
Homeowners should carefully manage activities near private wells to protect drinking water quality. This includes keeping contaminants away from the well itself, keeping hazardous chemicals out of septic systems and not mixing or using pesticides, fertilizers, herbicides, degreasers, fuels, and other pollutants near the well. The integrity of any above ground and underground storage tanks that hold home heating oil, diesel, or gasoline should also be monitored. Additional information about maintenance of drinking water wells appears on the Ulster County Cornell Cooperative Extension website.[33] The US Geological Survey publication *Groundwater and the Rural Homeowner*[34] discusses common well contamination problems and provides guidance to property owners, as well.

[32] https://www.epa.gov/privatewells/protect-your-homes-water#welltestanchor

[33] http://ulster.cce.cornell.edu/environment/emergency-preparedness/water-septic-issues

[34] US Geological Survey, *Groundwater and the Rural Homeowner,* 1994. pubs.usgs.gov/gip/gw_ruralhomeowner/.

Streams and Watersheds (Map 9)



Source: DEC

A watershed is the area of land from which water drains into a stream, river, lake or other waterbody. Watersheds are divided by high points on the land such as ridges, mountains and hills. Watersheds are nested, with smaller watersheds often referred to as catchments. Catchments are nested within subwatersheds, which are in turn nested within larger watersheds often called basins. There is a strong relationship between land use and water quality in streams, wetlands, and other waterbodies. Land and water are connected through the physical, chemical, and biological interactions of water, soil, and organisms. Healthy watersheds can recharge groundwater, reduce erosion and flooding impacts, minimize needs for public infrastructure, and be more resilient to climate change—all ecological benefits that cost less than the alternative of mitigating damage after it has occurred.[35]

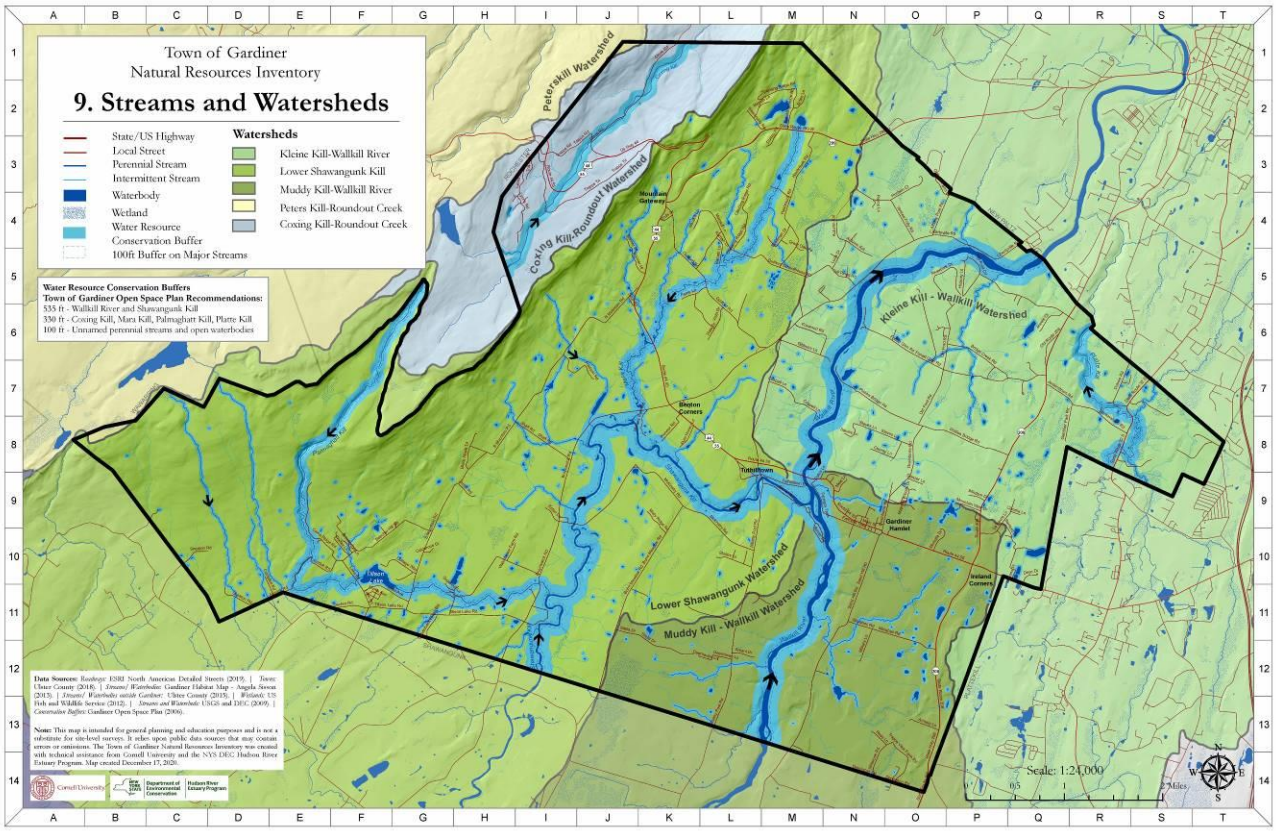
A stream or river is a natural waterway with a detectable current, having defined bed and banks, and may have perennial, intermittent or ephemeral flow. Streams and rivers drain water from the land within a watershed. The bed is the bottom of a stream or river. The bank is the side of the stream or river, making up the land area immediately adjacent to and sloping toward the bed. The bank is necessary to maintaining the stream's structure and integrity. Natural meanders are curves in the stream that slow down the water and reduce the energy that could cause erosion. The character of a stream is influenced by the amount of water it carries, the geology and soil types that it flows through and the shape, slope and land cover of its valley. Changing the course of a stream can destabilize the entire system, with impacts far upstream and downstream of the location of work.

Perennial streams flow continuously throughout years with normal precipitation, though some may dry up during droughts. Intermittent streams only flow seasonally or after rain. Ephemeral streams only flow for a short time after a precipitation event. Intermittent and ephemeral streams are often unmapped, but are widespread, accounting for an estimated 59% or more of total stream length in the United States. These small streams play an essential role in maintaining water quantity, quality, and

Healthy watersheds can:

- recharge groundwater
- reduce erosion and flooding impacts
- minimize needs for public infrastructure
- be more resilient to climate change

[35] "The Economic Benefits of Protecting Healthy Watersheds." US Environmental Protection Agency, 2015. https://www.epa.gov/sites/production/files/2015-10/documents/economic_benefits_factsheet3.pdf



overall watershed function or health.[36] They also play a vital role in dissipating stream energy during storms and reducing erosion and downstream flood impacts. See the Stream Habitat section for further discussion of stream values.

Major watersheds and mapped streams in the Town are shown on the Streams and Watersheds Map. Watershed boundaries are provided from the United States Geologic Survey (USGS) National Hydrography Dataset. The USGS StreamsStats tool can be used to delineate watersheds at a finer scale where desired. Streams and waterbodies on this and other maps in the inventory were derived from the 2015 Ulster County Surface Water Dataset, which was created by the county using high resolution (1 ft) LIDaR (Laser Imaging, Detection, and Ranging) data. Perennial and intermittent streams shown on this map and others in the NRI map series were digitized based on orthoimagery and topographic maps for the Gardiner Habitat Map.

All of Gardiner drains into the Wallkill River or the Rondout Creek. Both of these rivers ultimately flow into the Hudson River Estuary via the Rondout Creek in Kingston, NY. The Wallkill River Watershed Alliance (WRWA) and the Rondout Creek Watershed Alliance (RCWA) were formed through grassroots

[36] *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence (Final Report)*. U.S. Environmental Protection Agency, EPA/600/R-14/475F, 2015, Washington, DC. https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=296414

community efforts to support the protection and restoration of these important rivers and their watersheds. The Wallkill River Conservation and Management Plan, published in 2007, describes the existing environmental conditions, major issues, and recommendations for action within the watershed. In 2016, the WRWA released a 2017-19 Science-based Plan to better target their management efforts. This includes working with smaller subwatershed groups, like the Shawangunk Kill Watershed Alliance, *"to restore the Wallkill River to its prime, to act as the voice of the River, and to advocate for the restoration of its entire watershed."* In 2010, the RCWA produced an Interim Watershed Management Plan for the lower, non-tidal portion of the Rondout Creek, which describes the existing conditions of the Rondout Creek and its watershed and provides recommendations for future management. A newly created 2019 Guidance Document prioritizes these recommendations to better direct future action.

Development is closely linked to the health of a watershed and the water quality of its surface and subsurface waters. The location and configuration of impervious surfaces (e.g. roofs, pavement, buildings, and other development) in a watershed matters, especially when they are very near to streams and waterbodies. Some studies strongly suggest that there are critical thresholds of impervious cover in a landscape, that when passed, result in significant impacts to water. Specifically, researchers have demonstrated that where impervious surface cover exceeds 10% of a watershed's land cover, the probability of stream degradation greatly increases.[37] [38] However, research undertaken in several small Dutchess County watersheds found impacts to stream nutrient levels in watersheds with less than 5% impervious cover.[39] Conversely, other studies have shown that watersheds with a high percentage of forest cover are generally associated with higher water quality and can produce significant savings on drinking water treatment costs.[27]

Major Streams and Watersheds in Gardiner

The Wallkill River is a defining feature of Gardiner and its most significant river. The Lower Shawangunk Kill, Kleine Kill-Wallkill River, and Muddy Kill-Wallkill River watersheds all drain into this low gradient, warm-water river. The Shawangunk Kill is a regionally-important cool-water stream and is the Wallkill River's largest tributary in the Town. For more information on the ecology of the Shawangunk Kill, see the Ecological Context section of this report. The Coxing Kill and the Palmaghatt Kill are the two largest, high-gradient cold-water streams and have been identified as supporting trout by the DEC. The Platte Kill, Mara Kill, and other tributaries in the valley can be described as transitional streams, somewhere between high gradient cold-water and lower gradient warm-water. The relatively

[37] National Research Council, Committee on Reducing Stormwater Discharge Contributions to Water Pollution. 2008. Urban Stormwater Management in the United States. Water Science and Technology Board, Division of Earth and Life Studies of the National Research Council. National Academies Press, Washington D.C., pp 529. http://www.epa.gov/npdes/pubs/nrc_stormwaterreport.pdf

[38] Walsh C.J., A.H. Roy, J.W. Feminella, P.D. Cottingham, P.M Groffman, and R.P Morgan III. 2005 The Urban Stream Syndrome: Current Knowledge and the Search For A Cure. Journal of the North American Benthological Society, 24(3):706-723 pp18

[39] Cunningham M.A., C.M. O'Reilly, K.M. Menking,, D.P. Gillikin, K.C. Smith, C.M Foley, S.L Belli, A.M. Pregnall, M.A. Schlessman, and P. Batur. 2009. The Suburban Stream Syndrome: Evaluating Land Use and Stream Impairments in the Suburbs. Physical Geography. 30, 3, pp 269-284.

low percentage of impervious cover (buildings, pavement) in Gardiner's watersheds (see Table 3) suggest fairly high water quality, however, there are notable impairment issues in the Wallkill River, which are also influenced by factors beyond Gardiner at the larger watershed scale (see Waterbody Monitoring and Assessment).

Table 3. Watersheds in the Town of Gardiner

HUC-12 Watershed	Acres	% Canopy Cover	% Impervious Cover	Important Tributaries
Lower Shawangunk Kill	29,600	61.4	0.8	Shawangunk Kill, Palmaghatt Kill, Mara Kill
Kleine Kill-Wallkill River	27,970	56.2	2.6	Platte Kill
Muddy Kill–Wallkill River	33,696	46.1	3.2	None
Peters Kill-Rondout Creek	33,357	73.2	0.7	None
Coxing Kill–Rondout Creek	22,569	68.8	0.8	Coxing Kill

Water Resource Conservation Buffers

Vegetated buffer areas adjacent to streams are extremely important for protecting water quality and mitigating downstream flood impacts. They also often serve as wildlife corridors. For more information on these benefits, see the Floodplains and Riparian Areas section of the report. The 2006 Gardiner Open Space Plan recommends maintaining vegetated buffers, of varying width, in order to best protect habitat corridors adjacent to important stream habitat. The plan also identifies "conservation hubs" throughout the Town that are connected by a network of these stream corridors. See page 45 and Appendix C of the Gardiner Open Space Plan to learn more about the corridors associated with the streams below.

- Wallkill River and Shawangunk Kill –535 ft buffer recommended
- Coxing Kill, Kleine Kill, Mara Kill, Palmaghatt Kill, and Platte Kill – 330 ft buffer recommended
- All other perennial streams and surface waterbodies – 100 ft buffer recommended

Water Quality Classifications (Map 10)

DEC designates the "best uses" that a waterbody should support, which forms the basis for New York State Protection of Waters regulations. Waterbodies are classified by the letters A, B, C, or D for freshwater. The letter classifications and their best uses are described in regulation NYS Regulation 6 NYCRR Part 701. For more information about classifications, see the DEC's webpage on Water Quality Standards and Classifications.[40] For each class, the designated best uses are defined as follows:

> Activities allowed in and around waterbodies are regulated by DEC based on their classification and standard.

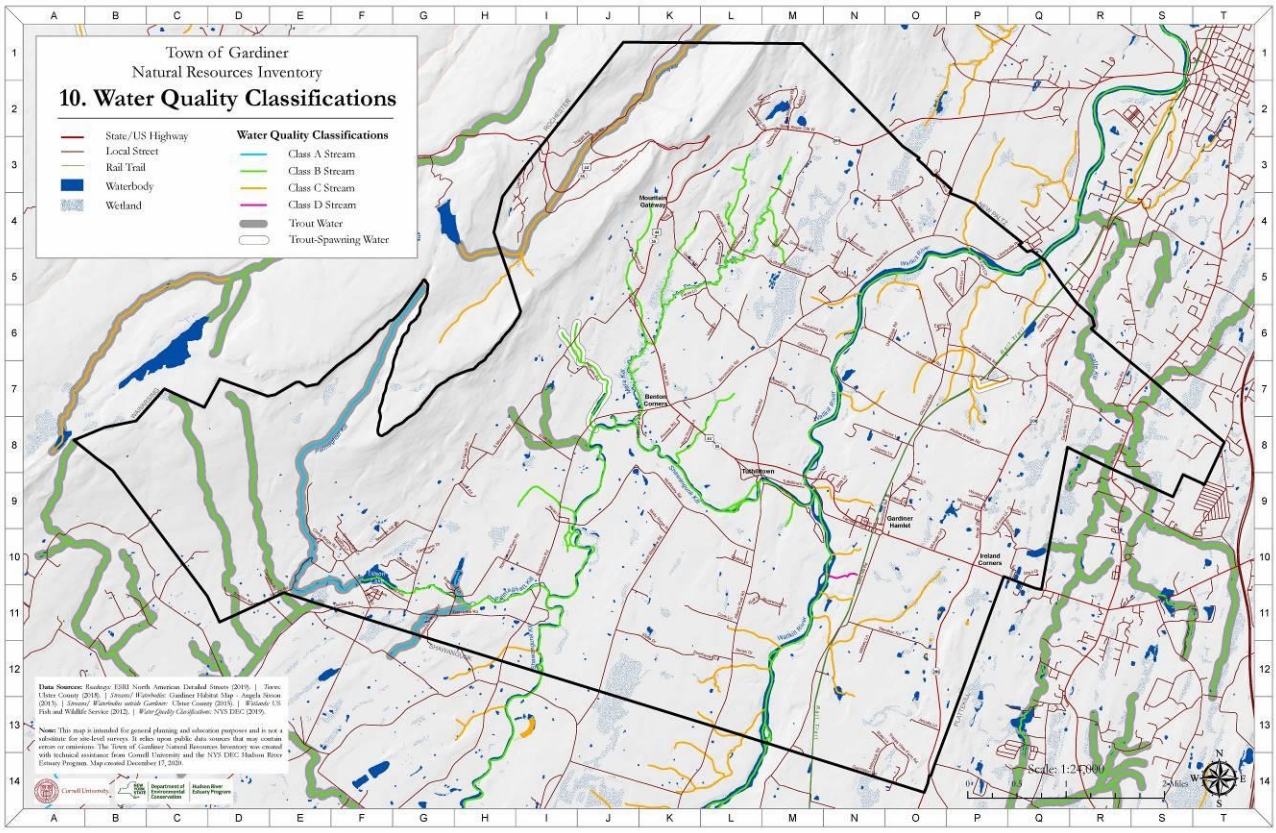
- Class A, AA- Water supply, primary and secondary contact recreation and fishing
- Class B- Primary and secondary contact recreation and fishing
- Class C- Fishing, suitable for fish propagation and survival
- Class D- Fishing

Waterbodies classified as A, B, or C may also have a standard of (T), indicating they are trout waters, or (TS), indicating they are trout spawning waters. The Water Quality Classifications Map shows the water quality classifications of surface waters in the Town. Official descriptions for the classifications and standards of waterbody segments in the Rondout Creek and Wallkill River drainage basin are found in 6 CRR-NY 855. Note that the waterbody classification does not necessarily indicate good or bad water quality – it relates simply to the designated "best uses" that should be supported. DEC recognizes that some waterbodies have an existing quality that is better than the assigned classification and uses an anti-degradation policy to protect and maintain high-quality streams.

Note that not all waterbodies appear on classification maps. However, the missing waterbodies will always have a classification. Waterbodies that do not appear on classification maps and have flow all year (perennial streams) have the classification of the waterbody into which they flow. Waterbodies that do not appear on these maps and have seasonal or intermittent flow have a classification of "D." DEC has the final authority to determine if a waterbody has perennial or intermittent flow.

Walleye caught in the Wallkill River. *DEC*

[40] "Water Quality Standards and Classifications." NYS Department of Environmental Conservation. https://www.dec.ny.gov/chemical/23853.html



DEC also establishes water quality standards, specific for particular parameters and pollutants, to protect the uses associated with these classifications. These standards are found in NYS Regulation 6 NYCRR Part 703. Standards can be numerical or narrative. For example, dissolved oxygen has a numerical standard of no less than 7.0 mg/l in trout spawning waters. Turbidity has a narrative water quality standard which states there should be "no increase that will cause a substantial visible contrast to natural conditions." Information on surface water and groundwater quality standards can be found at Surface Water and Groundwater Quality Standards.[41] If waterbodies are not supporting the standards for their best uses, they may be listed on the Priority Waterbody List as impaired (see the Waterbody Monitoring section). Waterbodies on this list are slated for watershed restoration plans and implementation strategies by the DEC.

Certain activities allowed in and around waterbodies are regulated based on their classification and standard. C(T), C(TS) and all types of B and A streams (as well as waterbodies under 10 acres located in the course of these streams) are collectively referred to as "protected streams." They are subject to the Protection of Waters regulations in Article 15 of the Environmental Conservation Law.[42] DEC regulates

[41] "Surface Water and Groundwater Quality Standards." NYS Department of Environmental Conservation. http://www.dec.ny.gov/regs/4590.html

[42] "Protection of Waters Program." NYS Department of Environmental Conservation. https://www.dec.ny.gov/permits/6042.html

the bed and banks of protected streams, defined as the areas immediately adjacent to and sloping toward the stream. Activities that excavate, fill or disturb these beds or banks require a DEC permit. See Protection of Waters: Disturbance of the Bed or Banks of a Protected Stream or Other Watercourse for more information.[43]

Article 15 also offers protection to navigable waters of the state. DEC permits are required for direct or indirect excavating or filling of navigable waters, which can include perennial streams and intermittent streams. This regulatory authority also covers estuaries, marshes, tidal marshes and other wetlands inundated at mean high water level or tide that are adjacent and contiguous at any point to any of New York State's navigable waters (Protection of Waters: Excavation and placement of fill in navigable waters). DEC water quality certification permits and U.S. Army Corps of Engineers (ACOE) permits may also be required for work involving streams; contact the DEC biologist responsible for applying state regulations in the protection of surface water resources for information regarding specific projects.

While the regulations stemming from stream classifications provide a level of protection from damage to the bed and banks of protected streams, lack of jurisdiction over "non-protected streams," including numerous class C streams, and over stream buffers more broadly may be an opportunity for local protection efforts, such as zoning setbacks or watercourse protection laws. Local stream protection efforts can play an important role in comprehensive watershed protection.

The Town of Gardiner regulates 150 feet beyond the top of the banks of any DEC regulated Class A, B, C(t) stream and requires a 100 foot setback for a number of potential development actions. Regulated streams include the Wallkill River (Class B), Shawangunk Kill (Class B), Mara Kill (Class B), Palmaghatt Kill (Class A), Platte Kill (Class B), and some other associated tributaries. For more information on these regulations, see §220-35 of the Town of Gardiner municipal zoning code.[44] The Gardiner Environmental Conservation Commission recently drafted an updated Wetlands and Watercourse law, which was presented to the Town Board in 2019. At the time of writing for this report it had not yet been formally adopted by the Town.

[43] "Protection of Waters: Disturbance of The Bed or Banks of a Protected Stream or Other Watercourse." NYS Department of Environmental Conservation. https://www.dec.ny.gov/permits/6554.html
[44] Town of Gardiner, Municipal Code. Section 220-35. https://ecode360.com/9151933

Waterbody Monitoring and Assessment (not mapped)

DEC monitors water quality through several routine statewide monitoring programs and publishes assessments that describe the quality of water resources. A waterbody's assessment results, compared with its classification, provides an understanding of its health and can lead to the designation of a stream or waterbody as impaired. A waterbody's level of impairment influences which programs, opportunities, and responsibilities the community has for addressing problems.

