Natural Areas and Wildlife in Your Community

A Habitat Summary Prepared for the Town of Germantown

December 2013

This summary was requested by the Town of Germantown to provide information for land use planning and decision-making. It identifies major ecological features and significant habitats in the town, including streams, forests, wetlands, and other natural areas with important biological values. This summary is based only on existing information available to the New York State Department of Environmental Conservation (NYSDEC) and its partners, and therefore should not be considered a complete inventory. Additional information about habitats in our region can be found in the *Wildlife and Habitat Conservation Framework* developed by the Hudson River Estuary Program (Penhollow et al. 2006) and in the *Biodiversity Assessment Manual for the Hudson River Estuary Corridor* developed by Hudsonia and published by NYSDEC (Kiviat and Stevens 2001).

Ecosystems of the estuary watershed—wetlands, forests, stream corridors, grasslands, and shrublands—are not only habitat for abundant fish and wildlife, but also support the estuary and provide many vital benefits to human communities. These ecosystems help to keep drinking water and air clean, moderate temperature, filter pollutants, and absorb floodwaters. They also provide opportunity for outdoor recreation and education, and create the scenery and sense of place that is unique to the Hudson Valley. Local land-use planning efforts are instrumental in balancing future development with protection of these resources. By conserving sufficient habitat to support the region's astonishing diversity of plants and animals, communities can ensure that healthy, resilient ecosystems—and the benefits they provide—are available to future generations. For more information on local conservation approaches, see *Conserving Natural Areas and Wildlife in Your Community: Smart Growth Strategies for Protecting the Biological Diversity of New York's Hudson River Valley* (Strong 2008).

To further support land use and conservation planning efforts in the Town of Germantown, this Natural Areas and Habitat Summary is supplemented by Water Resource and Climate Resilience Summaries.

Hudson River Estuary

Cornell University

This document was created by the New York State Department of Environmental Conservation's (NYSDEC) Hudson River Estuary Program and Cornell University's Department of Natural Resources. The Hudson River Estuary Program (http://www.dec.ny.gov/lands/4920.html) protects and improves the natural and scenic Hudson River watershed for all its residents. The program was created in 1987 and extends from the Troy dam to upper New York Harbor.

The Hudson River Estuary Program is funded by the NYS Environmental Protection Fund. The Biodiversity Outreach Program was created in partnership with Cornell University to help Hudson Valley communities learn what plants, animals, and habitats are found locally; understand the value of these resources; and increase their capacity to identify, prioritize, and conserve important natural areas through informed decision-making.

Additional information about habitats and the state of habitats in the Hudson Valley can be found on NYSDEC's webpages, starting with http://www.dec.ny.gov/lands/5094.html.

The core mission of the Hudson River Estuary Program is to:

- *Ensure clean water*
- *Protect and restore fish, wildlife and their habitats*
- *Provide water recreation and river access*
- *Adapt to climate change*
- *Conserve world-famous scenery*

For more information about this summary or the Estuary Program, please contact:

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Summary Content

This summary includes complementary text, maps, and tables. The Habitat Summary text describes the town's important known habitats and has the same headings as the maps. It details the information in the maps, including its sources and the data's ecological importance. There are six habitat summary maps for Germantown, which follow the Habitat Summary text:

Descriptions of grassland and young forest (including shrubland) habitats are included but not mapped. Following the maps, Tables 1-4 list known species and habitats of conservation concern recorded for Germantown.

At the end of the summary, references identify the sources of the information in this document and places to find more information. Some general conservation measures for protecting natural areas and wildlife are provided.

The summary presents available information about species and habitats of regional conservation concern in Germantown, including many records obtained from the Farmscape Ecology Program at Hawthorne Valley Farm. The program has been working in Columbia County to understand the relationships among agriculture, natural areas, and socio-economics. Extensive county-wide fieldwork by these researchers makes them an especially useful source.

Throughout this document, links will direct you to more information online - websites, publications, and fact sheets. In addition, viewing the maps in Adobe Reader will enable you to zoom in and turn off data layers.

Please note that some habitats and species identified in this document may be protected by state or federal programs. Please continue to work with DEC's Region 4 Office in Schenectady and other appropriate agencies as necessary. The Environmental Resource Mapper on NYSDEC's website can help identify those resources.

How to Use this Summary

This summary is limited to existing information and is not a substitute for on-the-ground survey and assessment; however, it provides a starting point for recognizing important natural areas in the town and surrounding areas. Effective conservation occurs across property and political boundaries and, therefore, necessitates a broader view of natural landscapes. By identifying areas with high-quality resources, this summary will be especially useful for setting priorities that support town planning. Habitat summaries like this one have been used by other communities for open space plans, comprehensive plans and natural resource inventories, and for developing critical environmental areas. One Hudson Valley town used the species lists in its comprehensive plan's generic environmental impact statement, another to designate critical environmental areas. Some communities have incorporated their summaries directly into plans, while others use the information to write their own documents.

Though this summary does not contain the detail needed for site planning, it is useful for environmental review. First, a good inventory makes it easier to review projects. By identifying high-quality habitats on a town-wide scale, it helps land-use decision-makers and applicants understand how a proposed site plan might relate to important areas off- site. Second, the summary informs environmental review by highlighting areas that might need a more detailed assessment. Third, the species lists identify species of conservation concern that may warrant attention during reviews. The planning board should consider requiring applicants to produce a letter from the New York Natural Heritage Program that identifies any rare plants, rare animals, and significant ecosystems that are known to be on or near a proposed development site. The planning board and applicants should also work closely with DEC Region 4 permits staff to ensure regulatory requirements are met.

Limitations of Maps in this Summary

Maps included here were created in a geographic information system, or GIS. Information on the maps comes from different sources, produced at different times and for different purposes. It is often collected or developed from remotely-sensed information (i.e., aerial photographs, satellite imagery) or derived from paper maps. For these reasons, GIS data often contain all the inaccuracies of the original data, in addition to any errors from 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 on the ground for legal purposes, including environmental review.

Conservation

Once you understand the kinds of habitats in town, you may want to identify conservation actions to protect resources and the benefits they provide to the community. Included with this summary are general conservation measures for protecting natural areas and wildlife that can help guide Germantown's plans and land-use decisions. More detailed information on the how and why of local habitat conservation is available in *Conserving Natural Areas in Your Community: Smart Growth Strategies for Protecting the Biological Diversity of New York's Hudson River Valley* (Strong 2008). This handbook was published by NYSDEC to support the Hudson River Estuary Biodiversity Outreach

Program. It details why towns should conserve their biological resources, as well as the tools and techniques local governments can use to conserve natural areas and wildlife. Chapter 5 covers habitat conservation. The document is available in CD or hard copy upon request.

Technical assistance is also available through the Hudson River Estuary Program, including assistance with incorporating natural resource conservation principles and information into municipal land-use planning procedures, plans, and policies. The Estuary Program and its partners also provide training to local leaders to recognize and map ecologically significant habitats and communicate their importance to the community. The Hudson River Estuary Grants program supports projects that continue to raise the capacity of municipalities, land trusts and non-profits to identify and assess watershed biodiversity, promote stewardship and conservation of vital habitats and create local conservation programs. For more information on technical assistance opportunities, please contact Ingrid Haeckel, Hudson River Estuary Conservation and Land Use Specialist.

How to Find More Information

Information in this summary can be enhanced by local knowledge. Local studies, maps, plans, and knowledgeable residents can provide details and may reveal previously unknown, high-quality ecosystems. Biological information in environmental impact statements may be useful, especially when a town has standards for environmental review. Additional information may be available in the future from the Farmscape Ecology Program. For help with incorporating additional information into the summary, please contact Ingrid Haeckel, Hudson River Estuary Conservation and Land Use Specialist.