The NYS Waterbody Inventory/ Priority Waterbodies List (WI/PWL) is a document that lists New York State's waterbodies and information about water quality in relation to the State's waterbody classifications

Stream Assessments

DEC's Stream Biomonitoring Unit conducts biomonitoring sampling throughout New York State based on the number and kinds of macroinvertebrates found in water samples. A biological (macroinvertebrate) assessment of the Wallkill River and lower Shawangunk Kill was conducted in 2017.[45] For the Wallkill River, sampling results reflected moderately impacted (poor) water quality, with sensitive taxa reduced, and the distribution of major taxonomic groups significantly different from what is naturally expected. Samples were dominated by more tolerant species. The nutrient biotic index indicated highly elevated enrichment. More simply put, the species of small aquatic organisms that survive in the Wallkill River reflect poor water quality conditions.

For the Shawangunk Kill, sampling results reflected good water quality. Conditions were in the slightly impacted range but approaching non-impacted and communities were most similar to natural conditions. The macroinvertebrate community showed some beginning sign of alteration, some expected sensitive species are not present and overall macroinvertebrate species richness was somewhat lower than expected, but overall there was still balanced distribution of all expected taxa. While the Shawangunk Kill remains relatively healthy at this time, it is vulnerable to the effects of human activity.

NYS DEC Division of Water also runs a citizen monitoring program for biomonitoring called Water Assessments by Volunteer Evaluators (WAVE). Citizen monitors visit a stream and collect and identify stream organisms. WAVE data is included in federal and state water quality reports and will be used to focus DEC assessments and local restoration efforts to where they are most needed. WAVE is particularly useful for unassessed waterbodies.

Riverkeeper is an environmental advocacy organization that aims to protect and restore the Hudson River from "source to sea." The Wallkill is a major "source" to the Hudson, and has therefore been the focus of years of water quality monitoring. Since 2012, Riverkeeper has engaged volunteers to monitor enterococcus as an indicator of fecal contamination in the Wallkill River. A recent analysis found that between 2012 and 2019 over 90% of the water samples taken from both the Wallkill River (94%) and

[45] Lower Wallkill River and Tribs WI/PWL Fact Sheet, 2018. https://www.dec.ny.gov/data/WQP/PWL/1306-0027.pdf, and Lower Shawangunk Kill and Tribs WI/PWL Fact Sheet, 2018. https://www.dec.ny.gov/data/WQP/PWL/1306-0045.pdf

the Shawangunk Kill (91%) did not meet EPA standards for safe swimming.[46]

Impairment

The Waterbody Inventory/Priority Waterbodies List (WI/PWL) is a document that lists New York State waterbodies and information about their water quality. The WI/PWL documents support (or evidence of impairment) of water uses, overall assessment of water quality, causes and sources of water quality impact/impairment, and the status of restoration, protection and other water quality activities and efforts. WI/PWL information is used to identify those water quality issues and specific waterbodies where efforts will have the greatest impact and benefit, objectively evaluate needs for project funding, monitor water quality improvement, and record and report changes over time. The WI/PWL includes waterbody fact sheets outlining the most recent assessment of support for best uses, identification of water quality problems and sources, and a summary of activities to restore and protect each individual waterbody. Assessment status and links to WI/PWL fact sheets for Town of Gardiner waterbodies are provided in Table 4.

Table 4. Waterbody Inventory/Priority Waterbodies List for the Town of Gardiner

Waterbody		Assessment	Pollution Sources
Lake	Heddens Lake*	Unassessed	Unassessed
	Tillson Lake	Unassessed	Unassessed
Stream	Coxing Kill	No Known Impact	N/A
	Dwaar Kill	Minor Impacts	Low Oxygen; Nutrients
	Palmaghatt Kill	Unassessed	Unassessed
	Plattekill	No Known Impact	N/A
	Shawangunk Kill (includes Mara Kill)	No Known Impact	N/A
	Wallkill River	Impaired	Nutrients

*Hedden's Lake was drained following a dam breach several years ago.

[46] Wallkill River Community Water Quality Monitoring Results: 2012-2019. Riverkeeper. https://www.riverkeeper.org/water-quality/citizen-data/wallkill-river/

Floodplains and Riparian Areas (Map 11)

The land corridor around streams includes floodplains and riparian areas, which provide many critical functions for a healthy stream and its watershed. Successful stream management done on a watershed scale must include the condition and connection of a stream to its floodplain and adjacent riparian areas.

Floodplains are an integral, morphological part of streams and rivers. They are low-lying areas, often next to streams and rivers, which are inundated during overbank flows that result heavy precipitation or snowmelt events. Floodplains are naturally connected to streams but can extend far from a stream or river and aren't necessarily found alongside of them. Flooding is a natural process and is one way a stream reacts to an increase in water coming into it. Streams of all sizes can have floodplains at various locations along their length. The total size of a floodplain and its distance from and connection to a stream can vary greatly with topography and other local conditions.

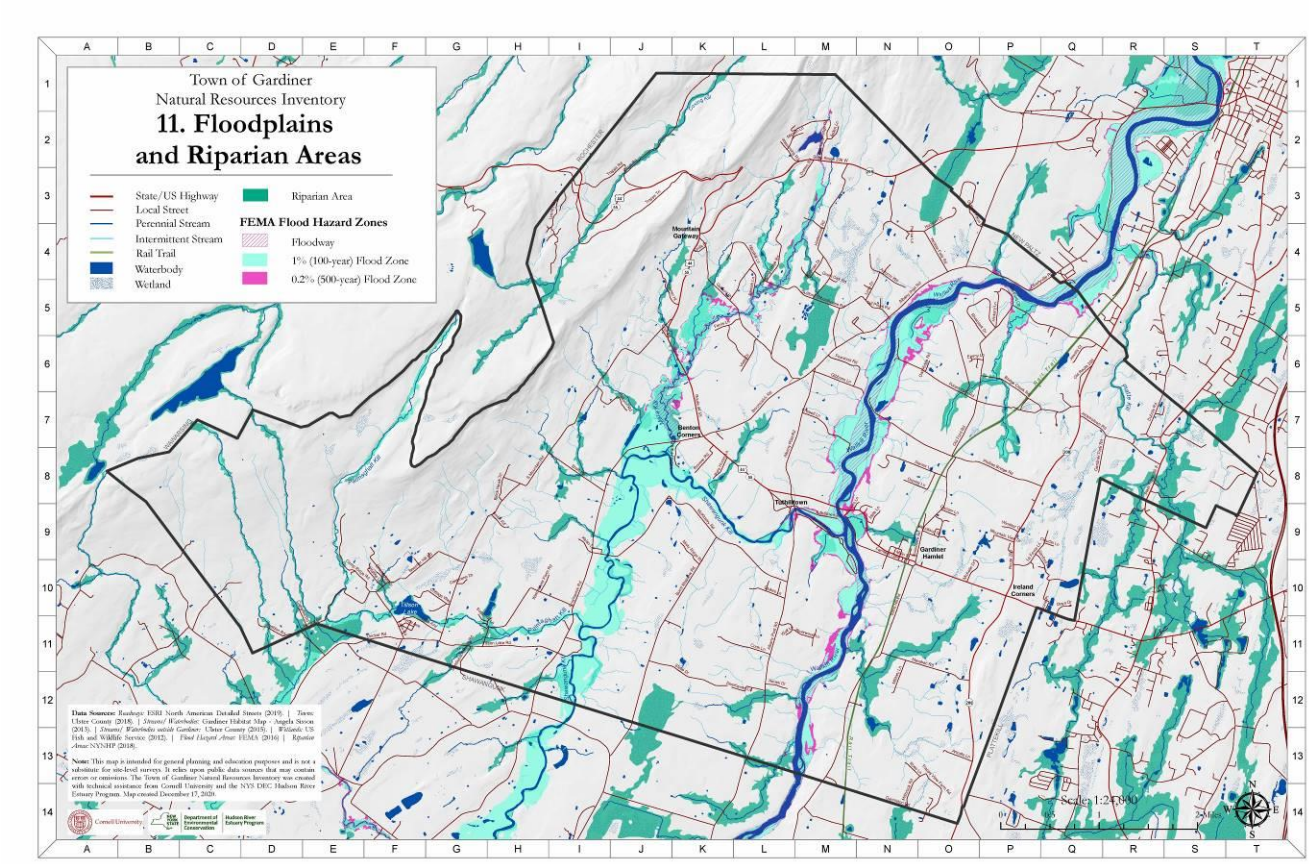
Floodplains provide many critical functions for a healthy stream and its watershed. When left in a natural state, floodplains act as a natural infrastructure, providing a safety zone between people and the damaging waters of a flood. They provide the space streams need to expand, contract, and change course over time. Floodplains are part of the river, thus any structures built there are at risk of significant property damage, and residential development in the floodplain puts the lives of residents at risk. The extent of floodplains can change over time in response to changes in land use in the stream and floodplain and the surrounding watershed, major flood events and/or obstructions in the stream or its floodway (defined below), stream projects (including dams and levees), and natural stream processes. Climate change models predict that New York's wet periods will be wetter in the future and this is expected to increase the frequency of flood events and their magnitude, making the protection of existing floodplains more important than ever. Limiting construction in these areas allows for the natural ebb and flow of the floodplain, preservation of water quality, and prevents property damage/loss.

Special Flood Hazard Areas

Locations within the "100-year" (1% annual chance) floodplain have at least a 1 in 4 (25%) chance of flooding during the course of a 30-year mortgage.

The Floodplains and Riparian Areas Map shows special flood hazard areas (SFHAs) mapped by the Federal Emergency Management Agency (FEMA) where the National Flood Insurance Program's (NFIP's) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies to homes purchased with a federally backed mortgage.[47] SFHA boundaries delineate areas deemed at risk of flooding during a 1% annual chance flood event, or what has been referred to as the "100-year flood." Regulatory agencies and flood mitigation experts are discouraging the use of the "100-year flood" moniker as it is statistically misleading and can lead to a false sense of security. The 1% annual chance flood is a specific discharge that has a 1% probability of

[47] "National Flood Insurance Program." Federal Emergency Management Agency. https://www.fema.gov/national-flood-insurance-program



occurring in any given year, regardless of any floods or droughts in previous years. In fact, the 1% annual chance flood can happen multiple times with a single calendar year. SFHA maps also delineate the 0.2% annual chance flood hazard areas ("500-year flood") and the regulatory floodway. The floodway is the channel of a stream or river that carries the deepest, fastest water downstream. Areas outside the SFHA can still be at risk of flooding. While SFHAs are delineated topographically, they are not necessarily synonymous with floodplains. The most current SFHAs mapped for Gardiner have an effective date of 2017.

SFHA mapping in Gardiner primarily encompasses the floodplains of the Wallkill River, Shawangunk Kill, Palmaghatt Kill, and the Mara Kill. Chapter 121 of Town Code, Flood Damage Prevention, regulates certain development activities in the 1% flood zone. The Town of Gardiner Floodplain Overlay District boundaries on the Gardiner Zoning map are approximate. See the Town of Gardiner code for more information on regulated activities and exemptions within the floodplain.[48] The Building Inspector is the designated floodplain administrator responsible for floodplain development permits and enforcement.

SFHA mapping is a valuable tool, but it is important to note that SFHAs are only estimates based on the

[48] Town of Gardiner, Municipal Code. https://ecode360.com/9149945#9149945 loodplain&searchId=19837041287615353

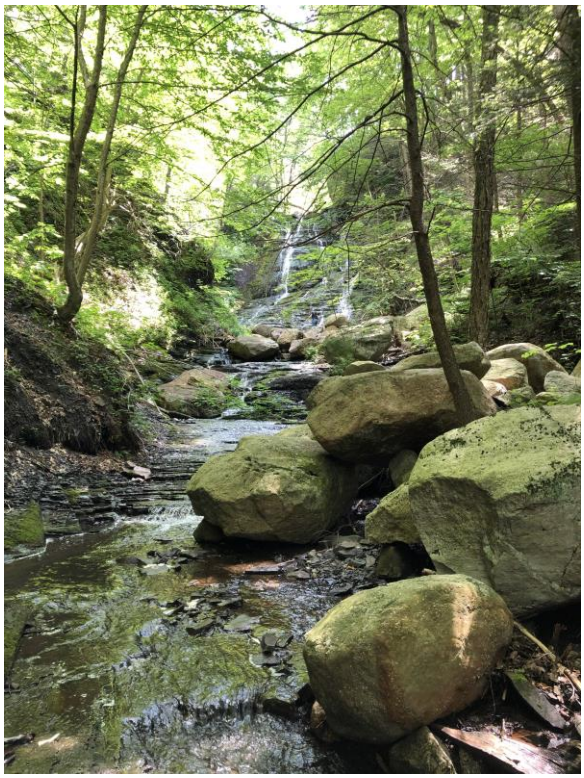
data and modeling technology available at the time of mapping, and they typically omit floodplains located along smaller streams. Due to the unpredictable nature of some kinds of floods, they often omit areas subject to flooding from localized drainage problems, including undersized culverts, ice jams, sheet flooding down a slope, and erosion hazards due to infrastructure. Climate change is furthermore changing precipitation patterns and increasing flood frequency in the Hudson Valley – annual rainfall occurring in heavy downpour events across the Northeast increased 74% between the periods of 1950-1979 and 1980-2009.[49] See the Climate section of this report for more information.

Riparian Areas

Riparian areas are areas adjacent to streams, ponds, wetlands, and other waterbodies and generally include the floodplain. Riparian areas are sensitive transition zones between land and water and are vital to stream physical processes, habitat, and water quality. They support unique soil and vegetation characteristics that are strongly influenced by proximity to water. Healthy riparian areas help clean water by intercepting runoff and filtering sediment and nutrients. They can attenuate flooding by slowing down and absorbing floodwaters. Forested riparian buffers provide organic matter that supports the in-stream food web and shade that keeps water cool. They also support unique, diverse habitats and serve as wildlife corridors.

From the standpoint of stream protection, naturally vegetated riparian buffers provide different functions depending on width.[50] In general, wider buffers provide better habitat connectivity and more protection to the water quality of streams and other waterbodies. Recent studies recommend 100 feet as the minimum buffer protection width to improve wildlife habitat, water quality and storm resiliency. Riparian buffers of 300 feet or more provide the greatest opportunity for natural functions to benefit ecological and human communities. While narrower buffers could still provide viable functions and critical protections, protecting existing buffers of greater width and restoring degraded ones can help protect streams.

The riparian areas shown were mapped by the New York Natural Heritage Program for the Statewide Riparian



Riparian area of a small stream in Gardiner. *Roberta Clements*

[49] Horton, R., D. Bader, C. Rosenzweig, A. DeGaetano, and W.Solecki. "Climate Change in New York State: Updating the 2011 ClimAID Climate Risk Information." New York State Energy Research and Development Authority (NYSERDA), 2014, Albany, NY. www.nyserda.ny.gov/climaid

[50] Sweeney, B.W. and Newbold, J.D. Streamside forest buffer width needed to protect stream water quality, habitat, and organisms: a literature review. JAWRA Journal of the American Water Resources Association, 50(3), pp.560-584, 2014.

Opportunity Assessment.[51] They are delineated around streams based on digital elevation data, known wetlands, and modeling for the 50-year flood zone. The riparian areas overlap with FEMA SFHAs but also include mapping along smaller streams omitted from the SFHA modeling. Thus, they help identify additional flood-prone areas, though they are not a substitute for official SFHAs. Note that the riparian areas were developed through modeling and have not been field verified. Nevertheless, they can provide a starting point to inform land use and stream protection efforts. The Hudson River Estuary Program's "Trees for Tribs" initiative offers free consultation and native trees and shrubs for qualifying streamside buffer planting projects in the estuary watershed.[52]

[51] Conley, A., T. Howard, and E. White. *New York State Riparian Opportunity Assessment*. New York Natural Heritage Program, State University of New York College of Environmental Science and Forestry, 2018, Albany, NY. http://nynhp.org/files/TreesForTribs2017/Statewide_riparian_assessment_final_jan2018.pdf

[52] "Hudson River Estuary Trees for Tribs Program." NYS DEC Hudson River Estuary Program. http://www.dec.ny.gov/lands/43668.html

Stream Habitats (Map 12)

From headwater creeks to meandering lowland rivers, Gardiner supports a variety of streams and rivers illustrated in the Stream Habitats Map. The Town's streams are an important water resource and support diverse aquatic life, as well as recreational activities like fishing and boating. Stream infrastructure, such as dams and culverts, plays an important role in determining connectivity and access to stream habitat for fish and other aquatic species.

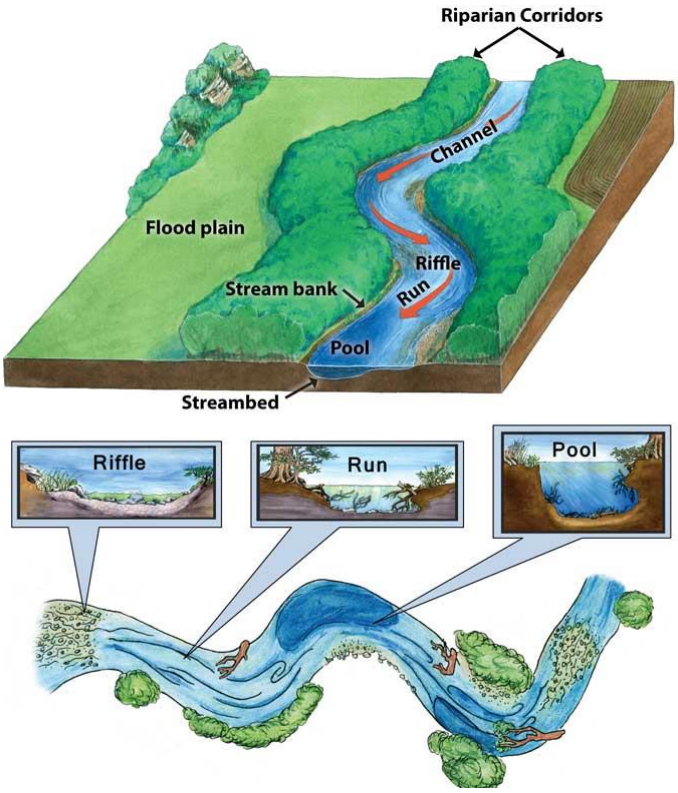
> *"The **Wallkill River** flows north approximately 90 miles from Lake Mohawk in Sparta, New Jersey until joining the Rondout Creek in Rifton, New York. Collectively the Wallkill and Rondout watersheds form the second largest tributary to the Hudson River Estuary**,** second only to the Mohawk River."*
>
> - ***Wallkill River Watershed Alliance***

Types of Streams and Stream Habitats

The beginnings of streams, referred to as headwaters, are often intermittent or ephemeral. Intermittent streams only flow during certain times of the year, fed by groundwater and runoff from rainfall and snowmelt. Some headwaters are ephemeral, only flowing after rainfall. Perennial streams and rivers flow year-round, with most water fed by smaller upstream intermittent and ephemeral streams or groundwater. Intermittent and epehmeral streams make up 50-80% of stream miles in a river system.[53]

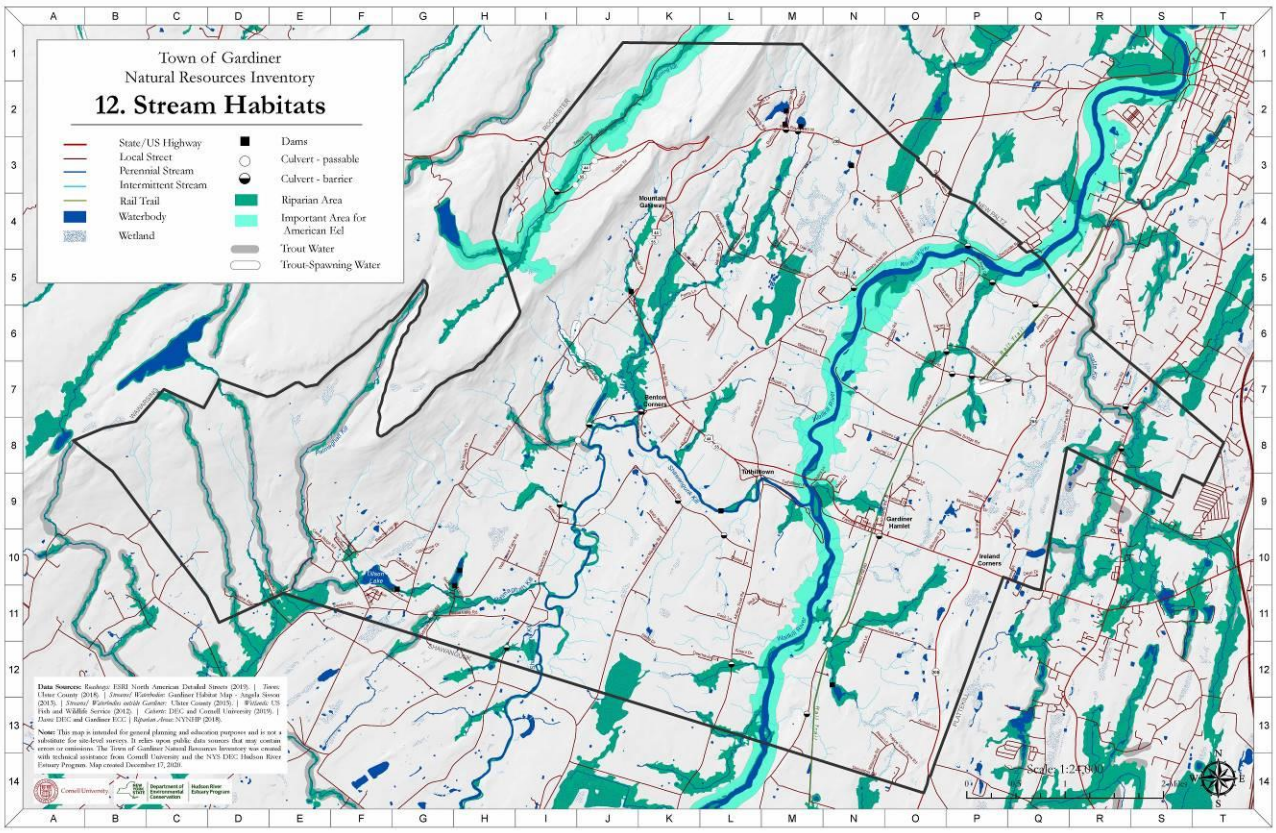
The vast network of intermittent streams in the landscape provide many of the same functions and values as larger perennial streams. Intermittent streams provide seasonal refuge and spawning habitat for small fish, habitat for macroinvertebrates that drift downstream to feed larger fish and organisms, and support nutrient cycling and flood control processes, among other benefits. However, they are often unmapped, underappreciated, and overlooked.