Important Habitats of the Town of Germantown

Landscape Context and Major Natural Features

The first step to understanding the major natural features in Germantown is to consider the town's place in relation to regional features that extend beyond its borders. Figure 1 shows where Germantown lies in the greater Roeliff Jansen Kill (Roe Jan) watershed, on the eastern shore of the Hudson River Estuary, a significant biodiversity area. In addition to these major natural features, this report identifies several high quality habitats throughout Germantown, including coastal and shoreline habitats, streams, streamside forests, wetlands, grasslands, young forests (including shrublands), and large forest blocks. The map of major ecological features (Figure 2) is based on limited available information; it shows the Hudson River and locations of important areas for two rare plants, migratory fish runs, and rare aquatic animals documented by the NY Natural Heritage Program, which are listed in Table 1. Very rare dragonfly and ant species have been documented by the Farmscape Ecology Program in grasslands at Keep Conservation Preserve off of County Rt. 8. Figure 2 also displays Significant Coastal Fish and Wildlife Habitat areas, including the Germantown-Clermont Flats and the lower reaches of the Roeliff Jansen Kill, which have small areas of globally-rare freshwater tidal wetlands and important submerged aquatic vegetation areas. Additional study is necessary to better describe Germantown's natural areas.

Habitats

Hudson River Coastal Habitat

Germantown is bordered to the west by the tidal Hudson River Estuary and to the north by the Roe Jan. The Estuary and part of the Roe Jan are affected by tides, although the water is completely fresh at this distance from New York City (110 miles). The connection to the Atlantic Ocean, upper watershed, and the changing tides make the shore zone a dynamic area. The following description of Hudson River Coastal Habitat in Germantown relies on reports and data from several sources which are noted and discussed separately. Some of the information is publicly available. Figure 3 shows Hudson River coastal and shoreline habitats in more detail than in Figure 2.

This regional landscape is identified as a Significant Biodiversity Area (Upper Hudson River Estuary) by the NYSDEC Hudson River Estuary Program because it is a globally rare ecosystem that supports many rare species as well as regionally important fisheries (Penhollow et al., 2006):

> "The Hudson River Estuary contains significant freshwater and brackish tidal wetlands, as well as other riverine and estuarine habitats, islands, riparian zones, and important tributaries. These habitats support a high diversity of fish, birds, and mammals….The open water, tidal wetlands, and tributaries in the upper reach of the Hudson are regionally important fish spawning habitats for anadromous fish, especially American shad, striped bass, Atlantic sturgeon and shortnose sturgeon, and provide habitat for all life stages of resident freshwater species. The numerous

creeks and tidal freshwater marshes in this stretch serve as breeding, nursery, and migration corridors supporting waterfowl, shorebirds, herons, raptors, and passerine birds. Regionally and globally rare tidal communities include freshwater tidal swamp, freshwater tidal marsh, freshwater intertidal mudflats, and freshwater intertidal shore."

Germantown's Hudson River coastal area encompasses the most biologically significant habitats in the town. Significant plants, animals, and habitats on the Hudson shoreline and tidal tributaries in Germantown include bald eagle, russet-tipped clubtail (a dragonfly), comely shiner (a minnow), globally rare freshwater tidal marshes, an important migratory fish concentration area, two types of rare plants occurring in tidal wetlands, and an important waterfowl concentration area. In addition, the NYS Breeding Bird Atlas recorded possible breeding occurring in the Germantown area of osprey (NY Special Concern) and peregrine falcon (NY Endangered). The endangered fish species shortnose sturgeon is found in the river near Germantown. Table 1 lists all of the rare plants, rare animals, and significant ecosystems found in this major natural area with web links to more information.

Significant Coastal Fish and Wildlife Habitats

There are many different kinds of coastal habitats in New York, including marshes, wetlands, mud and sandflats, beaches, rocky shores, riverine wetlands and riparian corridors, stream, bay and harbor bottoms, submerged aquatic vegetation beds, dunes, old fields, grasslands and woodlands and forests that provide habitat and feeding areas for animals and are also economically important. The NYSDEC has identified and evaluated coastal habitats throughout the state's coastal regions, providing recommendations to the NYS Department of State so that the most important or "significant" habitats may be designated for protection in accordance with the Waterfront Revitalization and Coastal Resources Act. The Significant Coastal Fish and Wildlife Habitats are useful for planning at the local level because they describe the highest quality habitats on the Hudson, outlining fish and wildlife values and activities that may have large impacts on the habitats.

There are two designated Significant Coastal Fish and Wildlife Habitat areas in Germantown, shown on Figure 2: Germantown-Clermont Flats and the Roeliff Jansen Kill. You can find detailed descriptions of these sites at the NYS communities and waterfronts webpage. General information is also provided to assist in evaluating impacts of proposed activities on characteristics of the habitat which are essential to the habitat's values. Both Significant Habitat areas in Germantown are important resident and migratory fish spawning areas, have rare plants, submerged aquatic vegetation, tidal wetlands, and are important for wildlife-related recreation. State and federal law requires that some projects may be reviewed for consistency with coastal policies on significant fish and wildlife habitat. Contact the NYS Department of State Coastal Program for more information on the protection and regulation of these habitats.

Underwater (subtidal) Habitats

Beds of submerged aquatic vegetation (SAV) occur along most of Germantown's Hudson River shoreline (Figure 3). SAV improves the water quality in the Hudson and provides essential habitat for invertebrate animals, which feed fish and waterfowl that use the estuary. Germantown-Clermont Flats is one of the most significant SAV beds in the Hudson River, encompassing approximately 988 acres of shallow,

freshwater, intertidal mud flats extending south from the hamlet of North Germantown into the Town of Clermont. SAV beds in the shallow and intertidal portions of the flats are dominated by wild celery and spatterdock and are an important spawning and nursery area for large concentrations of American shad, alewife, blueback herring, and white perch. Additional SAV beds important for migratory fish spawning and nursery habitat are found at the mouth of the Roe Jan. The town can obtain SAV data for free from the NYS GIS Clearinghouse, which can then be integrated into the local or county GIS system.

Tidal Hudson River Estuary Wetlands

The wetlands along the shoreline of the Hudson in Germantown are both freshwater and tidal, a globally rare ecosystem type. Tidal wetlands serve a very important purpose in the river, not only providing habitat for rare plants and young fish, but other benefits for people like flood attenuation and wastewater dilution/purification. The Natural Heritage Program has mapped rare plants such as golden club and heartleaf plantain in Germantown's tidal wetlands, and historical records from the Farmscape Ecology Program document the presence of eastern wild rice, uncommon in Columbia County. The russet-tipped clubtail, an extremely rare dragonfly, was identified by the Natural Heritage Program along the shoreline at Lasher Park and may occur elsewhere along the Hudson or its tidal tributaries in the town. Larvae of the russet-tipped clubtail are aquatic and inhabit rivers, streams, and large lakes with sandy substrate; adults are terrestrial and occur in surrounding habitats. A 2007 inventory by the NYSDEC identified about 24 acres of tidal wetlands on the Hudson River shoreline in Germantown. Almost two-thirds of the wetlands are upland intertidal mix (8.7 acres) or lower intertidal mix (8.2 acres) but there are also cattail marshes (3.2 acres), invasive water chestnut (1.6 acres), and smaller interspersed areas of other tidal wetland types. All tidal wetland types have been combined to facilitate viewing in Figure 3; however, the town can obtain the finer tidal wetlands data for free from the NYS GIS Clearinghouse.

Tidal Shoreline Status

Natural shorelines provide a vital transition zone between water and land and important habitat for diverse plants, fish and wildlife. Knowing the status of tidal shoreline habitat can help the town guide restoration and management of a more natural shoreline and identify natural shoreline areas that might be priorities for conservation. Furthermore, global sea level rise will fundamentally affect the shoreline of the Hudson River Estuary in the coming decades. Natural shorelines will potentially allow for the migration of tidal and shoreline habitats as sea level rises. For more information on sea level rise and climate resiliency in Germantown, see the accompanying Climate Summary.