Streams share some common habitat features. Many streams have alternating deep and shallow areas called pools and riffles. The



Source: https://texasaquaticscience.org/streams-and-rivers-aquatic-science-texas/

[53] https://www.americanrivers.org/conservation-resource/small-streams-wetlands/



deep, slow water in pools provides shelter and resting areas for fish. Shallow, swift water in the riffles adds oxygen to the water and provides fish with spawning and feeding areas. The fast moving water between riffle areas and pools is called a run. Some streams also form natural meanders or curves that slow down the water and absorb energy. These curves produce erosion such as cut banks and depositional areas like gravel bars where sediments are deposited. Large woody material such as logs, trees, and branches is an important component of in-stream habitat that supports the capture of sediment, gravel, and organic matter, prevents streambank erosion, and decreases water temperature – all factors that enhance habitat for fish and other organisms.

Beyond the stream channel and banks, riparian areas and floodplains support unique soil and vegetation that are strongly influenced by proximity to water and frequent flooding. Riparian trees are especially important for providing shade, bank stabilization, woody material, and nutrients that benefit fish and other aquatic life. When inundated, floodplains also provide important fish breeding and nursery habitat areas. Many other wildlife species also depend on riparian and floodplain habitats and use them as travel corridors. See the Floodplains and Riparian Areas Map for more information.

Trout and Trout Spawning Waters

Trout are valuable indicators of healthy aquatic ecosystems because of their high water quality and habitat requirements. They typically inhabit clear, cool, well-oxygenated streams and lakes and depend

on clean gravel areas for spawning. DEC's Water Quality Standards provide a starting point for identifying trout or trout-spawning stream habitat and suggest there is cold-water habitat suitable for trout in the Dwaar Kill, Palmaghatt Kill, Coxing Kill, and Platte Kill and for trout-spawning in small direct tributaries to the Shawangunk Kill and Wallkill River.

Important Areas for American Eel

The map identifies areas of importance in the Wallkill River for sustaining known populations of this declining species, mapped by the New York Natural Heritage Program and based on DEC Bureau of Fisheries surveys and other studies completed in New York since 1980. The important areas highlight stream reaches that provide important passage for eel traveling between ocean and freshwater habitats. Routes were modeled from tributary stream reaches with documented eel presence to the Atlantic Ocean, where this species spawns. The important areas include upstream habitat and stream adjacent areas that support the health and integrity of stream habitats used by migratory fish.

Dams and Culverts

Infrastructure in streams, such as dams and culverts, serve important functions, protecting roadways, generating energy, storing drinking water, and providing recreation opportunities. However, they can also create barriers that disconnect and decrease available habitat to fish and other aquatic organisms that use stream corridors. Dams and culverts can present physical barriers to passage, and these structures can also become impassable by changing water temperature or velocity. Dams can also cut off streamflow to downstream reaches during dry periods, especially common when the water behind the dam is consumed or diverted for other purposes. Streams flowing into undersized culverts can flood upstream and, in some cases, overtake and wash out a road during heavy precipitation or snowmelt. Although lakes and wetlands that form behind a dam can create beneficial wetland and open water habitat for a variety of species, protecting and restoring free-flowing streams should be evaluated where possible to restore stream habitat for species of greatest conservation need such as brook trout and American eel. These benefits should be considered together with other factors such as public safety, cost of infrastructure maintenance, recreation value, and existing habitat that would be altered.

Dam locations are provided from the New York State Inventory of Dams. While the DEC tries to maintain an accurate inventory, this data should not be relied upon for emergency response decision-making. Note that assessments by the DEC Hudson River Estuary Program in trial watersheds indicate that perhaps two to three times as many barriers exist than are recorded in the NYS Inventory of Dams.

Culvert data are provided from the North Atlantic Aquatic Connectivity Collaborative (NAACC), a network focused on improving aquatic habitat connectivity across the Northeast region. Thirty-five culverts have been formally assessed and identified as a significant aquatic barrier but it is likely that many more barriers exist in the Town. Culverts classified as barriers to aquatic organism passage (because they are elevated above the stream bed, for example) may be eligible for mitigation or replacement through a variety of grant funding programs. A comprehensive assessment has yet to be completed for Gardiner. The Hudson River Estuary Program is leading efforts in the Hudson Valley to assess road-stream crossings for aquatic habitat passage and to mitigate significant barriers.

Protecting and restoring vegetated stream buffers and restoring free-flowing streams where possible are effective actions to conserve and restore stream habitat. Bridges, open-bottom culverts and similar structures that completely span the waterway and associated floodplain/ riparian area generally have the least potential impacts on stream hydrology, floodplains, and habitat. The Town should explore technical assistance and grants available from the DEC Hudson River Estuary Program to assess and prioritize known aquatic barriers for removal or mitigation.

Wetlands (Maps 13A and 13B)

Wetlands are areas saturated by surface or groundwater sufficient to support distinctive vegetation adapted for life in saturated soil conditions.[54] There are many types of freshwater wetlands in Gardiner, including wet meadows, marsh, forested and shrub swamps, woodland pools, ponds, and lakes. In addition to providing critical habitat for many plants and animals, wetlands help to control flooding and reduce damage from storm surge, recharge groundwater, filter and purify surface water, and provide recreation opportunities. Upland buffer areas surrounding a wetland are essential to wetland survival and function; both may diminish wetland buffers are developed with pavement, buildings, and pollution-generating or other incompatible land uses.[55] The US EPA estimates that New York State has lost an estimated 60% of wetlands that historically occurred in the state,[56] and wetland loss is a continued threat.

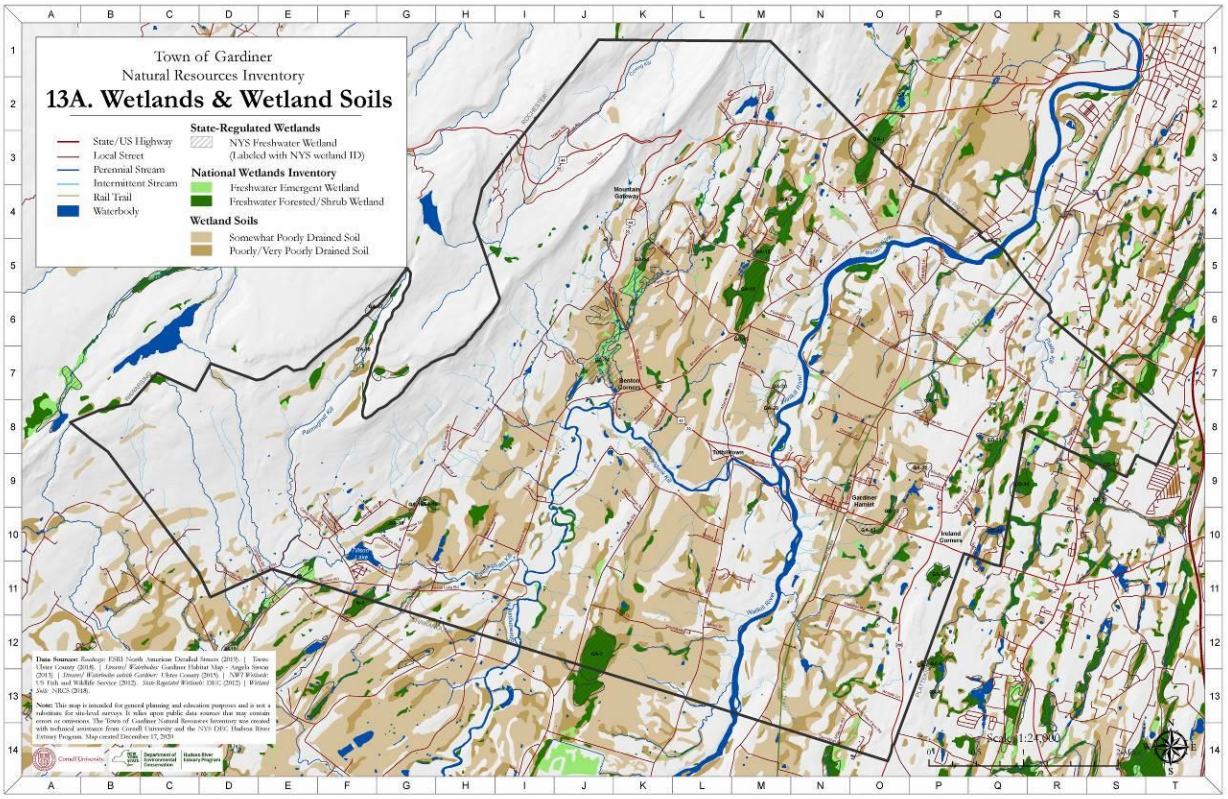
Wetlands:

- provide critical habitat
- control flooding
- reduce damage from storm surge
- recharge ground water
- filter and purify surface water
- store carbon
- provide recreational opportunities

The Wetlands and Wetland Soils Map (Map 13A) shows information from several existing sources that provide approximate locations and extent of wetlands. Open water habitats are symbolized in blue as "waterbodies." New York State Freshwater Wetlands only include wetlands larger than 12.4 acres, unless designated "of unusual local importance." The U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) includes wetlands of all sizes. NWI maps offer general information on wetland habitat, distinguishing forested wetlands (e.g., shrub or forest swamp) from emergent wetlands (e.g. marsh or wet meadow). Note that NWI maps often underestimate wetland area and omit smaller and drier wetlands. In particular, vernal pools, wet meadows, and swamps are often under-represented on maps. Many of DEC's wetland maps are outdated and have similar inaccuracies.[57]

Snapping turtles and other reptiles depend on a variety of wetland habitats. *Laura Rose*

[54] "Wetlands." NYS Department of Environmental Conservation. https://www.dec.ny.gov/lands/305.html
[55] *Planner's Guide to Wetland Buffers for Local Governments*. Environmental Law Institute, 2008, Washington, DC. www.eli.org/sites/default/files/eli-pubs/d18_01.pdf
[56] EPA 843-F-01-002d, September 2001
[57] *Wetlands Status and Trend Analysis of New York State - Mid-1980's to Mid-1990's*. Huffman & Associates, Inc. Prepared



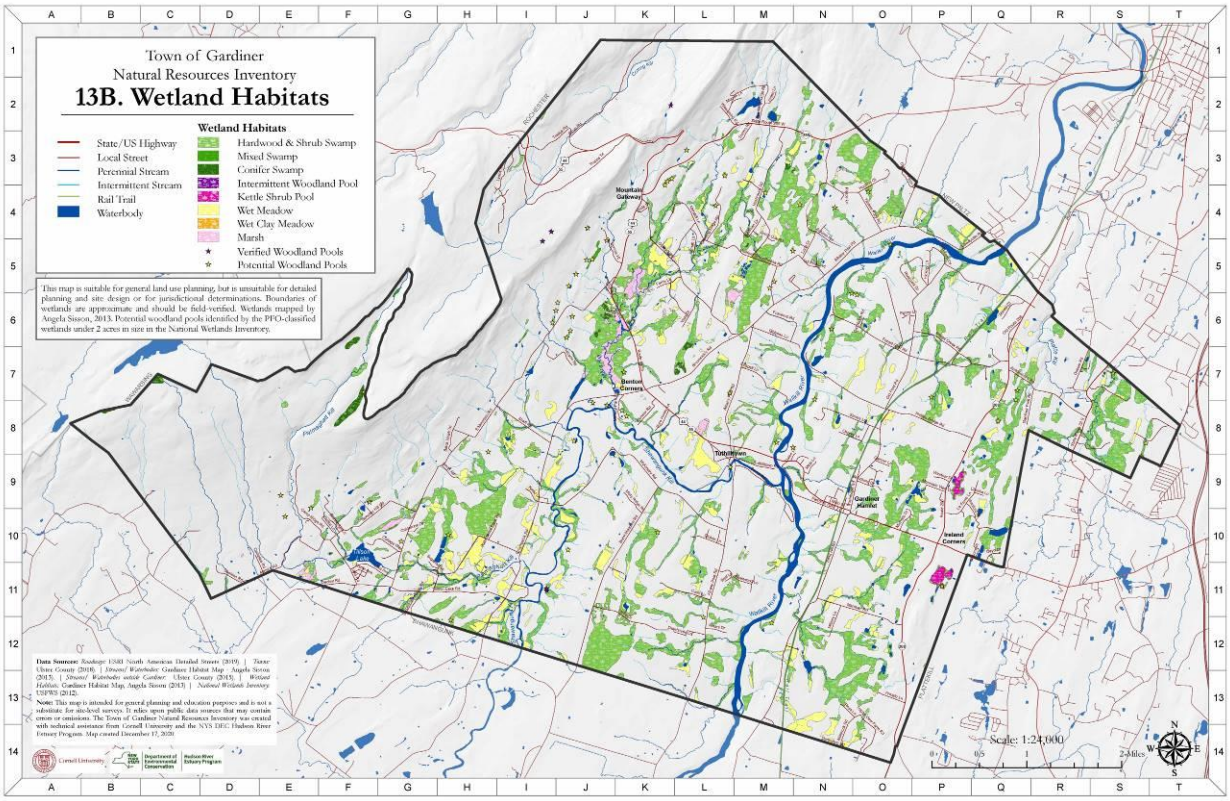
County soil maps are also a good source for predicting the location of potential wetlands. Soils classified in the *Soil Survey of Ulster County, New York*[58] as very poorly drained or poorly drained are good indicators of probable wetland areas, and soils classified as somewhat poorly drained may indicate possible wetland areas (see Soils section for further discussion of soil properties).[59] Note that the wetland soil areas cover a greater area than NWI and DEC wetland layers. Likewise, note that soil units are only mapped to an approximate area of about two acres, and that soils within the unit may not be homogeneous. Areas with mapped wetland soils should always be verified in the field during snow-free conditions for the purposes of environmental review.

Existing state and federal wetland maps are inherently inaccurate and omit many smaller, drier wetlands. They also do not provide much information about wetland habitat types. The Wetland Habitats Map (Map 13B) is derived from the 2014 Gardiner Habitat Map and should be routinely consulted when identifying local wetlands. This map was created through detailed analysis of aerial photos, soils data, and topography and shows wetland habitat types and locations in greater detail and accuracy than the NWI or DEC wetland maps. However, only limited field verification was completed for the Habitat

for New York State Department of Environmental Conservation, 2000.
http://www.dec.ny.gov/docs/wildlife_pdf/wetstattrend2.pdf

[58] Tornes, L.A., Soil Survey of Ulster County, New York, USDA Soil Conservation Service in cooperation with Cornell University Agricultural Experiment Station, Ithaca, 1979.
https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/new_york/ulsterNY1979/ulster.pdf

[59] Kiviat and Stevens, 2001.



Map, and the data should be field-verified during environmental reviews. The full Habitat Map report describes wetland habitat types, fauna, sensitivities, and impacts.[60] Wetland habitats identified in Gardiner include hardwood & shrub swamp, conifer swamp, mixed forest swamp, intermittent woodland pool, kettle shrub pool, marsh, wet meadow, constructed pond, and open water. There is a brief summary of wetland habitat types in the Habitat Map section of this report.

The largest wetland complexes in Gardiner are located within the Wallkill River valley floor. These include wetlands associated with the Mara Kill and other tributaries of the Wallkill and Shawangunk Kill. Many of the wetlands are forested, likely because they were historically too wet to farm. In addition, wet meadows commonly occur embedded within larger meadow and agricultural habitat areas, but are commonly overlooked due to their seasonally wet nature.

A handful of intermittent woodland pool locations are confirmed in Gardiner; however, many other potential woodland pool locations occur throughout the Town. Potential woodland pools were identified by Sisson based on the NWI wetlands in the "PFO" class that were under 2 acres in size and are only an approximation that requires field verification. An intermittent woodland pool is a small, isolated wetland in a forested setting, with standing water during winter and spring that dries up by mid- to late summer

[60] Sisson, A., 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, 2014. https://static1.squarespace.com/static/5bd1e899da50d36cfc91e963/t/5bd8a3174d7a9c6813c845b8/1540924207685/NRI+Report_Habitat_Map%281%29.pdf

during a normal year. It is synonymous with the term "vernal pool" when located in a forested setting. Seasonal drying and the lack of a stream connection prevent establishment of fish populations, which are major predators on amphibian eggs and larvae. The pools provide important breeding habitat for several amphibians that spend most of their lives in the surrounding upland forest floor habitat. The *NY Amphibian and Reptile Atlas* documented the presence of mole salamanders in Gardiner, such as the Jefferson salamander and spotted salamander, confirming the availability of high quality woodland pool habitat in the Town. Specific development and management recommendations are available to minimize impacts to woodland pools and associated wildlife.[61] [62] Woodland pools should ideally be assessed during the spring or early summer to verify whether quality amphibian breeding habitat is present.

Several other species of conservation concern occur in Gardiner's wetland habitats. The *NY Breeding Bird Atlas* indicates that pied-billed grebe (NY-Threatened), a marsh bird, is present in Gardiner. The *NY Amphibian and Reptile Atlas* documented several rare turtles in Gardiner including bog turtle (NY-Threatened), spotted turtle (NY-Special Concern and candidate for federal listing), and stinkpot (high priority species of greatest conservation need). Bog turtle occurs in groundwater-fed sedge meadows, wet meadows, and calcareous fens. Spotted turtle moves seasonally between nearby wetland and upland habitats and is thus highly dependent on connectivity of wetland complexes. Stinkpot (also known as eastern musk turtle) is found in ponds, lakes, marshes and rivers that are generally slow-moving have abundant emergent vegetation and muddy bottoms.

State and federal laws protect some but not all wetlands. The New York State Freshwater Wetlands Act generally regulates activities in and around large wetlands, including a 100-foot adjacent area.[63] To be protected, a wetland must be at least 12.4 acres or considered of unusual local importance, and appear on the NYS Freshwater Wetlands Map. The U.S. Army Corps of Engineers regulates wetlands of all sizes in New York under section 404 of the Clean Water Act.[64] However, to be protected, wetlands must be connected to a navigable waterway. Vernal pools and other isolated wetlands less than 12.4 acres are generally unprotected by state or federal wetland regulations.[65]

The Town of Gardiner Wetlands and Watercourse regulations (§220-35) require additional review relating to DEC and ACOE-regulated wetlands.[66] A more comprehensive Wetlands and Watercourse Protection Law was drafted in 2019 but has not yet been adopted by the Town.

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[61] Morgan, D. and A. Calhoun. *The Maine Municipal Guide to Mapping and Conserving Vernal Pools*. University of Maine, Sustainability Solutions Initiative, 2012, Orono, ME. http://www.vernalpools.me/wp-content/uploads/2015/06/Maine-Municipal-Guide-to-Mapping-and-Conserving-Vernal-Pool.pdf

[62] Calhoun, A. and M. Klemens. *Best development practices: Conserving pool-breeding amphibians in residential and commercial developments in the northeastern United States*. MCA Technical Paper No. 5, Metropolitan Conservation Alliance, Wildlife Conservation Society, 2002, Bronx, New York. https://www.nae.usace.army.mil/Portals/74/docs/regulatory/VernalPools/BestDevelopmentPractices20Oct2014.pdf.

[63] " Freshwater Wetlands Program." NYS DEC. http://www.dec.ny.gov/lands/4937.html

[64] "Section 404 of the Clean Water Act." United States Environmental Protection Agency. https://www.epa.gov/cwa-404

[65] "Conserving Small Wetlands in the Hudson Valley." NYS DEC. http://www.dec.ny.gov/lands/47486.html

[66] Town of Gardiner, Municipal Code. Section 220-35. https://ecode360.com/9151933?highlight=wetland,wetlands&searchId=20349986827811851#9151933

Section 5: Habitats and Wildlife

Ecological Context (Map 14)

The first step to understanding habitats in Gardiner is to consider the Town's larger ecological context. The Ecological Context map helps illustrate the major ecological features in Gardiner extending beyond the Town's borders, including habitat areas that have been identified as significant at inter-municipal, regional, and statewide levels. By visualizing how natural resources extend beyond political boundaries, Town leaders can better plan for conservation of significant ecological features and understand the potential impacts of individual decisions at a broader scale. Furthermore, conservation of large, connected natural areas will help protect biodiversity and be vital to ensuring plants and animals can move and adapt to climate change. Whether planning or making decisions at the site scale or town-wide level, stepping back to understand a site's ecological context can help guide new development and construction to avoid cumulative impacts or "death by a thousand cuts" to major natural features. Understanding the interconnectedness of all things results in understanding the need for protecting the ecology.