Tidal shoreline comprises lands directly on the Hudson River and the shorelines of tidal wetlands, tidal tributaries and coves, including both naturally vegetated and engineered shoreline. Germantown has approximately 6.3 miles of shoreline directly along the Hudson River, about 1.5 miles of which has been engineered (primarily with revetment) to accommodate the Amtrak railroad tracks (Figure 3). The natural shoreline is very narrow in most places because of the railroad line and includes approximately 4.2 miles of woody vegetation and 0.5 miles of grass or herbaceous broadleaf vegetation. Coves on the eastern side of the railroad provide an additional 1.75 miles of shoreline, and the tidal portions of tributaries are also considered shoreline habitat. The first barrier to fish migration on the Roe Jan is a

dam at Bingham Mills, about 7 km from the Hudson near where Mill Road crosses over the stream in the Town of Livingston; if this is also the head of tide then this stretch makes up an important portion of tidal shoreline (Schmidt and Cooper 1996). Historical records from the Farmscape Ecology Program describe an unusual rocky cove and gorge in Cheviot with heartleaf plantain in the cove and mountain maple, a regionally rare, northern species growing on the walls of the gorge; however, fieldwork is necessary to determine if those plants are still present. The town can obtain Hudson River Estuary shoreline habitat data for free from the NYSGIS Clearinghouse.

Although much of Germantown's shoreline is dominated by the Amtrak railroad, there may be opportunities for managing or restoring the habitat value of Hudson River shoreline areas such as public riverfront lands. Shoreline at the Cheviot Boat Dock and Park consists of vertical bulkhead and rip rap revetment with little vegetation. Lasher Park and Boat Dock in North Germantown on Anchorage Road is more natural with grass and woody vegetated shoreline. For more information on managing shorelines, refer to the work of the Hudson River Sustainable Shorelines Project.

Streams

Stream corridors, including the stream channel itself, wetlands, floodplains, and shoreline vegetation bordering the channel provide important ecosystem services to people of the town, including clean water, fishing opportunities, and flood management. Hudson River tributary streams and their associated shoreline and floodplain areas offer some of the most productive wildlife habitat in the region and host both resident and migratory fish populations.

All of the land in Germantown drains to the Hudson River (Figures 1 and 4). The eastern half of the town drains to the Roeliff Jansen Kill, a tributary of the Hudson River. Several smaller streams including Camp Creek drain from the western half of the town directly into the Hudson. The Streams map (Figure 4) shows streams from digitized USGS topographic maps. The USGS stream data may be inaccurate or incomplete and does not show many of the intermittent streams in Germantown.

The New York State Freshwater Conservation Blueprint Project used fish survey data to model migratory fish runs, which are shown on Figure 2 (White et al. 2011). Alewife, blueback herring, and white perch spawn in the lower Roe Jan from the Hudson to below the dam at Bingham Mills between April and June. American eel are able to pass upstream of Bingham Mills to other tributaries of the Roe Jan and also use habitats in Camp Creek. All stream habitats in the town are identified as warm water based on the NYSDEC's water quality classifications and are not known to have trout or trout spawning, although cool water sections of the Roe Jan upstream from Germantown are important trout habitat. Additional information on fish habitats in the Roe Jan is provided in the NYS Department of State's Significant Coastal Fish and Wildlife Habitat description. The mocha emerald, a very rare dragonfly inhabiting small, shaded streams in forested areas has been documented in Germantown at the Keep Conservation Preserve. Its larvae develop in running water, whereas adults are terrestrial and are found in habitats surrounding forested streams. Important areas for the extremely rare russet-tipped clubtail

dragonfly occur along the Hudson River and nearby tributary streams, shown on Figure 2. For more information on dams and other aquatic barriers, see the accompanying Water Resource Summary.

For additional discussion of stream water quality and watershed characteristics in Germantown, see the accompanying Water Resource Summary.

Forests

The ability of forests to provide wildlife habitat, clean water, and economically viable forest products depends in part on our ability to maintain sizeable tracts of forest. The Large Forests map (Figure 5) shows forests 200 acres or larger in Germantown. The map was created from land cover data developed for the Coastal Change Analysis Program (National Oceanic and Atmospheric Administration 2006). Land cover categories considered 'forest' for this analysis include deciduous forest, evergreen forest, mixed forest, and palustrine forested wetland. Forests were divided according to a buffered distance from roads to identify unfragmented forest patches. Interstate roads were buffered by a total of 300 feet, state and county roads by 66 feet. Forest patch size classifications follow the Orange County Open Space Plan (Orange County Planning Department 2004) as cited in Strong (2008).

In general, larger forests provide more benefits to human communities and higher quality forest habitat than smaller ones. However, remember each forest's value is relative to the values of other forests in the community, watershed, or natural landscape. Even small patches of forest can be extremely valuable, depending on their landscape context. For example, the series of forest patches along a stream can create a riparian corridor that helps maintain water quality, provide wildlife habitat, and serve as a travel route for forest plants and animals. Similarly, wooded hedgerows in an agricultural landscape often provide a refuge for animals that do not typically use agricultural fields.

Although approximately half of Germantown is wooded, the town's forest is highly fragmented by roads and farmland. The largest forest block occurs along the Roeliff Jansen Kill and is estimated to measure over 2000 acres, but it is relatively narrow and fragmented by smaller roads, and thus may not have the ecological function of a more intact large forest block. Nevertheless, this forested stream buffer is a significant natural asset that helps to maintain stream habitat quality and water quality and allows for wildlife migration and movement between uplands and resource-rich areas along the stream. Overall, we know very little about the habitat quality of the forests in the Town of Germantown. The NYS Breeding Bird Atlas has several records of birds that indicate high-quality forest habitat in a block (scarlet tanager, wood thrush), as well as high quality streamside forest habitat (Louisiana waterthrush, yellow-throated vireo).

Rare and uncommon forest plants tend to occur in rich forests (moist, nutrient-rich, deep soils, near calcareous outcrops) or poor forests (dry, acidic, rocky soils). In Germantown's rocky forested areas, the historically documented whorled milkweed, fragrant sumac, or rusty woodsia -all uncommon or rare in Columbia County- might still be found. Current Farmscape Ecology Program records from Germantown

forests indicate the presence of hackberry, flowering dogwood, and spotted wintergreen, uncommon or rare species in Columbia County.

The Farmscape Ecology Program has shown that floodplain forests in Columbia and Dutchess counties are home to a unique suite of plants and animals that tolerate occasional flooding (Knab-Vispo and Vispo 2010). Common species such as silver maple and box elder and rare species such as green dragon and winged monkeyflower are almost exclusive to these forests. Of particular ecological interest are "legacy" floodplain forests, which have been forested at least since the 1940s and likely much longer. Forests not completely cleared during that period, although they might have been used as woodlots for selective timber harvest, have significantly less invasive shrubs and more native forest herbs than recently reforested floodplains. In addition to their biological values, floodplain forests play a vital role in minimizing soil erosion and surface runoff and help to reduce downstream flood intensity and stage. Only one location of reforested floodplain has been mapped in Germantown near the mouth of the Roe Jan; however, there may be potential for further floodplain forest restoration in the town. The Hudson River Estuary Program's "Trees for Tribs" Initiative offers free native trees and shrubs for qualifying streamside buffer planting projects in the Hudson River Estuary watershed. For additional information on the functions of floodplains and riparian buffers and their occurrence in Germantown, see the accompanying Water Resource Summary.