Significant Biodiversity Areas

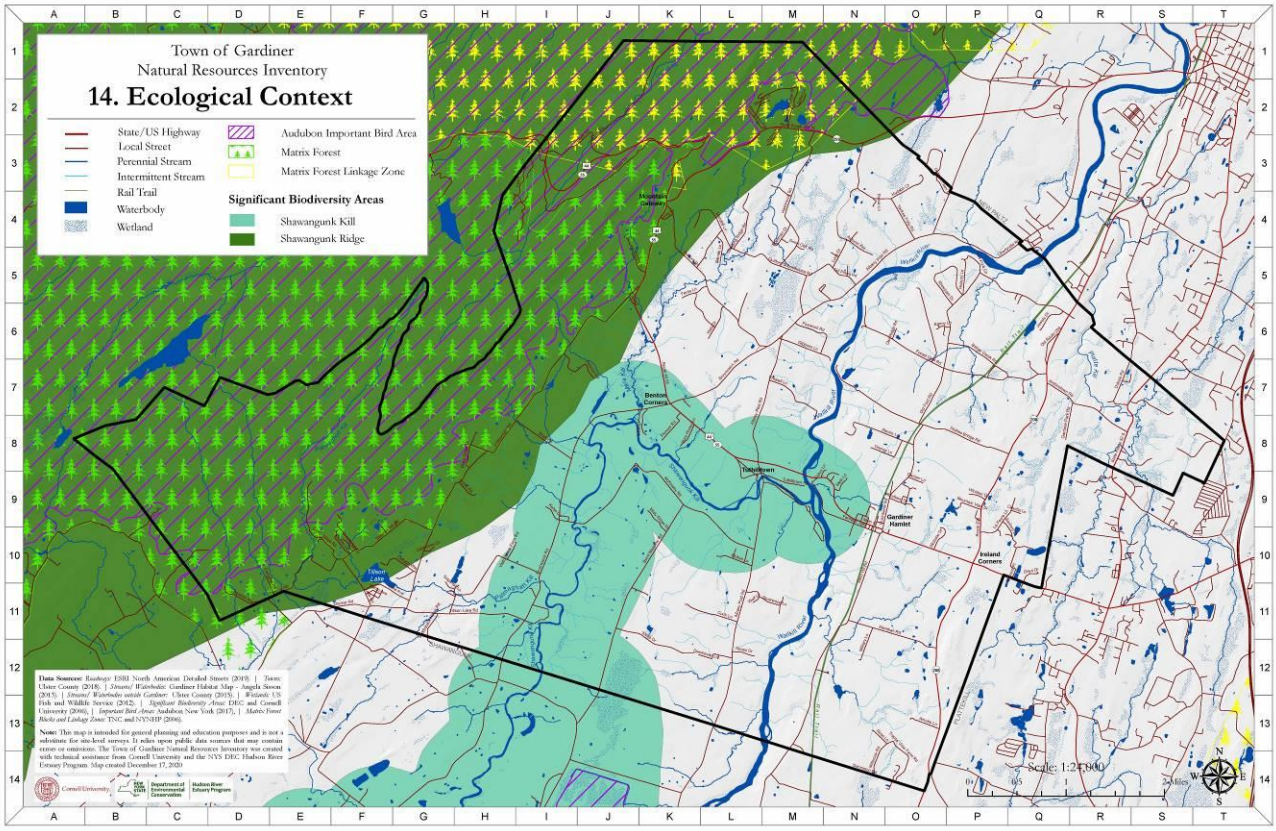
The Shawangunk Ridge and the Shawangunk Kill corridor are Significant Biodiversity Areas (SBAs) are regionally-significant landscape features recognized in DEC's *Hudson River Estuary Wildlife and Habitat Conservation Framework.*[67] SBAs are areas with a high concentration of biological diversity or value for regional biodiversity. They are defined by unique topography, geology, hydrology, and biology that distinguish them from neighboring areas.

The Shawangunk Ridge has been identified by many regional and national conservation organizations as a top priority for conservation in the northeast. In fact, The Nature Conservancy (TNC) has designated the ridge as one of the "last great places on Earth" for conservation. The northern portion of the Shawangunk Ridge, where Gardiner is situated, is especially important for supporting 42 state-rare species, 8 state-rare ecological communities, and 3 globally-rare ecological communities.[68] The collective interest in protecting this

> The Shawangunk Ridge is one of the highest priorities for biodiversity conservation in New York State and has been named by the Nature Conservancy as one of the "last great places on Earth."

[67] Penhollow, M., P. Jensen, and L. Zucker. *Wildlife and Habitat Conservation Framework: An Approach for Conserving Biodiversity in the Hudson River Estuary Corridor.* New York Cooperative Fish and Wildlife Research Unit, Cornell University and New York State Department of Environmental Conservation, Hudson River Estuary Program, 2006, Ithaca, NY. https://www.dec.ny.gov/docs/remediation_hudson_pdf/hrebcf.pdf

[68] J. Thompson. *What Makes New York's Shawangunk Mountains One of the "Last Great Places"?* ESRI ArcNews. 2012. https://www.esri.com/news/arcnews/winter1112articles/what-makes-new-yorks-shawangunk-mountains-one-of-the-last-great-places.html



area has resulted in conservation of tens of thousands of acres of land, most of which is owned and managed by the State of New York and the Mohonk Preserve. However, further conservation is necessary to protect portions of the Shawangunk Ridge and its foothills, which also provide important habitat for rare species and support habitat connectivity.

The Shawangunk Ridge SBA encompasses a high diversity of natural communities found on the Ridge, some of which are state-rare or globally-rare and all of which provide habitat for numerous associated plant and animal species.

> *"The Shawangunk Ridge contains an unusual diversity of plant communities and a high diversity of associated plant and animal species. The high diversity in the area is due in part to the wide range of topography and substrate. The area contains communities that range from wetland to ridgetop, slope, and cliff.*

Pitch pines are a fire-dependent tree species that thrive on the Shawangunk Ridge.
Roberta Clements

The forest habitats are important as a migration corridor for raptors, other migratory birds, and wide-ranging mammals… The Shawangunk Ridge is the northernmost ridge in the Appalachian Ridge and Valley physiographic province…This results in an unusual area where many regionally rare plants and animals are found at or near the limits of their ranges. Other rare species found in the habitat area are those adapted to the harsh conditions on the ridge…"[69]

The Shawangunk Ridge Biodiversity Partnership was formed to coordinate efforts between landowners and experts in the conservation of these unique and rare habitats and species. One product of this partnership was the development and implementation of the Northern Shawanagunk Ridge Fire Management Plan, which provides a critical strategy for maintaining the globally-rare dwarf pine ridge ecosystem.

The Shawangunk Kill SBA has also been identified as an important and uncommon habitat, largely owing to high water quality and minimal human disturbance.

"The Shawangunk Kill supports high diversities of fish and mussels, unusual for the Hudson River Estuary corridor. Six species of freshwater mussels have been identified in this stretch of the river, including the globally rare swollen wedge mussel… Wood turtle occurs in riparian habitat of the Shawangunk Kill and its tributaries."[70]

The *Hudson River Estuary Wildlife and Habitat Conservation Framework* suggests preventing excessive water withdrawals that might lower water levels in the Shawangunk Kill, negatively impacting rare species. The Framework also recommends that landowners adjacent to the Shawangunk Kill create or maintain wide vegetated buffers between human activities (e.g. development and agricultural practices) and the stream area, including its floodplain.

More information about the SBAs can be found in the *Conservation Framework*.

Matrix Forest Blocks and Regional Forest Linkage Zones

The Nature Conservancy (TNC) has identified globally-rare matrix forests across the northeastern United States -- forests large enough to withstand major natural disturbances, maintain important ecological processes, and support populations of forest-interior wildlife and plants.[71] In partnership with the New York Natural Heritage Program, TNC also mapped forest linkage zones across New York State. The forest linkages represent intact natural corridors that connect matrix forests at a regional scale. In the Town of Gardiner, the forests associated with Minnewaska State Park are identified as a matrix forest. This forest is a critical hub that is linked to the large forests of Esopus to the northeast (via a forest linkage that includes forests in the Mohonk Preserve), to the Catskills in the northwest, and to Pennsylvania in the south.

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[69] Penhollow et al., 2006, pg. 100

[70] Penhollow et al., 2006, pg. 97

[71] Anderson, M. and S. Bernstein (editors). *Planning methods for ecoregional targets: Matrix forming ecosystems.* The Nature Conservancy, Conservation Science Support, Northeast & Caribbean Division, 2003, Boston, MA

Audubon Important Bird Areas

Audubon New York has identified the Northern Shawangunk Mountains as an Important Bird Area (IBA) of continental significance. The site "supports an exceptional example of a characteristic higher elevation forest bird community with particularly good representation of a pine woods community."[72] Priority species for conservation associated with this IBA are shown in Table 1 and include species such as peregrine falcon, golden-winged warbler, and wood thrush.

The Shawangunk Ridge and its adjacent lowlands constitute important regional biodiversity priorities. Forests within the Shawangunk Ridge SBA are designated as either a Matrix Forest Block or an associated linkage zone. The size and condition of these forests, along with their contribution to regional forest connectivity, contribute to the high habitat value identified in the Northern Shawangunks IBA. In addition, the clean water coming off the Ridge and limited development in the area also contribute to the overall habitat quality within the Shawanugunk Kill SBA.

[72] Audubon New York, Northern Shawanugnk Mountains Important Bird Area, https://www.audubon.org/important-bird-areas/northern-shawangunk-mountains (Accessed July 27, 2020)

Habitats (Map 15)

In 2014, Angela Sisson completed a Habitat Map and Report identifying and describing the habitats found in the towns of Gardiner and Shawangunk, building on earlier habitat mapping completed by volunteers from both Towns participating in Hudsonia's 10-month Biodiversity Assessment Training program.[73] The habitat map was created through a combination of remote sensing and field verification of selected habitats. Remote sensing involved using a Geographic Information System (GIS) to overlay data to inform the identification of habitats. Data layers included topography, aerial photography, the Ulster County soil survey, mapped wetlands from the National Wetlands Inventory, and FEMA floodplains. Field verification through site visits was conducted between 2007 and 2010.

Green frogs utilize a variety of Gardiner's habitats. *Laura Rose*

The Habitat Map shows the great diversity of habitat types throughout the Town of Gardiner. At the time of the 2014 report, 25,210 acres of the Town are natural habitats while 3,227 acres are developed. Wetlands make up about 4,977 acres of the Town (Map 13B) with about 208 miles of perennial and intermittent streams. The waterbodies and streams mapped in the 2014 Habitat Map are used throughout this NRI as they are considered to be the most accurate rendering of these resources currently available. Large contiguous forests and meadows were also mapped because of their value to sensitive species that require large undisturbed patches of habitat to thrive. Similarly, potential woodland pools and wet clay meadows and their associated adjacent areas were mapped and are further discussed in the accompanying report. Table 5 lists the significant habitats mapped in the Town of Gardiner with brief descriptions and total acreage.

The Habitat Map and the accompanying report can be used to inform planning for the protection of these habitats. The map can be used to review site-specific development proposals by providing habitat information about any given parcel along with important adjacent or contiguous habitats. During the review process, the report recommends that landowners, developers and reviewers should:

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.

[73] Sisson, A., 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, 2014. https://static1.squarespace.com/static/5bd1e899da50d36cfc91e963/t/5bd8a3174d7a9c6813c845b8/1540924207685/NRI+Report_Habitat_Map%281%29.pdf

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; 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 formal environmental review process.

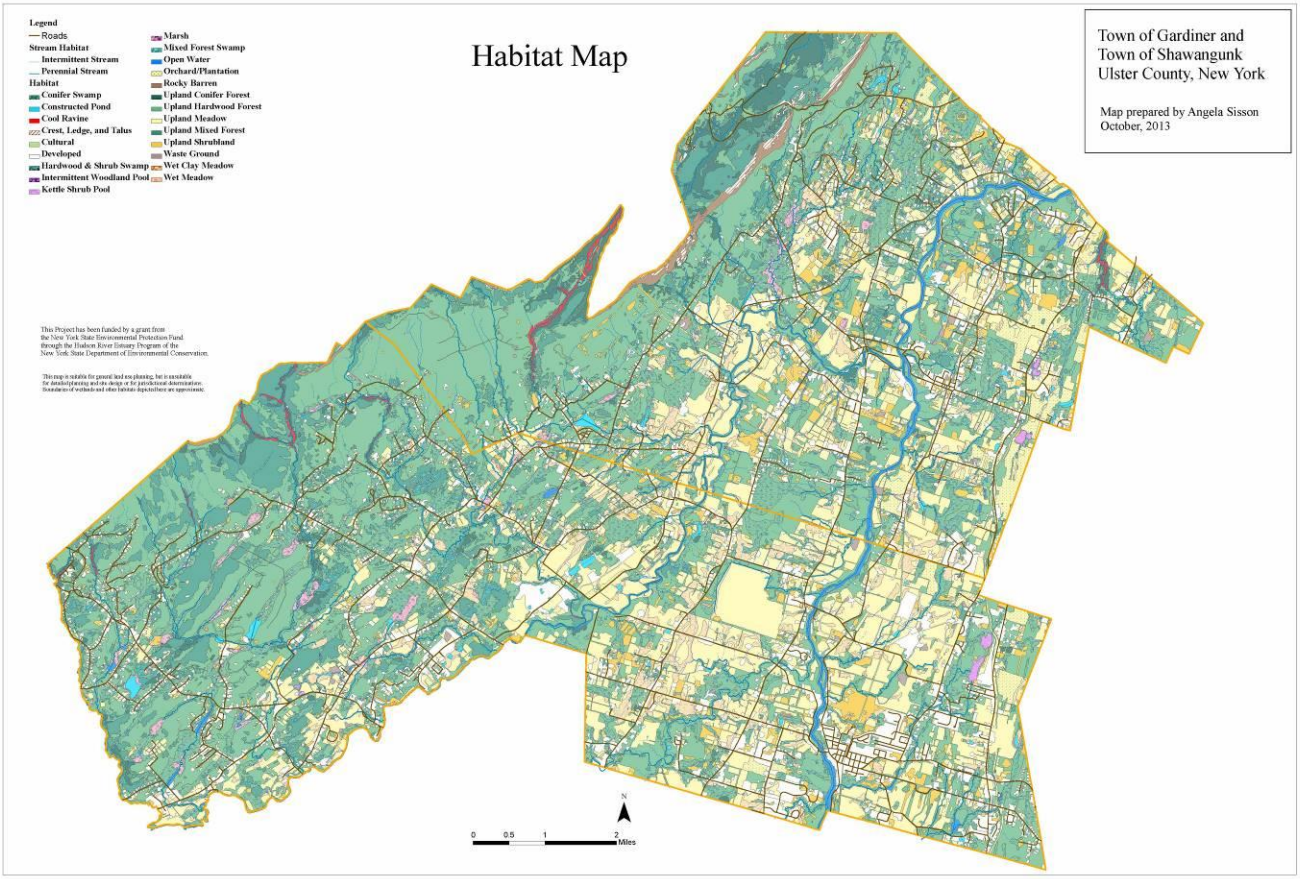

Table 5. Significant Habitats in the Town of Gardiner

Upland Habitats		
Name	**Description**	**Acres**
upland hardwood forest	non-wetland forest dominated by hardwood trees (conifers make up < 25% of canopy).	10,144 acres
upland conifer forest	non-wetland forest dominated by conifer trees (>75% of canopy).	1,014 acres
upland mixed forest	non-wetland forest with a mix of hardwoods and conifers (conifers make up 25-75% of canopy).	2,040 acres
crest/ledge/talus	partially or fully-exposed bedrock on a summit or knoll (crest) or slope (ledge). Talus occurs where rock fragments accumulate at the base of ledges and cliffs.	169 acres
cool ravine	ravine with steep rocky walls narrowly flanking and extending at least 15 ft above a stream, creating cool microclimate conditions. Ravine walls are typically forested including hemlock.	123 acres
rocky barren	open woodland with a sparse and often stunted canopy of pitch pine, oaks, and scrub oak, occuring on mountain summits or slopes with exposed bedrock and thin soils.	309 acres
orchard/plantation	actively maintained or recently abandoned fruit orchards, tree farms, or plant nurseries.	889 acres
upland shrubland	open (nonforested) area with shrubs making up > 20% of ground cover.	1,291 acres
upland meadow	open area dominated by herbaceous vegetation (shrubs and saplings < 20% ground cover; may have scattered trees) and either unmowed or mowed infrequently (up to a few times a year, such as a hayfield); includes pasture, cropland, abandoned fields.	4,108 acres
cultural	open area (may have scattered trees) mowed frequently or otherwise managed in an intensive way (lawn, playing field, golf course, garden, park, cemetery).	69 acres
waste ground	land that has been severely altered by human activity but lacks pavement or structures. Gravel mines, quarries, dumps, wetland fill, abandoned lots, or construction sites. Places where soil has been removed, and sometimes replaced with fill.	77 acres
development	buildings, roads, pavement, and adjacent lawn areas.	3,227 acres
Wetland Habitats		
hardwood & shrub swamp	wetland (identified by predominance of hydrophytic vegetation) dominated by trees and/or shrubs. (conifers make up < 25% of canopy).	3,153 acres

conifer swamp	wetland dominated by conifer trees or shrubs (>75% of canopy).	59 acres
mixed forest swamp	wetland with a mix of hardwood and conifers trees and/or shrubs (conifers make up 25-75% of canopy).	9 acres
intermittent woodland pool	small, isolated, seasonally flooded pool, generally with an open basin, surrounded by forest.	1 acre
kettle shrub pool	seasonally-flooded shrub swamp in a glacial kettle.	27 acres
marsh	wetland dominated by hydrophytic herbaceous vegetation that stays saturated/flooded most of the time.	124 acres
wet meadow	area of seasonally saturated or flooded soils dominated by hydrophytic herbaceous vegetation.	1,043 acres
constructed pond	manmade body of water with a mostly managed shoreline (bordered by developed or cultural areas).	182 acres
open water	body of water (natural or manmade) with a mostly undeveloped shoreline.	379 acres
intermittent stream	stream that has flow at least part of the year, including man-made ditches.	140.3 miles
perennial stream	stream that generally flows year-round.	67.3 miles

Unique Upland Habitats (Map 16)

In addition to the numerous important stream and wetland habitats in the Town, Gardiner has a variety of unique upland (e.g., non-wetland) habitats. These habitats support a diversity of both rare and common species and natural communities that are rare or exceptionally high quality. Map 16 is especially important as a resource to interpret the Open Space Priority Area Rating Criteria, as described in the 2006 Gardiner Open Space Plan (Appendix C).

Cliff and Talus

Cliffs are vertical exposures of bedrock that include ledges above and talus down-slope.[74] Talus is the accumulation of rock fragments (some of which can be very large) below a ledge. These habitats are often difficult to access and for that reason they can act as an ecological refuge for species that are vulnerable to human disturbance.[75] They are also used as habitat by a variety of species include nesting peregrine falcons, timber rattlesnakes, and mountain spleenwort. The cliff and talus habitats in Map 16 are confined to the Shawangunk Ridge and were mapped by the Shawangunk Ridge Biodiversity Partnership's Green Assets Program in 1996. The Open Space Plan recommends maintaining a 1,000-foot undisturbed buffer around these habitats to minimize harmful impacts associated with development, mining, and outdoor recreation.

Dwarf Pine Ridge

Dwarf pine ridges are unique to the northern Shawangunks and for this reason they are considered to be globally-rare.[76] The large majority of these stunted pitch pine forests are protected by a variety of conservation partners, with the largest examples found in the Sam's Point area of Minnewaska State Park. While this habitat is protected within the confines of the State Park, increased levels of recreation can degrade those areas closest to trails, viewpoints, and other high visitation sites. Fire suppression is another threat, as pitch pines require periodic burning to reproduce. The dwarf pine ridges in Map 16 are confined to the Shawangunk Ridge and were mapped by the Shawangunk Ridge Biodiversity Partnership's Green Assets Program in 1996. The Open Space Plan recommends maintaining a 1,500-foot undisturbed buffer around these habitats to minimize harmful impacts associated with outdoor recreation.

Chestnut Oak Forest >1,000 acres

New York's chestnut oak forests represent some of the northernmost occurrences of this important oak species. The Shawangunk Ridge is one of the best places to see these forests in the Hudson Valley, where forest patches over 1,000 acres are preserved. Species such as the timber rattlesnake and northern long-eared bat depend on these forests as their hunting grounds. Major threats to these forests include

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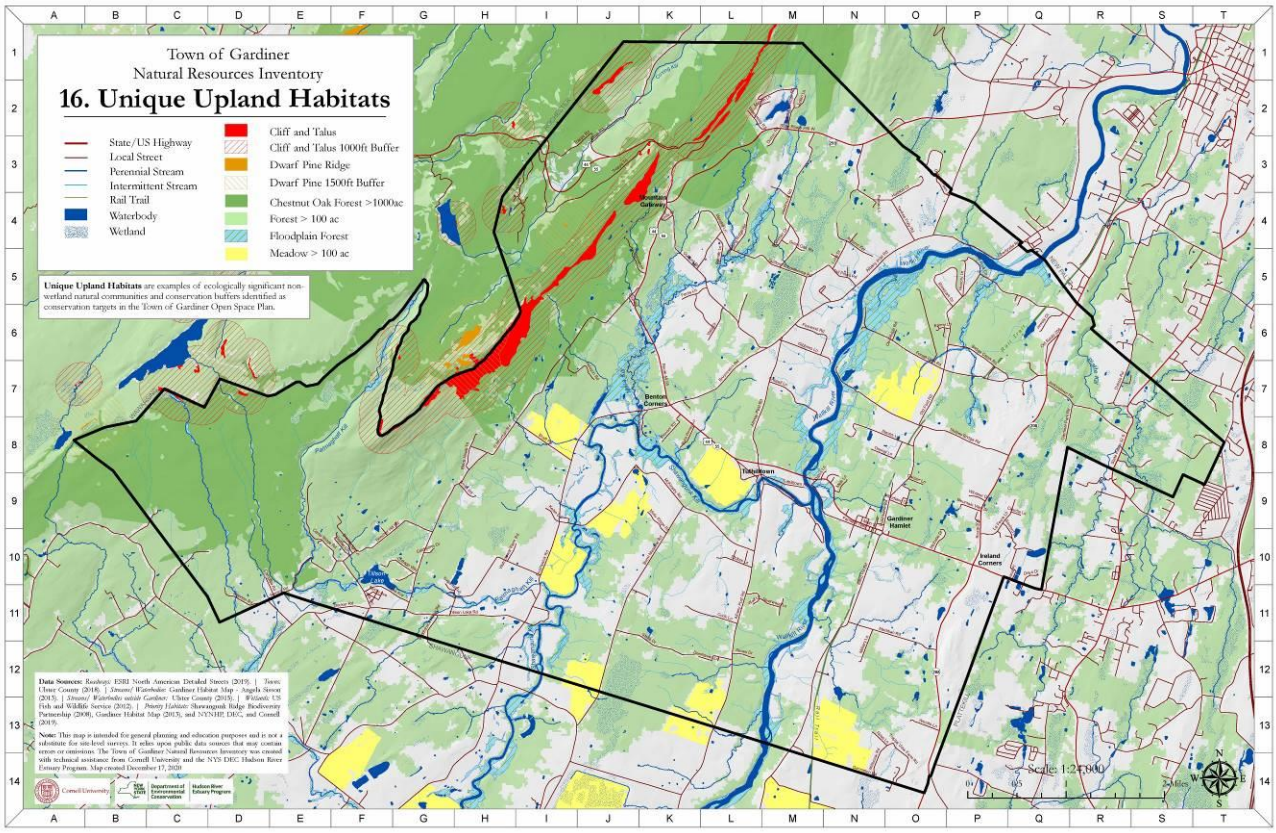
[74] Conservation Guide: Cliff Community. New York Natural Heritage Program. https://guides.nynhp.org/cliff-community/#conservation-management

[75] Habitat Fact Sheet: Crest, Ledge, and Talus. Hudsonia Ltd. https://hudsonia.org/wp-content/files/fact%20sheets/Crest,ledge,talus.pdf

[76] Conservation Guide: Dwarf Pine Ridges. New York Natural Heritage Program. https://guides.nynhp.org/dwarf-pine-ridges/



forest fragmentation, development, and invasive species. Fire suppression is also a threat to this forest community, which is fire-adapted. In addition, deer browse is impacting chestnut oak forest regeneration in Gardiner.[77] The chestnut oak forests in Map 16 were mapped by the Shawangunk Ridge Biodiversity Partnership's Green Assets Program in 1996.

Forest >100 acres

Forests provide numerous benefits including wildlife habitat, clean water, climate moderation, and forest products. Forests are located throughout the Town but the largest and most intact forests are associated with the Shawangunk Ridge. Threats to forests are similar to those described in the Chestnut Oak Forest section above. The data displaying forests greater than 100 acres were sourced from the Forest Condition Index.[78] For more information about individual forest patches shown on Map 16, see the Forests section of the NRI.

Floodplain Forest

Floodplain forests, located in low-lying areas adjacent to streams and rivers, are important as habitat and

[77] Conservation Guide: Chestnut Oak Forest. New York Natural Heritage Program. https://guides.nynhp.org/chestnut-oak-forest/

[78] Conley, A. K., E. Cheadle, and T. G. Howard. *Updating Forest Patches and a Patch Assessment for the Hudson Valley.* New York Natural Heritage Program, State University of New York College of Environmental Science and Forestry, 2019, Albany, NY. www.nynhp.org/forest-patches

for their role in flood mitigation and water quality. These forests, located along the major waterways in Town, are critical habitat for rare species such as the red-headed woodpecker and Indiana bat. Floodplains can also slow down and store large qualities of floodwater, reducing impacts to downstream communities. For more information see the Floodplains and Riparian Areas section of this report. Floodplain forests were mapped where Gardiner habitat map forests intersected with FEMA Flood Hazard Areas.

Meadow >100 acres

Grassland and meadow habitat can support a variety of life, including rare plants, butterflies, reptiles, and birds, in addition to providing agricultural uses and scenic values. Large meadows can provide important habitat for grassland-associated bird species, including northern harriers and bobolinks, who use these areas as hunting grounds and/or nest sites. The quantity and quality of grasslands for wildlife have rapidly decreased in the Northeast during the last century due to increased human population, changes in agricultural technology, and abandonment of family farms. All of Gardiner's meadows that are greater than 100 acres are located in the Wallkill Valley and in close proximity to the Wallkill River or Shawanagunk Kill. Meadows on Map 16 were sourced from the Gardiner Habitat Map.

Cool Ravines

According to the Habitat Map Report, "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… [In addition,] remnant old growth forest may be found in cool ravines."[79] Two large examples of cool ravines are shown from the town-wide Habitat Map: the 97-acre Palmaghatt Ravine on the Shawangunk Ridge, and the Platte Kill Gorge in eastern Gardiner.

[79] Sisson, 2014, pg. 28

Important Biodiversity Areas (Map 17)

The Important Biodiversity Areas Map highlights the most significant ecological features in Gardiner based on existing records of rare species and significant natural communities from the New York Natural Heritage Program (NYNHP). NYNHP is a partnership between DEC and SUNY College of Environmental Science and Forestry, with a mission to monitor and conserve New York State's rare plants, animals and habitats. Note that many areas have yet to be formally surveyed, and additional study may reveal other important occurrences in the Town.

Significant Natural Communities

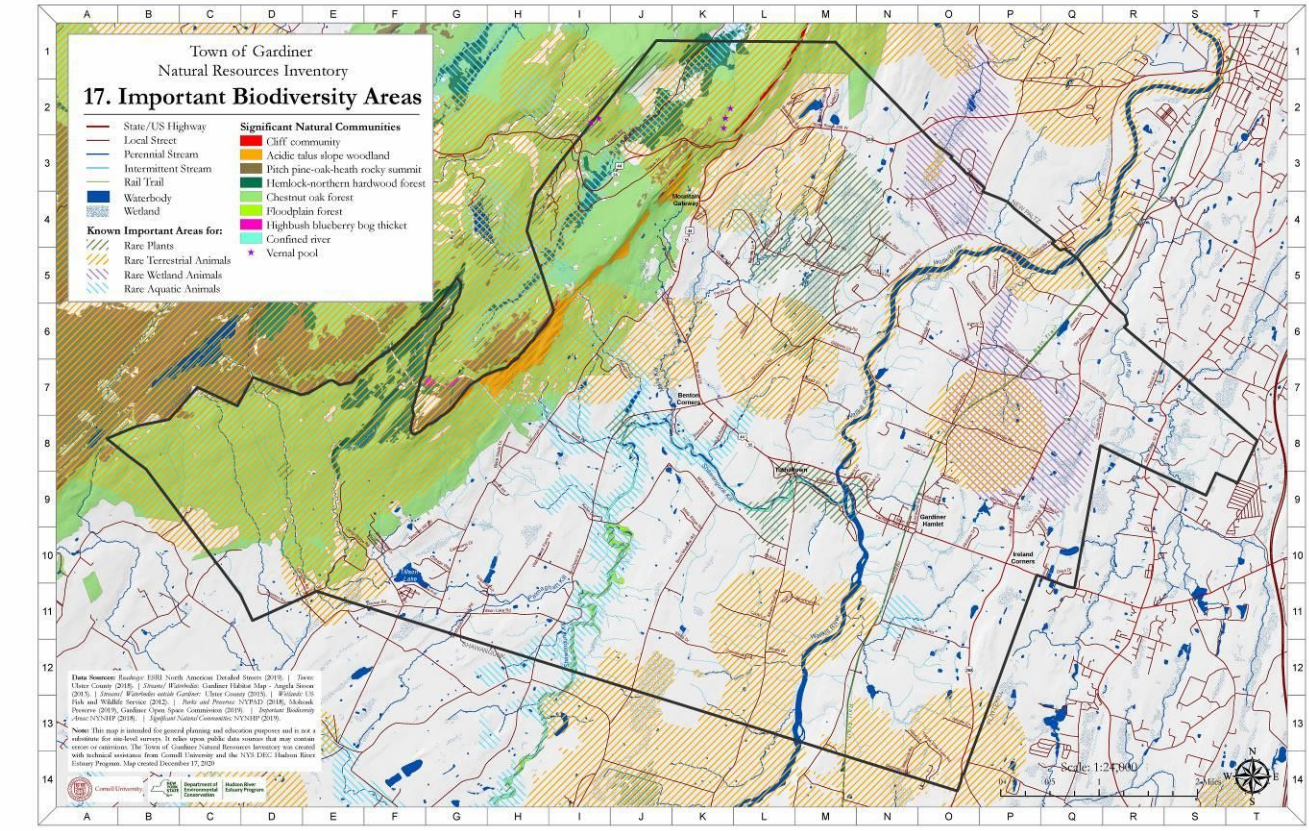
NYNHP has mapped several occurrences of rare and/or high quality natural communities in Gardiner. These are based on a more detailed classification of habitats than used in the town-wide Habitat Map. They include forests, cliffs and summits, and isolated wetlands. The following list of mapped communities includes links to online guides with illustrated descriptions and conservation and management guidance:

- cliff community
- acidic talus slope woodland
- pitch pine-oak-heath rocky summit
- hemlock-northern hardwood forest
- chestnut oak forest
- floodplain forest
- vernal pool
- dwarf shrub bog
- highbush blueberry bog thicket
- confined river

Known Important Areas for Rare Animals and Rare Plants

NYNHP has also identified important areas for sustaining populations of rare animals and rare plants based on documented occurrences.[80] These areas include the specific locations where a species has been observed, the adjacent habitat, as well as areas critical to maintaining the quality or integrity of the habitat. Proactive planning that considers how species move across the landscape, with careful attention to maintaining connected habitat complexes, will contribute to the long-term survival and persistence of rare species and significant natural communities. Table 6 provides a complete list of species of conservation concern known from Gardiner. To request more detailed rare species or habitat data, visit http://www.dec.ny.gov/animals/31181.html or contact NaturalHeritage@dec.ny.gov.

[80] New York Natural Heritage Program and New York State Department of Environmental Conservation, Biodiversity Databases [May 2020], Important Areas Digital Data Set, 2018, Albany, NY.



Rare Animals

Gardiner has an amazing diversity of habitats suitable for rare bird species, in particular, species that depend on large meadows and wetlands. A species in decline is a symptom of habitat loss and degradation on a broad scale.

Important areas were identified for grassland specialists including Henslow's sparrow and upland sandpiper, who use hay fields and pastures as ground nest sites that are safe from predators like foxes and raccoons. Other species also use these fields for winter hunting grounds, including the northern harrier and short-eared owl. The whip-poor-will has been observed using shrubby meadow habitats and forests on the Shawangunk Ridge.

Bald eagle nesting has been documented in Gardiner along the Wallkill River. While Bald Eagle breeding and non-breeding populations are increasing in New York, development pressure and its impacts on habitat remain significant threats. Nesting sites are sensitive to human disturbance

Peregrine falcon was extirpated from the state in the 1960s by DDT and PCB poisoning but has been steadily recovering since 1983. Peregrine Falcons have been documented nesting on the cliffs of the Shawangunk Ridge. Threats include habitat disturbance and loss, human recreation near nests, nest poaching, shooting by hunters, and effects of contamination.

Red-headed woodpecker lives in open swamps with dead, standing trees, and other open areas with scattered trees and has been documented in wetlands of Humpo marsh, a large emergent wetland to the east of the Shawangunk Ridge. Dead trees with cavities provide nesting habitat and should be preserved where feasible.

Pied-billed grebe is a wetland bird with a preference for large wetland complexes including extensive marsh and open water habitat. Nesting by these species has been documented in Humpo Marsh. They are threatened by continued wetland loss in the Hudson Valley and by habitat degradation due to fragmentation, exotic plant invasions, and nutrient enrichment from fertilizer runoff and other sources entering wetlands.

The Hudson Valley is known for high **reptile** diversity, with about 73% of all of New York State's reptiles species found in the region.[81]

Wood turtle occurs along low gradient streams and adjacent forested and open uplands in Gardiner. Wood Turtles are threatened by habitat loss, stream degradation, vehicle strikes, nest predation, and the pet trade.

Bog turtle is one of the smallest turtles in North America and is one of the rarest in New York State. This secretive species can be found in special wetland habitats such as sedge meadows, wet meadows, and calcareous fens. Local bog turtle populations are threatened by habitat loss, road mortality, invasive species, and the pet trade.

Timber rattlesnake inhabits mountainous or hilly forests, often with rock outcroppings, steep ledges, and rock slides. They migrate widely from their dens in summer to forage in the forest surrounding den sites. Forests, ledges, and rocky barrens of the Shawangunk Ridge provide high quality habitat for timber rattlesnakes. Timber rattlesnakes are threatened due to habitat loss and fragmentation, illegal collecting, and malicious killing.

Rare species, like this eastern box turtle, are vulnerable to illegal collection for the pet trade. *Roberta Clements*

Invertebrates, such as insects and shellfish, are often overlooked in ecological surveys but their important ecological functions and

[81] Penhollow, M., P. Jensen, and L. Zucker. *Wildlife and Habitat Conservation Framework: An Approach for Conserving Biodiversity in the Hudson River Estuary Corridor.* New York Cooperative Fish and Wildlife Research Unit, Cornell University and New York State Department of Environmental Conservation, Hudson River Estuary Program, 2006, Ithaca, NY. https://www.dec.ny.gov/lands/5096.html

tremendous species diversity have become the target of conservation efforts in recent years. The loss of invertebrates is a sign of a faltering ecosystem in peril.

The brook floater is a freshwater mussel that can be found in clean streams with fast moving water. Small populations of this species persist in the Shawangunk Kill but are threatened by changes in river flows, loss of habitat, siltation and sedimentation, water pollution, invasive non-native mussels and clams, and hybridization with another mussel species. Dams in particular serve to disconnect sections of stream habitat, increase sedimentation, and alter river flows.

The rare dragonflies found in Gardiner generally require clear headwater streams, seeps, or fast flowing larger rivers. American spiketail, brook snaketail, rapids clubtail, and southern pygmy clubtail might be found along the Coxing Kill and Peters Kill on the Shawangunk Ridge or along the Shawangunk Kill in the valley. Contamination or alteration of their stream habitat and its adjacent area is the primary threat to these species.

Other rare insects with important areas include a suite of moths that are generally associated with the pine barrens and heath habitats found on the Shawangunk Ridge. Threats to the blueberry grey, toothed apharetra, black-eyed zale, and pine barrens zanclognatha include habitat destruction, fire suppression impacts to their habitats, and the use of insecticides.

Rare Plants

Rare plants do not receive the same type of regulatory protection that some rare animals receive, however, they are still critical components of our local ecosystems as they provide food and habitat to a variety of animal species. Map 17 shows important areas on the Shawangunk Ridge for mountain spleenwort, ambiguous sedge, clustered sedge, broom crowberry, spreading rush, Appalachian sandwort, and rhodora. In the Wallkill River valley, important areas for Davis' sedge, buttonbush dodder, beakgrass, and riverweed can be generally found near wetlands and watercourses, especially those associated with the Mara Kill, Shwanagunk Kill, and Wallkill River.

The Town of Gardiner has an abundance of known rare species, habitats, and areas that are likely to support diversity but have not been formally surveyed. Map 17 shows that important natural communities have been mapped covering most of the Shawangunk Ridge. Historically, development and agriculture were concentrated in the Wallkill River Valley, where many lands continue to be dedicated to cropland and pasture interspersed with fragmented blocks of upland forest and wetlands. These areas nevertheless support important areas for a diversity of animals and plants, many of which are unique to lowland environments. For example, Map 17 shows important winter habitat for the short-eared owl, a species that requires expansive grasslands associated with agriculture.

NOTE: The DEC Region 3 Office should be contacted at 845-256-3098 with any concerns or questions about the presence of protected species in Gardiner.

Table 6. Species of Conservation Concern in the Town of Gardiner

The following table lists species of conservation concern that have been observed in the Town of Gardiner and some adjacent areas. The information comes from the New York Natural Heritage Program (NYNHP) biodiversity databases, New York State Department of Environmental Conservation (DEC) wildlife biologists, the 2000-2005 *New York State Breeding Bird Atlas* (NYBBA), the 1990-1999 *New York Amphibian and Reptile Atlas* (NYARA), the Mohonk Preserve (MP) and the John Burroughs Natural History Society (JBNHS). Species from the NYBBA are included in the table if they were documented in Atlas blocks. Note that the NYBBA blocks and JBNHS reports include some records from areas outside of but adjacent to the Town. The table only includes species listed in New York as endangered, threatened, special concern, Species of Greatest Conservation Need (SGCN), or a Hudson River Valley Priority Bird species recognized by Audubon New York. Historical records and unlisted plant species identified as rare by the NYNHP are also included. Generalized primary habitat types are provided for each species, but for conservation and planning purposes, it's important to recognize that many species utilize more than one kind of habitat. More information on rare animals, plants, and ecological communities can be found at http://guides.nynhp.org. This table was provided for the Town of Gardiner Natural Resources Inventory project in July 2020 by the NYSDEC Hudson River Estuary Program to inform land-use planning and decision-making.

			NYS Conservation Status					
Common Name	**Scientific Name**	**General Habitat**	Hudson River Valley Priority Bird	Species of Greatest Conservation Need xx = high priority	Special Concern	Threatened	Endangered	**Data Source**
Mammals								
eastern red bat	*Lasiurus borealis*	forest		x				DEC
hoary bat	*Lasiurus cinereus*	forest		x				DEC
little brown bat	*Myotis lucifugus*	cave, forest, wetland		xx				DEC
Birds								
Acadian flycatcher	*Empidonax virescens*	forest	x					MP
American bittern	*Botaurus lentiginosus*	wetland	x	x	x			NYBBA
American goldfinch	*Spinus tristis*	young forest, shrubland	x					NYBBA
American kestrel	*Falco sparverius*	meadow	x	x				NYNHP
American redstart	*Setophaga ruticilla*	forest	x					NYBBA
American woodcock	*Scolopax minor*	young forest, shrubland	x	x				NYBBA

			NYS Conservation Status					
Common Name	**Scientific Name**	**General Habitat**	Hudson River Valley Priority Bird	Species of Greatest Conservation Need xx = high priority	Special Concern	Threatened	Endangered	**Data Source**
bald eagle	*Haliaeetus leucocephalus*	lake, stream, forest	x	x		NY		NYNHP
Baltimore oriole	*Icterus galbula*	forest	x					NYBBA
barn owl	*Tyto alba*	grassland	x	xx				NYBBA
belted kingfisher	*Megaceryle alcyon*	lake, stream	x					NYBBA
blackburnian warbler	*Dendroica fusca*	forest	x					MP
blackpoll warbler	*Setophaga striata*	forest	x					MP
black-and-white warbler	*Mniotilta varia*	forest	x					NYBBA
black-throated blue warbler	*Dendroica caerulescens*	forest	x	x				NYBBA
black-throated green warbler	*Dendroica virens*	forest	x					NYBBA
blue-winged warbler	*Vermivora pinus*	young forest, shrubland	x	x				NYBBA
bobolink	*Dolichonyx oryzivorus*	grassland	x	xx				NYBBA
broad-winged hawk	*Buteo platypterus*	forest	x					NYBBA
brown thrasher	*Toxostoma rufum*	young forest, shrubland	x	xx				NYBBA
Canada warbler	*Wilsonia canadensis*	young forest, shrubland	x	xx				MP
cerulean warbler	*Dendroica cerulea*	forest	x	x	x			MP
chestnut-sided warbler	*Setophaga pensylvanica*	young forest, shrubland	x					NYBBA
chimney swift	*Chaetura pelagica*	urban	x					NYBBA
cooper's hawk	*Accipiter cooperii*	forest	x		x			NYBBA
downy woodpecker	*Picoides pubescens*	forest	x					NYBBA
eastern kingbird	*Tyrannus tyrannus*	young forest, shrubland	x					NYBBA
eastern meadowlark	*Sturnella magna*	grassland	x	xx				NYBBA
eastern towhee	*Pipilo erythrophthalmus*	young forest, shrubland	x					NYBBA
eastern wood-pewee	*Contopus virens*	forest	x					NYBBA
field sparrow	*Spizella pusilla*	young forest, shrubland	x					NYBBA