Wetlands

Wetlands not only provide quality habitat for unique plants and animals, but provide important benefits for human communities, including pollutant removal, flood storage, and carbon storage. The Wetlands map (Figure 6) shows wetlands as mapped by the U.S. Fish and Wildlife Service (USFWS) for the National Wetlands Inventory (NWI), and NYSDEC Freshwater Wetlands (12.4 acres and larger), as well as some information on potential wetlands based on county soil maps. "Probable wetlands" are those classified in the soil survey as very poorly drained or poorly drained, and "possible wetlands" are those classified as somewhat poorly drained soils (after Kiviat and Stevens 2001). As the 2007 Town of Germantown Comprehensive Plan notes, 30 of the 57 soil types found in Germantown tend to be poorly drained, largely due to high clay concentrations. NWI data are available for viewing on the USFWS website. NYSDEC Regulatory Freshwater Wetlands may also be viewed using the Environmental Resource Mapper on the NYSDEC website and GIS files are available from the NYS GIS Clearinghouse. Note that probable and potential wetlands cover a greater area than the NWI or NYSDEC wetland layers. NWI maps are known to be inaccurate, generally underestimating wetland area because on-the-ground wetlands are larger than those shown on the map and because smaller and drier wetlands tend to be missed (Zucker and Lau, unpublished report). In particular, vernal pools, swamps, and wet meadows are often under-represented on wetland maps. Consider identifying these features in a natural resource inventory or during planning board review, and remember that nothing can replace the on-the-ground delineation for understanding wetlands.

Despite having a good sense of where wetlands might be, we do not know the types of wetlands present or their relative importance for biodiversity. Plant data from the Farmscape Ecology Program show that

a few wetland types in Germantown harbor rare or uncommon species. Swamps are wetlands dominated by woody plants that may have standing water for only part of the year. Swampy woods in the town are home to mermaidweed, swamp azalea, tufted loosestrife, water parsnip, and wild raisin, species that are uncommon in Columbia County. Wet meadows are another important habitat in Germantown. Wet meadows have herbaceous vegetation and standing water or saturated soils for part of the year (Kiviat and Stevens 2001). The 2007 Comprehensive Plan notes that many former agricultural fields in Germantown that were once tiled and drained are now wet meadows supporting diverse plant and animal communities. The Farmscape Ecology Program documented three uncommon plant species from wet meadows and moist oldfields in Germantown: Canada lily, field milkwort, ragged-fringed orchid, and squarrose sedge.

Hudson River shoreline wetlands are covered in the Hudson River Coastal Habitat section.