Common Name	Scientific Name	General Habitat	NYS Conservation Status					Data Source
			Hudson River Valley Priority Bird	Species of Greatest Conservation Need xx = high priority	Special Concern	Threatened	Endangered	
golden-winged warbler	*Vermivora chrysoptera*	young forest, shrubland	x	xx	x			MP
grasshopper sparrow	*Ammodramus savannarum*	grassland	x	xx	x			NYBBA
hooded warbler	*Wilsonia citrina*	forest	x					MP
Louisiana waterthrush	*Seiurus motacilla*	forest	x	x				NYBBA
northern flicker	*Colaptes auratus*	forest	x					NYBBA
northern goshawk	*Accipiter gentilis*	forest	x	x	x			MP
northern harrier	*Circus cyaneus*	grassland	x	x		NY		NYBBA
olive-sided flycatcher	*Contopus cooperi*	young forest, shrubland	x	xx				NYBBA
osprey	*Pandion haliaetus*	open water, wetland	x		x			MP
peregrine falcon	*Falco peregrinus*	cliff	x	x			NY	NYBBA
pied-billed grebe	*Podilymbus podiceps*	wetland	x	x		NY		JBNHS
prairie warbler	*Dendroica discolor*	young forest, shrubland	x	x				NYBBA
purple finch	*Carpodacus purpureus*	forest	x					NYBBA
purple martin	*Progne subis*	wetland	x					NYBBA
red-headed woodpecker	*Melanerpes erythrocephalus*	forest	x	xx	x			NYNHP
red-shouldered hawk	*Buteo lineatus*	forest	x	x	x			NYBBA
rose-breasted grosbeak	*Pheucticus ludovicianus*	forest	x					NYBBA
ruffed grouse	*Bonasa umbellus*	young forest, shrubland	x	x				MP
savannah sparrow	*Passerculus sandwichensis*	grassland	x					NYBBA
scarlet tanager	*Piranga olivacea*	forest	x	x				NYBBA
sharp-shinned hawk	*Accipter striatus*	forest	x		x			NYBBA
short-eared owl	*Asio flammeus*	grassland	x	xx			NY	MP
sora	*Porzana carolina*	wetland	x					JBNHS

			NYS Conservation Status					
Common Name	**Scientific Name**	**General Habitat**	Hudson River Valley Priority Bird	Species of Greatest Conservation Need xx = high priority	Special Concern	Threatened	Endangered	**Data Source**
upland sandpiper	*Bartramia longicauda*	grassland	x	xx		NY		NYBBA
veery	*Catharus fuscescens*	forest	x					NYBBA
whip-poor-will	*Caprimulgus vociferus*	young forest, shrubland	x	xx	x			NYBBA
willow flycatcher	*Empidonax trailli*	young forest, shrubland	x					NYBBA
wood thrush	*Hylocichla mustelina*	forest	x	x				NYBBA
worm-eating warbler	*Helmitheros vermivorum*	forest	x	x				MP
yellow-billed cuckoo	*Coccyzus americanus*	young forest, shrubland	x					NYBBA
yellow-throated vireo	*Vireo flavifrons*	forest	x					NYBBA
Reptiles								
bog turtle	*Glyptemys muhlenbergii*	wetland		xx		US	NY	NYNHP
eastern box turtle	*Terrapene c. carolina*	forest, young forest		xx	x			NYARA
eastern rat snake	*Pantherophis alleghaniensis*	forest		x				DEC
northern black racer	*Coluber c. constrictor*	forest, shrubland, meadow		x				NYARA
northern copperhead	*Agkistrodon contortrix mokasen*	forest, rocky summit, wetland		x				MP
snapping turtle	*Chelydra serpentina*	wetland, stream, forest, lake		x				DEC
spotted turtle	*Clemmys guttata*	wetland		xx	x			DEC
stinkpot	*Sternotherus odoratus*	wetland, stream		xx				NYARA
smooth greensnake	*Opheodrys vernalis*	stream, lake, wetland		x				MP
timber rattlesnake	*Crotalus horridus*	forest, rocky summit		xx		NY		NYARA
wood turtle	*Clemmys insculpta*	stream		xx	x			NYARA

Common Name	Scientific Name	General Habitat	NYS Conservation Status					Data Source
			Hudson River Valley Priority Bird	Species of Greatest Conservation Need xx = high priority	Special Concern	Threatened	Endangered	
Amphibians								
Jefferson salamander	*Ambystoma jeffersonianum*	vernal pool, forest			x			MP
Fish								
American eel	*Anguilla rostrata*	coast, stream		xx				DEC
bridal shiner	*Notropis bifrenatus*	stream, lake		x				DEC
brook trout	*Salvelinus fontinalis*	stream		x				DEC
comely shiner	*Notropis Amoenus*	stream		xx				DEC
Mussels								
brook floater	*Alasmidonta varicosa*	stream		xx			NY	NYNHP
Insects								
comet darner	*Anax longipes*	wetland		x				MP
southern pygmy clubtail*	*Lanthus vernalis*	stream						NYNHP
Plants								
ambiguous sedge	*Carex amphibola*	wetlands, meadows, forest					NY	NYNHP
Anderson's peat moss	*Sphagnum andersonianum*	wetland					NY	NYNHP
Angerman's peat moss	*Sphagnum angermanicum*	wetland					NY	NYNHP
broom crowberry	*Corema conradii*	rocky summit					NY	NYNHP
buttonbush dodder	*Cuscuta cephalanthi*	wetland					NY	NYNHP
clustered sedge	*Carex cumulata*	rocky summit, wetland				NY		NYNHP
Davis' sedge	*Carex davisii*	coast				NY		NYNHP
mountain spleenwort	*Asplenium montanum*	cliff				NY		NYNHP
ovate spikerush	*Eleocharis ovata*	lake, wetland					NY	NYNHP
rhodora	*Rhododendron canadense*	wetland, pine barren				NY		NYNHP
riverweed	*Podostemum ceratophyllum*	stream				NY		NYNHP

			NYS Conservation Status					
Common Name	**Scientific Name**	**General Habitat**	Hudson River Valley Priority Bird	Species of Greatest Conservation Need xx = high priority	Special Concern	Threatened	Endangered	**Data Source**
winged monkeyflower*	*Mimulus alatus*	stream, wetland, forest, meadow						JBNHS
Historical Records**								
Allegheny woodrat	*Neotoma magister*	forest, cave, rocky summit		xx			NY	NYNHP
bradley spleenwort	*Asplenium bradleyi*	rock/cliff					NY	NYNHP
large twayblade	*Liparis liliifolia*	wetland, forest					NY	NYNHP
scarlet Indian-paintbrush	*Castilleja coccinea*	grassland, wetland, forest					NY	NYNHP

*Listed by NYNHP as a rare species in New York State

**Generally includes records from before 1980 where subsequent surveys did not confirm the presence of the species

Forests (Map 18)

Forests provide numerous benefits including wildlife habitat, clean water, climate moderation, and forest products. Though each forest's value is relative to the surrounding landscape, in general, larger forests provide higher quality habitat and greater benefits than smaller ones. Historically most forest across the Hudson Valley region was cleared for agriculture. Forests have made a remarkable recovery over the past century or more, but vary widely in ecological value based on size, proximity to development, deer browse pressure, presence of invasive species or tree diseases, and past land use history, among other factors.

Forest fragmentation is the process of breaking large patches of forest into smaller areas, often by clearing it for new roads or development. Fragmentation decreases forest habitat quality and health, disrupts wildlife movement, and facilitates the spread of invasive species.

Forest fragmentation is a major threat posed by land use today and occurs as large forests are divided by new roads or development. Fragmentation decreases habitat quality and health, disrupts wildlife movement, and facilitates the spread of invasive species. These impacts are greatest at forest edges but can extend for hundreds of feet into forest patches, often displacing sensitive species that depend on interior forest. Figure 2 illustrates what happens when a forest is fragmented. Fragmentation reduces or eliminates core forest habitat, affecting suitability for wildlife that depend on those conditions.

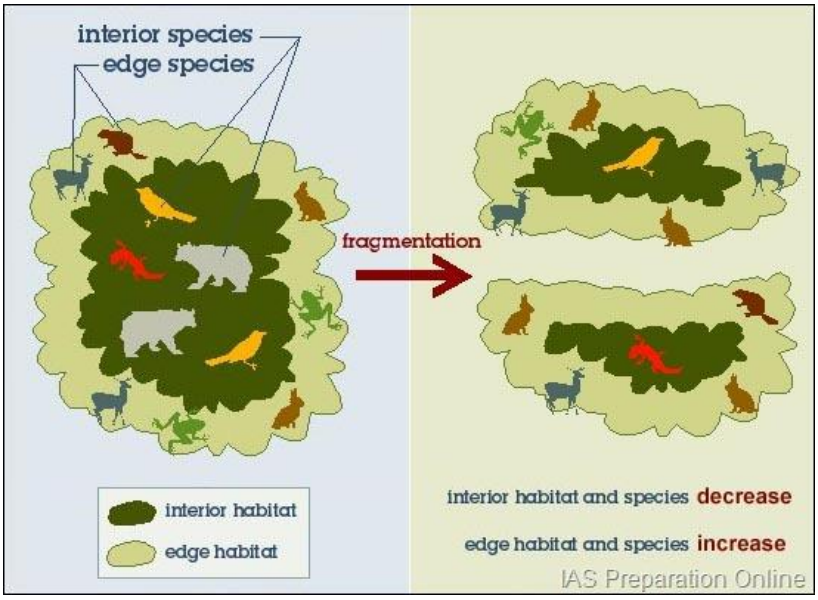
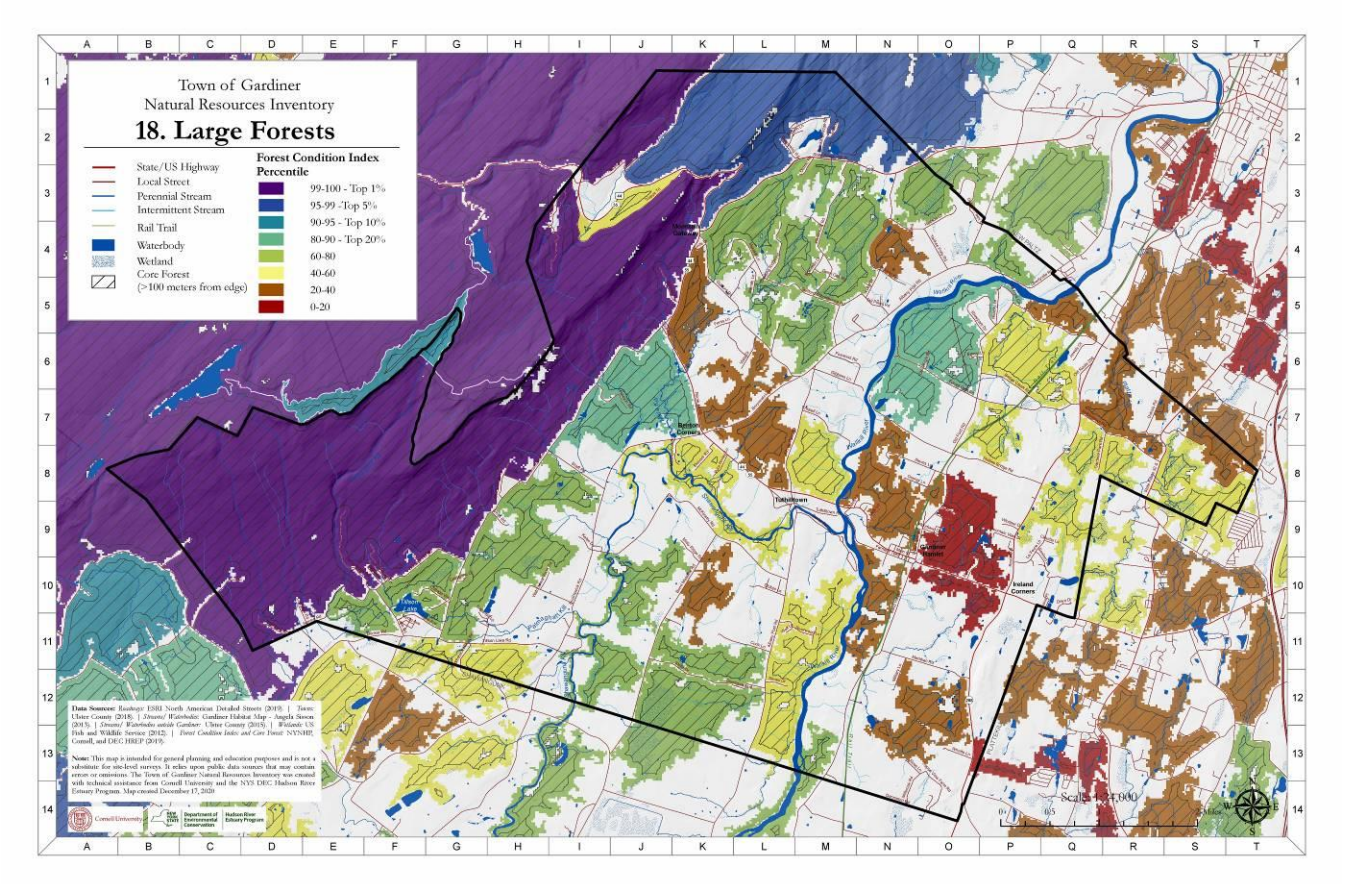


Figure 2. The Effect of Forest Fragmentation on Species Diversity

Forest Condition Index

Forests vary in their ability to support native species and withstand or recover from external stressors such as fragmentation, severe storms, and invasive species. The Hudson Valley Forest Condition Index

maps and prioritizes forest patches based on a variety of metrics relating to ecosystem health or integrity. Large forest patches in the Hudson River estuary watershed were first identified through a landscape fragmentation analysis using forested and other woody land cover classes from the 2016 National Land Cover Database. The resulting areas represent continuous patches of forest unfragmented by major roads, railroads, and non-forest habitat, with a minimum patch size of 100 acres. The forest patches were then scored for 22 metrics related to forest condition, connectivity, stressors, habitat, and other ecosystem values. These component metrics were summed to create the index and ranked according to percentile of all forest patches in the estuary watershed.[82]



Core Forests

Core forests are interior forest areas surrounded by at least a 100-meter wide buffer of edge forest habitat. These interior forest areas support a unique array of plants and animals that are easily disturbed by the human activity generally associated with more open habitats (e.g. agricultural fields, meadow, roads and developed areas). Core forest is especially important for sensitive wildlife including many forest songbirds, which avoid nesting near areas with human disturbance. Although the value of individual forest patches for wildlife depends on landscape context and other factors, core forests that are at least 500 acres in size are more likely to provide enough suitable habitat to support a diversity of

[82] Conley, A. K., E. Cheadle, and T. G. Howard. *Updating Forest Patches and a Patch Assessment for the Hudson Valley.* New York Natural Heritage Program, State University of New York College of Environmental Science and Forestry, 2019, Albany, NY. www.nynhp.org/forest-patches

interior forest species.[83] Core forests were mapped based on the large forest patches identified for the Forest Condition Index, described above. Avoiding further fragmentation of core forests will help conserve the integrity and habitat value of ecologically significant forest patches.

The forests on the Shawangunk Ridge are not only important to the vitality of Gardiner's economy and community character but are also regionally important as intact and connected forest ecosystems. Map 18 identifies the areas within and adjacent to Minnewaska State Park and the Mohonk Preserve as some of the most important forests in the entire Hudson Valley. Those areas shown in purple are ranked in the top 1% of all mapped forest patches in the region due to their large size, habitat diversity, number of rare species present, and connectedness with other important habitats. Similarly, the forests shown in dark blue are in the 5% of Hudson Valley forests for many of the same reasons. Areas adjacent to these Shawangunk Ridge forests are important buffer areas but also have high ecological value in their own right. Several of the forests on the east side of North and South Mountain Road are important specifically for their habitat diversity. Other important forests in the Town can be found along the Shawangunk Kill and Wallkill River, as well as the area noted as "between the Kills" in the 2007 Open Space Plan (K-11/12 on the map).

By guiding development away from core forest habitat, fragmentation of these resources can be limited, and vital benefits can be maintained. The highest quality forests may be good candidates for protection or other municipal conservation efforts.

Forest Health

Beyond fragmentation, the greatest threats to forests in Gardiner today are from overabundant deer, climate change, and the introduction of tree diseases, forest pests, and other invasive species. The Lower Hudson PRISM works to promote education, prevention, early detection and control of invasive species and is helping communities prepare for and respond to these threats. Guiding future development to minimize forest fragmentation will help avoid the spread of invasive species into interior forests and conserve important habitats in the Town.

[83] Environment Canada. How Much Habitat is Enough? 2013, Toronto, Ontario, CA. https://www.documentcloud.org/documents/2999368-THUNDER-BAY-How-Much-Habitat-Is-Enough-3rd-Ed-2013.html

Intact Habitat Cores (Map 19)

In 2013, Ulster County was selected as a case study for a collaboration with the Green Infrastructure Center (GIC) and NYS DEC to develop a methodology for mapping natural green infrastructure and create a model for replication by other counties in New York State. [84] The project was developed around a vision to "draw more focused attention to critical resource protection areas … in a meaningful, visual and accessible manner. Borne of this focused attention are initial steps to address pressing concerns and potential threats to Ulster County's critical resources as well as new recognition of great opportunities inherent in better protecting and understanding our natural assets."[85]

The GIC formed a mapping team with county staff coordinated by the Ulster County Department of the Environment, and determined the key focal areas to overlay on the base map. The county staff reviewed and consulted key documents, such as the Open Space Plan; technical reports, such as those covering the Catskills and Shawangunk Ridges; and current on-going efforts such as the Greenways Plan. The GIC also consulted with key stakeholder groups, such as the Nature Conservancy, Hudsonia and the Federated Sportsmen's Club of Ulster County; local towns within Ulster County's borders; other county departments and agencies, such as Economic Development and Tourism; state and regional offices of the DEC; and the U.S. Environmental Protection Agency.

To create a map of intact habitats, a digital data layer consisting of large areas of intact habitat was created using natural land cover. Next, a layer consisting of developed lands and transportation features was overlaid to determine which areas were fragmented. Edge areas were removed to determine the amount of land that makes up the interior habitat. Following that step, the habitat cores were analyzed for additional attributes relating to size, biological and habitat diversity and water quality. Finally, based on these attributes, the cores were ranked to aid in prioritization for protection or conservation actions. Cores are ranked as Outstanding, High, Medium, or General. These categories are based on each core's size and shape, species diversity, and water quality and quantity values. Individual cores were ranked relative to other habitat cores at the county level.

Map 19 shows intact habitat cores in the Town of Gardiner.[86] Habitat cores associated with the Shawangunk Ridge are rated as "outstanding." Cores rated as "high" include one to the east of North and South Mountain Road and one straddling the boundary with the Town of Shawangunk. Other lower rated cores are still important for the reasons described above, considering the value they provide to the adjacent natural and human communities.

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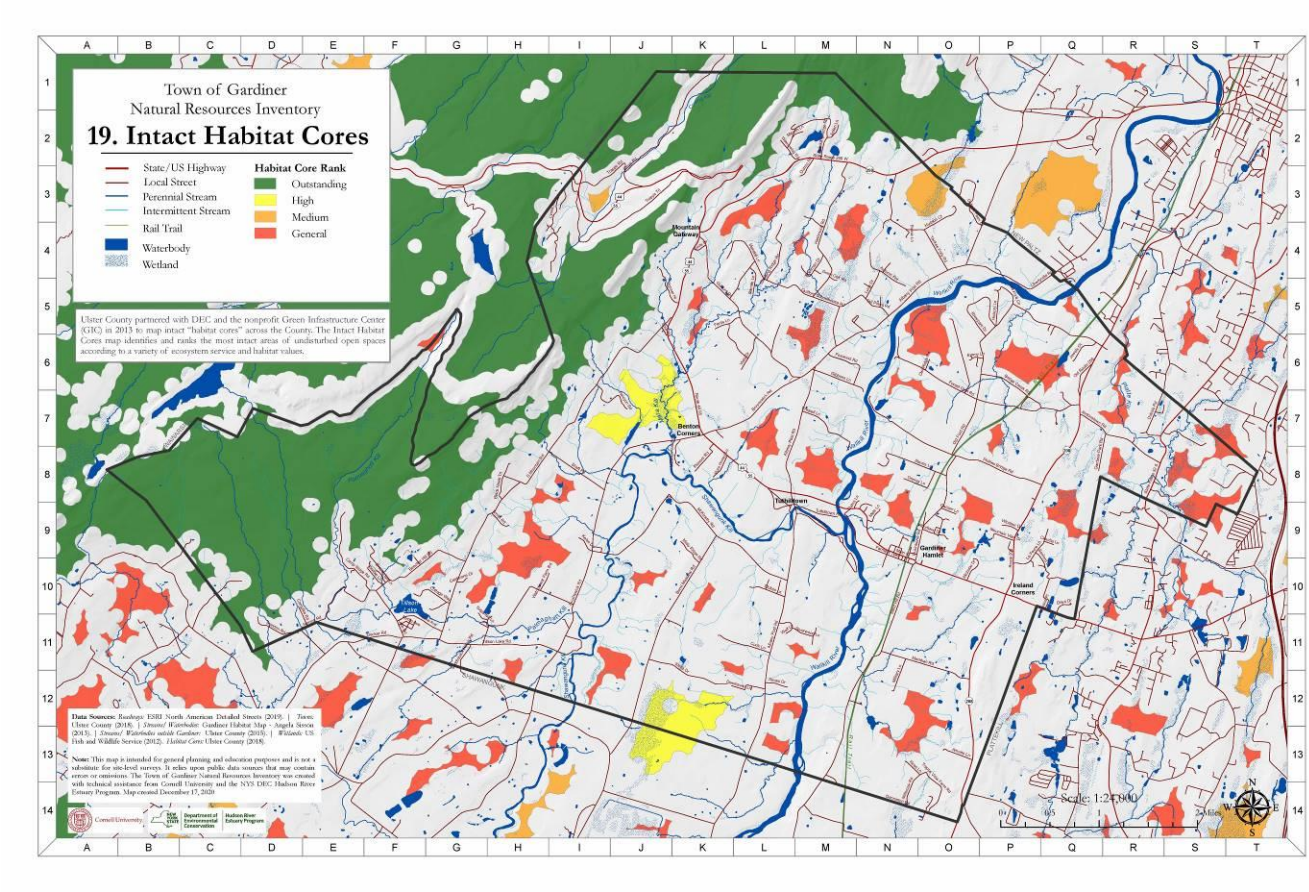
[84] Firehock, K. Evaluating and Conserving Green Infrastructure Across the Landscape: A Practitioner's Guide for New York. Green Infrastructure Center, Charlottesville, VA, 2013. Ulster County case study available at http://www.gicinc.org/PDFs/GIC%20NY-Practitioners%20Guide-Chapter%205-reduced.pdf

[85] Ibid., pg. 87

[86] Firehock, K. 2013. Evaluating and Conserving Green Infrastructure across the Landscape: A Practitioner's Guide for New York. Green Infrastructure Center, Charlottesville, VA. Ulster County case study available at http://www.gicinc.org/PDFs/GIC%20NY-Practitioners%20Guide-Chapter%205-reduced.pdf

Gardiner's intact habitat cores represent significant natural "green infrastructure" on the landscape providing clean air and water and valuable ecological functions that are otherwise costly to replicate through costly engineering. Habitat cores provide pathways for wildlife, protect water and air quality, and support natural resources industries such as farming, forestry and recreation. They can be used to inform local planning and prioritization for conservation.



Climate Resilience for Biodiversity (Map 20)

Areas with diverse physical environments, complex topography, and connected habitats are most likely to support a diversity of plants and animals *today*, and into the future.

Climate change is slowly bringing profound changes to natural communities in Gardiner. Warming temperatures and changing precipitation patterns will make conditions less hospitable for some of the local flora and fauna – and more hospitable to other species, including newcomers. This process is shifting species ranges and rearranging habitats in ways that are difficult to predict. The locations of rare species or important natural communities may change. Common habitats providing important ecosystem benefits to the Town will also be affected. These include large intact forests, wetlands, and stream corridors that support stormwater management, flood control, aquifer recharge, climate moderation, and carbon sequestration.

In a dynamic, changing environment, it is important to identify natural areas most likely to support biodiversity and ecosystem benefits into the future. Conserving these "strongholds" for nature will ensure that plants and animals have places to move and adapt as local climate conditions change. Conserving resilient sites for nature will also contribute to Gardiner's adaptation and resilience to flooding, extreme heat, and other climate-related hazards.

The Climate Resilience for Biodiversity Map shows climate resilience values from the Nature Conservancy's *Resilient Sites for Terrestrial Conservation*[87] and *Resilient and Connected Landscapes*[88] projects. Modeling for climate resilience was based on three primary attributes: geodiversity (diversity of physical environments), topographic complexity, and landscape connectedness. Sites that have diverse physical environments, complex topography, and connected habitats are places most likely to support a diversity of plants, animals, and habitats today and in the future.

- **Geodiversity** reflects unique combinations of geology, elevation, and landforms. Ecosystem and species diversity relate strongly to their associated geophysical settings. Conserving a range of physical environments will in turn protect a diversity of plants and animals under both current and future climates.

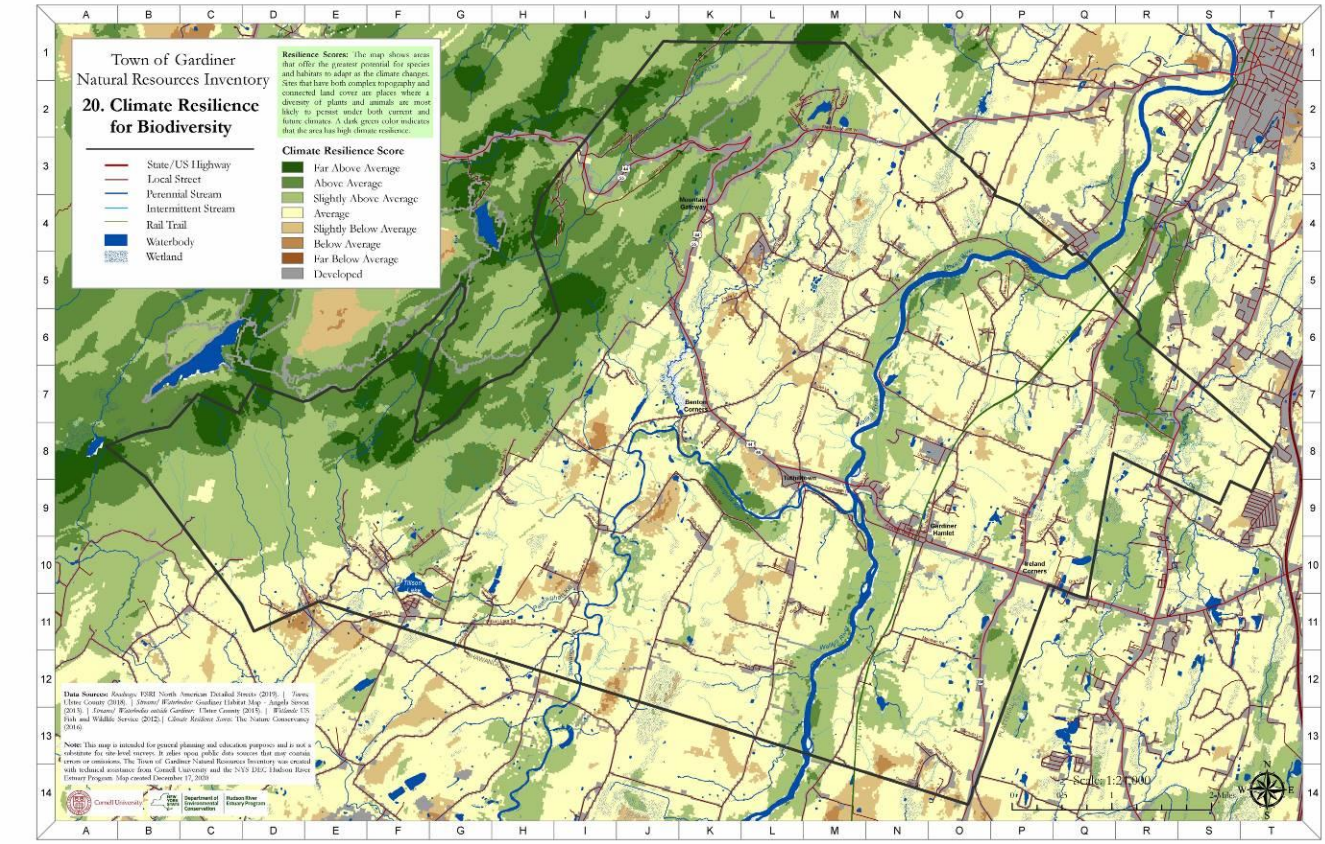
[87] Anderson, M.G., M. Clark, and A. Olivero Sheldon. 2012. Resilient Sites for Terrestrial Conservation in the Northeast and Mid-Atlantic Region. The Nature Conservancy, Eastern Conservation Science.

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

- **Complex topography** is important because it creates a range of temperature and moisture options for the species, providing a variety of local microclimates. Factors that create microclimates include slope, aspect (i.e. north vs. south-facing), shade, and proximity to waterbodies.
- **Connected landscapes** are places that allow species to move and disperse, and processes like water movement can occur unimpeded. Maintaining a connected area in which species can move ensures that the area can adapt to climate change.

On the map, dark green indicates high estimated resilience. Brown indicates areas vulnerable to climate change. The areas in Gardiner that have the highest Climate Resilience Score are generally associated with the Shawangunk Ridge, however, other important areas include portions of stream corridors along the Platte Kill, Shawangunk Kill, and other tributaries of the Wallkill.

Amphibians, like this red-spotted newt, require connected landscapes to persist in a warming climate.
Roberta Clements



Section 6: Land Use

Zoning

The Zoning Map, created in 2019 by Angela Sisson, illustrates land use regulations that apply to real property in the Town.

> *"The power to enact local laws [including zoning] is granted by the State Constitution. The scope of this power and the procedures for implementing it are set out in the* ***Municipal Home Rule Law****. A local law has the same status as an act of the State Legislature."*
>
> - NYS Department of State

Zoning

Cities, towns and villages in New York State are authorized by state statutes (called "zoning enabling laws") to regulate the use of land by enacting what is commonly referred to as "zoning." Zoning governs the way land in a municipality is used and developed. Its goal is to carry out the municipality's long-range land use objectives. Zoning regulates the uses to which property may be devoted, the siting of development on land, and the density of development on property. Typically, zoning laws divide the community into land use districts and establish building restrictions regarding building height, lot area coverage, the dimension of structures, and other aspects of building and land use. New York is a "home rule" state and municipalities have the choice of whether to implement zoning.

The Town of Gardiner has divided the municipality into seven primary zoning districts with four overlay districts, shown on the official zoning map. Zoning districts include:

- Commercial Light Industry (CLI)
- Highway Commercial (HC)
- Hamlet Mixed-use (HM)
- Hamlet Residential (HR)
- Ohioville Acres (PDD)
- Rural Agricultural (RA)
- Shawangunk Ridge Protection (SP1-3)
- Floodplain (FPO)
- Hamlet Expansion (HEO)
- Mobile Home Floating District (MHF)
- Scenic Protection (SPO)

The Shawangunk Ridge Protection District is divided into three sub-districts with SP-1 being the least restrictive and SP-3 being the most restrictive. Restrictions include minimum lot sizes, maximum building heights, maximum building size and impervious area, and in some cases the transfer of development rights on portions of the property via a conservation easement.[89] SP zones are displayed as an overlay on copies of several of the NRI maps, including the Base Map, Aquifer Recharge Areas, Ecological Context, Unique Upland Habitats, and Important Biodiversity Areas.

[89] Shawangunk Protection District. Town of Gardiner Zoning Code. https://ecode360.com/9151593?highlight=sp&searchId=23814241968452719

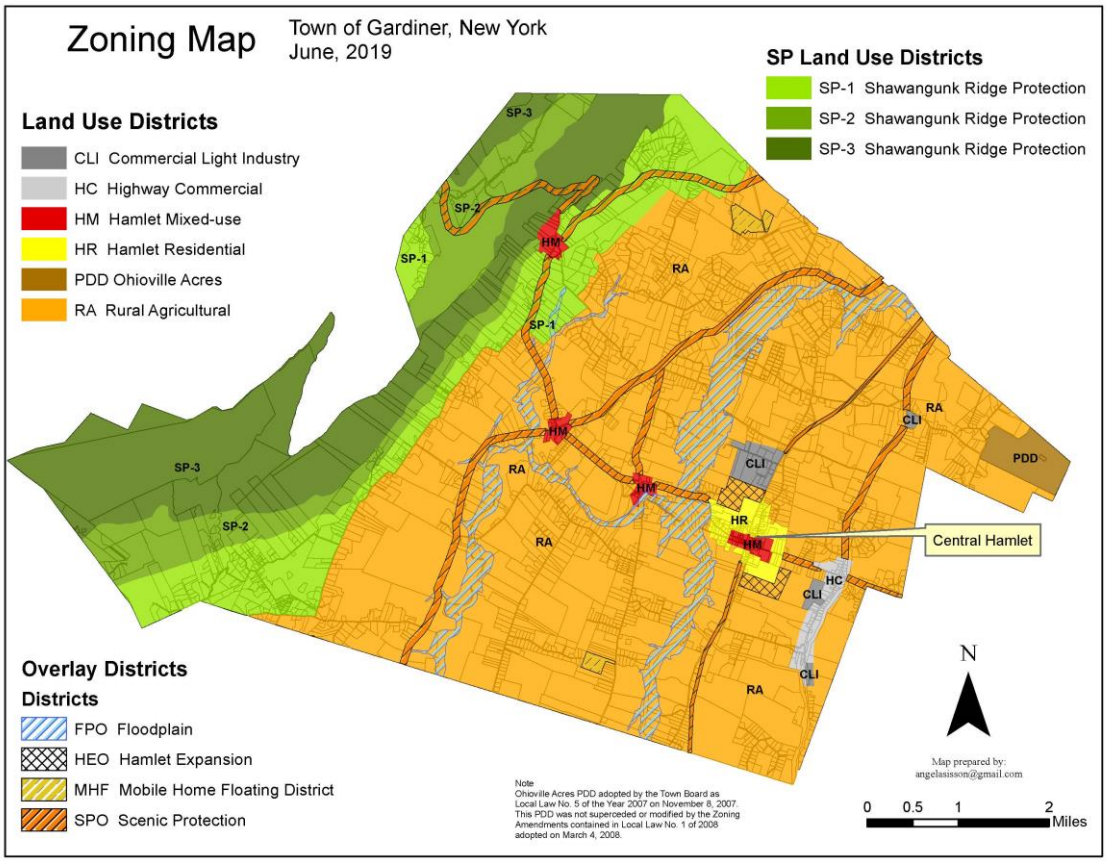


Figure 3. Zoning map for the Town of Gardiner.

Overlay districts maintain the restrictions set forth in their underlying districts, however, they include additional regulations, often associated with a feature that crosses district boundaries. One example in the Town of Gardiner is the floodplain district, which imposes additional regulations on areas within the FEMA-mapped floodplain areas in Town.[90] The Scenic Protection Overlay District is designed to protect the views from designated scenic roads and the Wallkill Valley Rail Trail by requiring Planning Board review of a variety of potential actions.[91]

Examining the zoning map in relation to other maps of the Natural Resources Inventory can provide insight into potential development scenarios that could affect the existing natural resource base, ecology, and other significant features. This map is also useful when viewed in relation to the other NRI maps and can inform decisions about how to update the comprehensive plan and zoning districts.

[90] Floodplain Overlay District. Town of Gardiner Zoning Code. https://ecode360.com/9151543?highlight=floodplain&searchId=23813509156307117

[91] Scenic Protection Overlay District. Town of Gardiner Zoning Code. https://ecode360.com/9151543?highlight=floodplain&searchId=23813509156307117

Agricultural Resources (Map 21)

The Agricultural Resources Map shows the distribution of high quality farmland soils and designated agricultural districts in the Town.

Soils

Successful agriculture requires quality soils. High-quality soils require less fertilizer and nutrients inputs, leading to lower costs and higher production rates. Prime Farmland Soils as defined by the USDA and New York State are considered the most productive soils for farming.[1] Farmland Soils of Statewide Importance are soils that do not meet all criteria for Prime Farmland. Though not as productive as Prime Farmland, if managed properly, these soils can produce fair to good yields. There are soils conducive to agriculture found across the Town. With the exception of the Shawangunk Ridge, most of Gardiner supports important agricultural soils. Soils adjacent to the Wallkill River and Shawangunk Kill are particularly fertile.

Tax Exemptions and Agricultural Districts

State Agricultural District designation entitles landowners to a mix of incentives aimed at preventing the conversion of farmland to non-agricultural uses. Agricultural tax exemptions limit local property tax liability to a prescribed agricultural assessment value. Properties with an agricultural exemption in 2020 are shown on the map as "Active Agricultural Parcels." In Gardiner, Agricultural Districts and tax exemptions are widespread and generally mirror those areas with concentrations of important soils. Farm products in the Town are diverse, ranging from orchards and vineyards to vegetable and Community Supported Agriculture operations, to livestock farms.

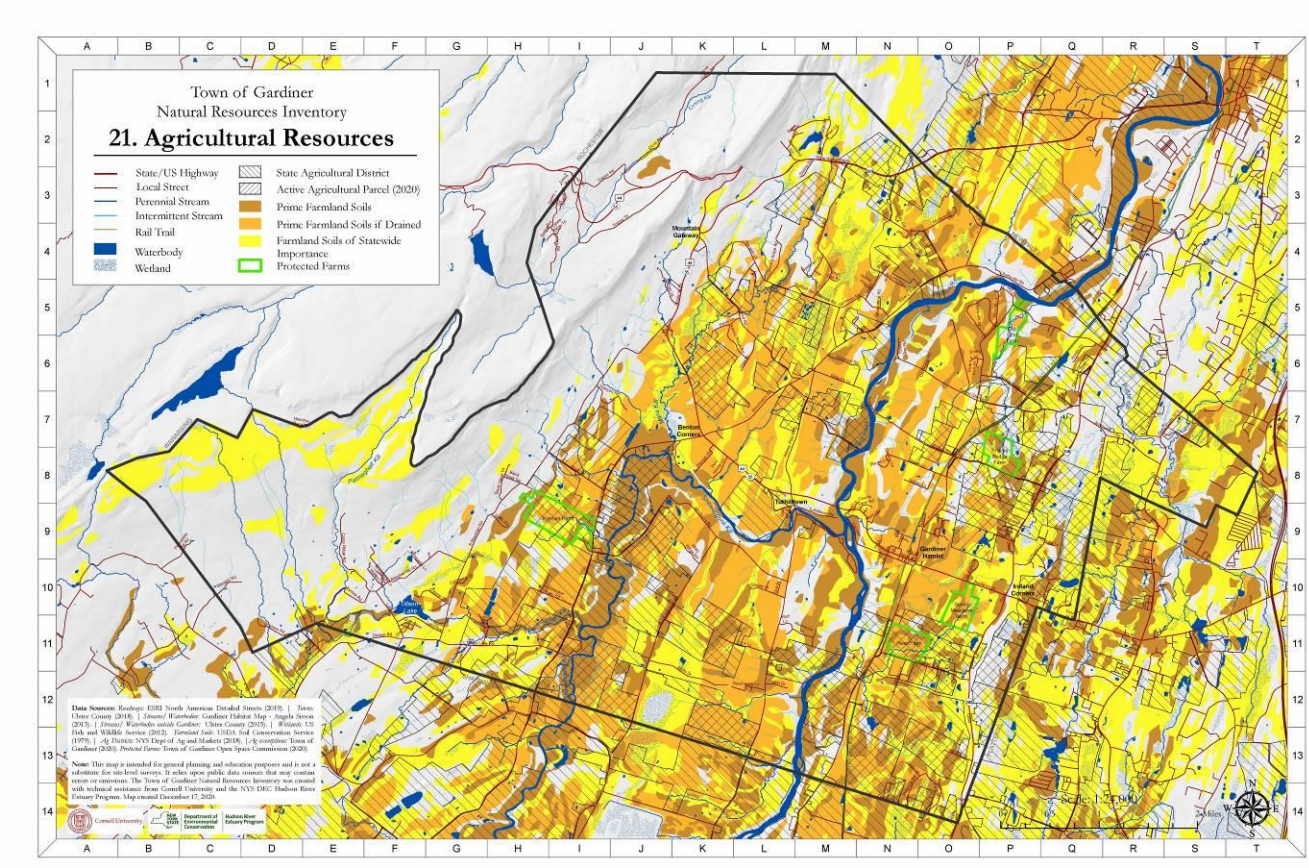
Protected Farms

Protected Farms are privately-owned agricultural lands that are protected from certain forms of development through a conservation easement. A conservation easement is a voluntary legal agreement between a landowner and a land trust or government agency that permanently limits uses of the land in order to protect its conservation values. For more information on protected farms, see the Preserved Land section (Map 22).

The **NYS Agricultural Districts Law** allows for state review of local laws affecting farms located within an agricultural district. In cases where a local law is determined to be unreasonable, the NYS Department of Agriculture and Markets will work with the local government to develop mutually acceptable alternatives.

Phillies Bridge Farm is an example of the Community Supported Agriculture (CSA) model of farming. *Phillies Bridge Farm*

Large areas of farmland can promote a critical mass of farming, which is important to the long-term viability of agriculture in the Town and in the County. Understanding the distribution of these agricultural resources should be an important consideration in Town planning and development management processes. Growing food locally can benefit the local economy, the environment, and the health and welfare of the community, if sustainable agricultural practices are used. In addition to providing the community with a local source of crops, livestock, and economic benefits, farmlands can also serve as an important source of food and cover for wildlife, and provided certain practices are used, can help control flooding and protect wetlands and watersheds. Farmland also contributes to scenic beauty and open space.



Preserved Land (Map 22)

Access to parks and open space within a community brings substantial social, environmental, economic, and health benefits.[92] These places help define a Town by giving residents opportunities to enjoy the natural beauty of the region and provide areas to promote relaxation and exercise.

A variety of parks, conservation easements, public lands, and other preserved lands in the Town were identified by Gardiner's Open Space Commission in 2019 and updated in 2020 using Ulster County tax parcel records and data provided Ulster County Information Services, Minnewaska State Park, the Mohonk Preserve, the Wallkill Valley Land Trust, the Open Space Institute, The Town of Gardiner's assessor, Locust Grove Estate, Riverpark Homeowner's Association and private landowners.

*It is reasonable to state that Mohonk Preserve, Minnewaska, and Sam's Point have a combined economic impact on the local area of about **$12.3 million** and support **358 local jobs**.*

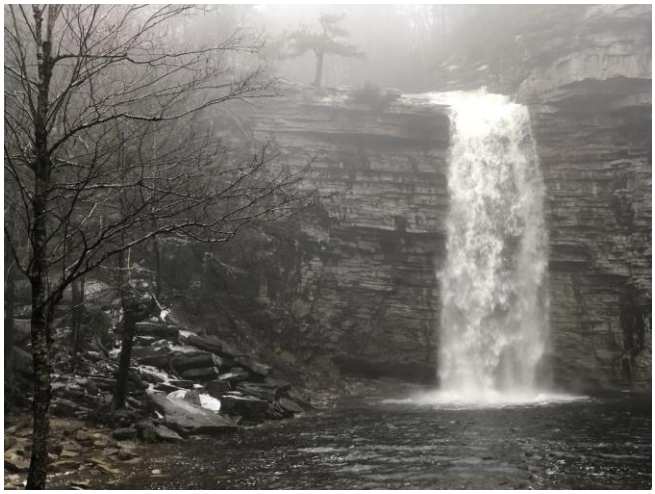
- 2010 Study of the Economic Impact on the Local Economy of Minnewaska State Park Preserve, Mohonk Preserve, and Sam's Point Preserve

The Gardiner Open Space Commission's responsibilities include advising and assisting the Town in protecting the important resources identified in the Town's 2006 Open Space Plan. More information is available on the Town website at https://www.townofgardiner.org/open-space-commission.

Table 6. Public and Protected Land in the Town of Gardiner

Landowner	Acres
Minnewaska State Park	2,890
Mohonk Preserve	1,966
Town of Gardiner	275
Other landowners*	1,450
Total Protected Land*	**6,581**

*Approximate. Includes Conservation Easements.

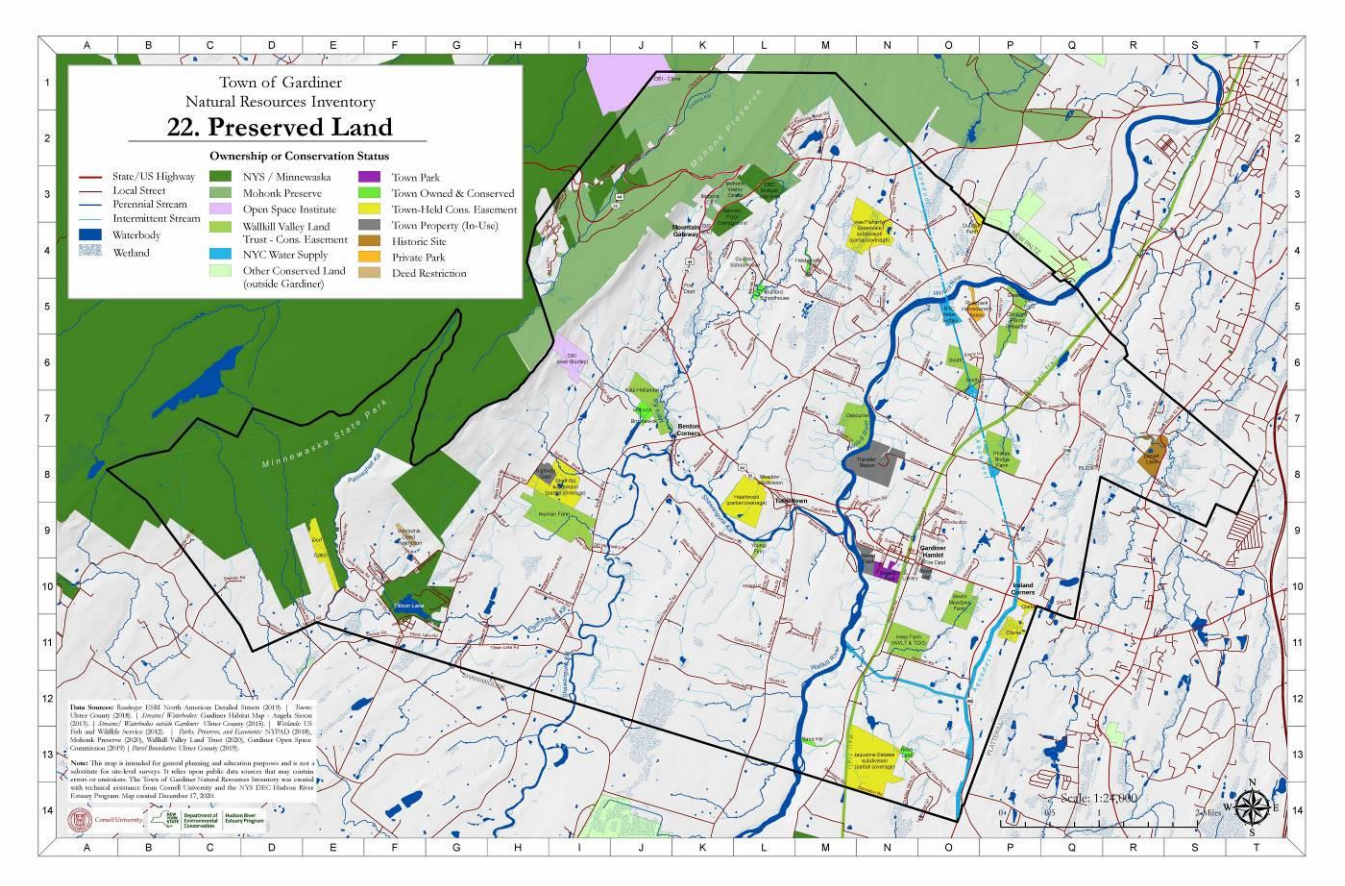


Awosting Falls, located in Minnewaska State Park, is one of many dramatic features that draw thousands of visitors to the Gardiner area each year. *Roberta Clements*

A conservation easement is a voluntary legal agreement between a landowner and a land trust or government agency that permanently limits uses of the land in order to protect its conservation values. Landowners retain many of their rights, including the

[92] Sherer, P. M. *The Benefits of Parks: Why America Needs More City Parks and Open Space*. 2006

right to own and use the land, sell it and pass it on to their heirs.[93] Local lands trusts, such and the Wallkill Valley Land Trust and Mohonk Preserve, have established conservation easement programs and may purchase land directly to help residents preserve their land for future generations. The Town of Gardiner also accepts conservation easements. The US Department of Agriculture's Natural Resource Conservation Service (NRCS) also offers voluntary easement programs to landowners who want to maintain or enhance their land in a way beneficial to agriculture and/or the environment.[94]



Trails

Safe access for pedestrians and bicycles allows residents to use alternate forms of transportation, which helps reduce car congestion, increases overall health of the community, and provides economic benefits.[5] In recent decades, shared-use bicycle and pedestrian paths have become a trademark of "livable" communities, making them more attractive to potential home buyers and businesses. Trails have become increasingly important to the tourism economy of the region, as thousands flock to parks on the Ridge or towns in the valley as a close-to-home escape. The Wallkill Valley Rail Trail, which is a great example of this type of free resource, is managed by the Wallkill Valley Land Trust and, in Gardiner, the Town of Gardiner. The trail begins in and traverses 5.5 miles through the Town of Gardiner, continuing through several towns to the City of Kingston. A portion of the trail north of

[93] "What can you do?" Land Trust Alliance. https://www.landtrustalliance.org/what-you-can-do/conserve-your-land/questions

[94] "Protecting and Enhancing our Natural Resources. USDA Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements

Gardiner is designated as a part of the newly established Empire State Trail. Numerous other trails can be found at the Mohonk Preserve, Minnewaska State Park and in the Town Park. Volunteers are working on creating a new trail in the beautiful acreage of Gardiner's Transfer Station.

The Preserved Land map can help Gardiner consider how projects adjacent to parks, existing conserved space, open space, and trails may impact the value residents gain from these areas, as well as ways to maintain and enhance habitat connectivity between preserves and other protected lands. This map can also help identify opportunities to grow and connect parks, preserves, paths, and trails as new projects arise. As new projects arise, the Town should use site plan and subdivision reviews to consider creating and maintaining habitat connections for the movement of plants and animals. It should also consider creating new connections among parks and trails, and the potential to create connections among future trails, for pedestrian mobility and accessibility. (Creating connections for pedestrians can also advance habitat connectivity objectives.) In order to accomplish these objectives, private land can be put under a conservation easement or conveyed to the Town, Mohonk Preserve, the State of New York, Wallkill Valley Land Trust, or other appropriate entity.

Cultural Resources (Map 23)

The Town of Gardiner has a wide variety of cultural resources, which include recreational lands, national and locally-significant historic sites, tourist-focused byways, and scenic vistas. While many of these community assets are not generally considered "natural" resources, they are fundamental to Gardiner's character and are therefore included in this report.

Although we lack mapped information about indigenous settlement in Gardiner, it must be acknowledged. Native Americans settled the Hudson Valley region between 6,000 and 4,000 years ago. The first inhabitants in the Gardiner area of the Hudson Valley were the Lenape and spoke a dialect known as Munsee, and are thus also known as the Munsee Lenape.[95] They cleared and farmed fertile bottomlands of river valleys and hunted, fished, and gathered foods from surrounding areas. European settlement in the 1600s brought deadly diseases and warfare. Conflicts with European settlers led to the displacement of Munsee Lenape people, who were forced to move westward to reservations. Today, the descendants of Munsee Lenape people are federally-recognized as the Stockbridge-Munsee Mohican Nation and are based in Wisconsin.

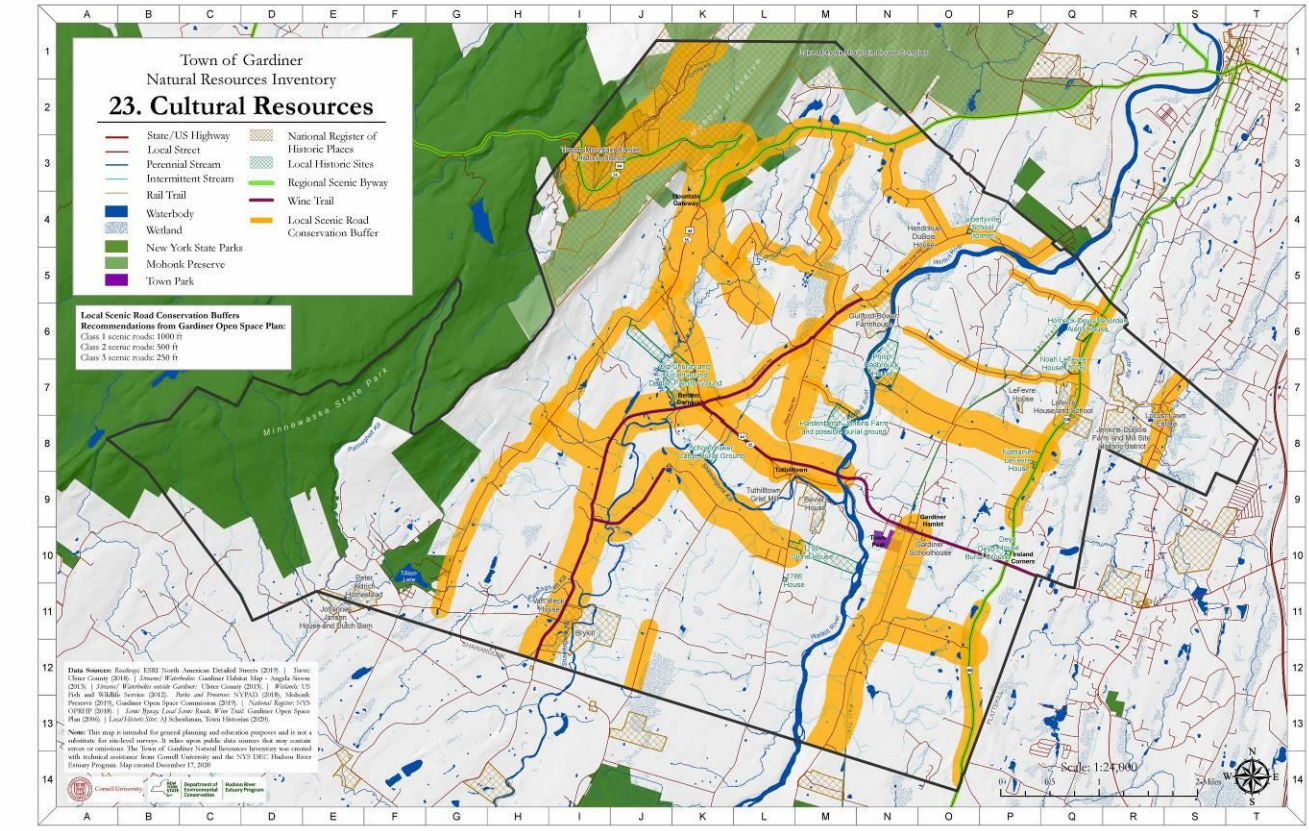
Parks and Preserves
Parks and preserves include lands managed by the Town of Gardiner, New York State or the Mohonk Preserve as a public preserve or parkland. Entry fees apply to both Minnewaska State Park and Mohonk Preserve and can vary based on the type of recreation (i.e. climbing, hiking, skiing, or biking).

National Register of Historic Places
Maintained by the United States National Park Service, the register documents significant historic places found in the United States. Official designation can result in:

- Increased visibility during local land use planning
- Federal income tax incentives
- Eligibility for grant funding

For more information, visit the National Parks Service website:
https://www.nps.gov/subjects/nationalregister/national-register-and-rehabilitation-tax-credits.htm

[95] Levine, D. "Discover the Hudson Valley's Native American History," Hudson Valley Magazine, https://hvmag.com/life-style/history/hudson-valley-tribes/



Local Historic Sites

In addition to the sites listed on the National Register of Historic Places, the Town of Gardiner has many other locally recognized sites. The list below was graciously completed with contributions from current Town Historian A.J. Schenkman and previous Town Historian Leroy Carlson. For more information on the Town of Gardiner's history and the history of the wider Wallkill Valley, please visit the Historical Society of Gardiner and Shawangunk website.

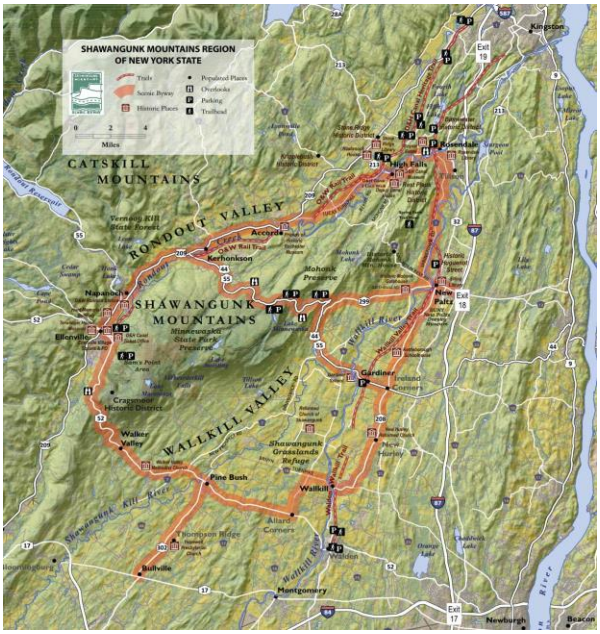
- Noah LeFevre House 1776
- Stone House - Possibly Hasbrouck 1790
- Rail Bridge 1910
- Abraham-Maria Lefevre House ca. 1742
- Abraham P. Lefevre House ca. 1772
- Bevier House* ca. 1850
- Brykill* 1724
- Bruynswick Burial Ground ca. 1843
- Constable Burial Ground ca. 1799

- Daniel Deyo House (J.G. Ronk House) 1745
- Deyo Burial grounds of historic families
- Deyo House, Currently Ulster Savings Bank 1870
- Gardiner School* (Town Hall) 1875
- Shawangunk Gristmill (foundation and sluiceway) predates Tutthill ca 1750
- Guilford Bower Farmhouse* 1850
- Hardenbergh-Jenkins Farm(new) 1831 House and possible Burial Ground
- Hendrickus Hasbrouck House* 1775
- Horneck-Deyo-Vanorden, Aiello House 321 Route 208 (Kettleboro) 1830
- Jenkins-DuBois Farm and Mill Site 1793
- John A. Lefevre House * 1772
- Kettleboro School House* 1835
- Locust Lawn Estate* Evert Terwilliger House 1738
- Mohonk Mountain House (partial) 1869
- Nathaniel Lefevre House (Boy's Industrial Colony) currently McCord Farm 1840
- Old Church and Burial Ground, Denton Family Ground,, Benton Corners, ca. 1738
- Peter Aldrich Homestead* 1750
- Philip Hasbrouck House
- Phillies Bridge Farm (1742) foundati(1745) house (1850)
- Schoonmaker Large Burial Ground ca. 1815
- Trapps Mountain Hamlet Historic District* ca. 1800
- Tuthilltown Gristmill *(old center of Gardiner) 1788
- Ulster County Poorhouse Site (Fairgrounds) 1828
- VanVleck House* ca. 1800

* Denotes placement on the National Historic Register

Regional Scenic Byway

The Shawangunk Mountains Scenic Byway is a state-recognized 88-mile route which encircles the northern Shawangunk Mountains and travels through the beautiful Rondout and Wallkill Valleys. This byway links communities that have a common relationship to the northern Shawangunks and highlights a distinct region of the state with its own special character. The Shawangunk Mountains Regional Partnership includes the towns of Crawford, Gardiner, Marbletown, Montgomery, New Paltz, Rochester, Rosendale, Shawangunk, and Wawarsing, and the villages of Ellenville and New Paltz. It is the management organization for the Shawangunk Mountains Scenic Byway.[96] The following publications were designed to assist local communities in protecting the scenic character that catalyzed the creation of the byway:



Map of the Shawangunk Mountains Scenic Byway

- **A Guide for Planning Boards**
- **Corridor Management Plan**
- **Open Space Plan**

Wine Trail

The Shawangunk Wine Trail is home to 15 wineries nestled between the Shawangunk Mountains and the Hudson River including the oldest winery in America, Brotherhood, located in Washingtonville, NY. In the Town of Gardiner, there are two wineries on the Wine Trail; Whitecliff Vineyard and Winery and Robibero Winery.[97]

Local Scenic Road Conservation Buffer

In addition to being part of the regional Shawangunk Mountains Scenic Byway, there are approximately 49 miles of locally-designated scenic roads in Gardiner. Scenic roads were identified around the year 2006 through a windshield survey conducted by an Open Space Commission member and a volunteer with expertise in scenic resources. The roads were ranked on a 3-point scale, with Class 1 being the most scenic. Characteristics which contribute to the scenic nature of a roadway that were evaluated include agricultural landscapes; open views of the Shawangunk Ridge and other hills and valleys; natural features such as streams, rivers, creeks, undeveloped woodlands or open meadows; and historical buildings or landscapes.

[96] *Shawanagunk Mountains Scenic Byway*. https://www.mtnscenicbyway.org/

[97] *Shawangunk Wine Trail.* https://www.shawangunkwinetrail.com/

An example of a Class I road is Route 7/Bruynswick Road, from which there are exceptional views of open farmlands backed by cliffs of the Shawangunk Ridge. Another example is Marabac Road in the eastern part of town from which views of the Wallkill River and the Shawangunk Ridge provide the background to farms and woods.

The Town's scenic roads provide views of open farmlands and a diverse composition of many different elements that extend well beyond the road corridor. Scenic roads are identified and "buffered" as a way to identify linear corridors with scenic resources worthy of protection. However, in order to truly preserve the Town's scenic resources at the town scale, a more comprehensive "landscape-based" approach is required.[98]

View of the Shawangunk Ridge from the Wallkill Valley. *Roberta Clements*

Scenic Views

Gardiner's distinct natural beauty is recognized on a local, state, and national level. Gardiner is increasingly desirable as a place to live, work, and visit. The Scenic Resources in the Shawangunk Mountains Region: A Guide for Planning Boards defines scenic resources as "public or publicly accessible areas, features, patterns and sites that are recognizable, visited and enjoyed by the public for their visual and aesthetically pleasing qualities and which contribute to a community's distinct character."[99]

In addition to creating a community's sense of place, views of nature can have direct economic and health impacts, benefiting tourists and residents alike. Natural scenery is the backdrop for New York State's nearly 115 billion dollar tourism industry; the state's third largest employer.[100] Residents also enjoy viewing nature, either through active recreation or by admiring it as they go about their daily business. Numerous studies document the health benefits of simply looking at trees, which include reduced stress, improved mental health, increased academic performance, and enhanced social cohesion.[101] The Town of Gardiner has recognized this through adoption of a Scenic Protection Overlay District, which expands Planning Board review to a wide range of projects within the district.

Nearly every spot in Gardiner provides natural scenic beauty. Some examples include views from the

[98] Gardiner Open Space Plan, 2007, pg. 20. https://www.townofgardiner.org/open-space-plan.

[99] Scenic Resources in the Shawangunk Mountains: A Guide for Planning Boards. LandWorks. 2012

[100] "Tourism." Empire State Development. https://esd.ny.gov/industries/tourism.

[101] Bowyer, J., S. Bratkovich, K. Fernholz, J. Howe, H. Groot, E. Pepke. *The Human Health and Social Benefits of Urban Forests.* Dovetail Partners Inc. 2016. https://www.dec.ny.gov/docs/lands_forests_pdf/ucfdovetail2016rpt.pdf.

ridge overlook on Route 44/55, from “Gertrude’s Nose” in Minnewaska State Park, of the Walkill River from its banks or a kayak, of agricultural vistas of lowing cattle, of enticing vineyards, apple orchards, and corn fields, of historic Tuthilltown and stone houses, of the stunning cliffs of the Shawangunks and Mohonk Preserve, and the list continues.

The location of scenic roadways can inform planning and design of new development projects. There are design guidelines available to the Town to help maintain community character and minimize impacts to scenic resources – see Scenic Resources in the Shawangunk Mountains Region: A Guide for Planning Boards.

Conclusion

Potential Future Uses of the NRI

- Create an online map to allow customized viewing of the NRI map layers.
- Discuss adoption of the NRI by local law to specify its use and advance Climate Smart Community certification for the Town of Gardiner.
- Update Planning Board checklists to refer to information in the NRI.
- Explore technical assistance and grants available from the NYS DEC Hudson River Estuary Program to assess and prioritize known aquatic barriers (dams and culverts) for removal or mitigation.
- Identify and map wildlife corridors in the Town.
- Develop an Open Space Inventory to identify priority parcels for conservation.
- Research and propose the designation of Critical Environmental Areas.
- Research possible updates to the Town conservation subdivision regulations.
- Research and discuss the benefits of establishing an Environmental Board.