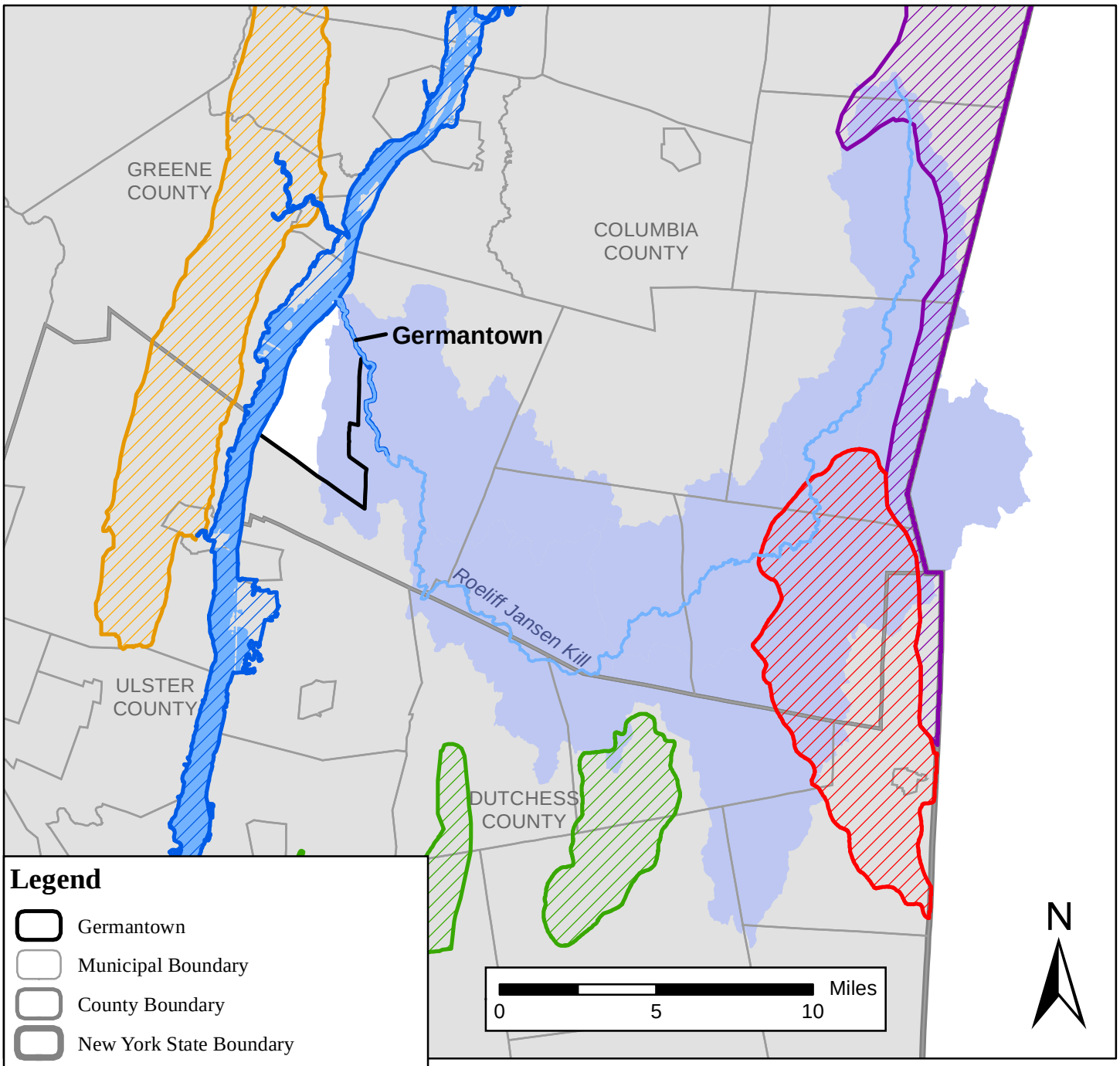
Grasslands and Young Forests (not mapped)

Grassland, or meadow habitat, can support rare plants, butterflies, and bird species in addition to agricultural uses and contribution to scenic values. The quantity and quality of grasslands for wildlife have rapidly decreased in the Northeast over the last century due to an increase in human population, changes in agricultural technology, and the abandonment of family farms. This continuing trend threatens populations of grassland birds that had adapted to the agricultural landscape. Breeding bird records from Germantown indicate that grassland habitat is significant in the town. Table 2 shows four grassland bird species of state conservation concern known to breed in Germantown (NYS Breeding Bird Atlas), including bobolink and eastern meadowlark. Such species are not uncommon for a Hudson Valley town with active farmland. Grassland breeding birds respond to vegetation structure rather than a mix of grass species, so hayfields dominated by non-native plants can provide suitable habitat for species of conservation concern as long as they are managed appropriately. See Figure 4: Land Use and Land Cover in the accompanying Water Resource Summary for the location of grassland habitat (including pasture and hayfield) in Germantown obtained from the USGS National Landcover Database (2006).

Young forests and shrublands are lands in transition between meadow and forest, characterized by few or no mature trees, with a diverse mix of shrubs and/or tree saplings, along with openings where grasses and wildflowers grow. They also occur in recently cleared areas, and are sometimes maintained along utility corridors by cutting or herbicides. In Germantown, abandoned orchards and agricultural land contribute to young forest habitat. Young forest is an important habitat type for many wildlife species that is dwindling throughout the region as mature forests have recovered in former agricultural areas and natural forest disturbances triggering young forest growth such as fires have been suppressed. Eight young forest and shrubland bird species of conservation concern in the state that are known to breed in Germantown (NYS Breeding Bird Atlas), including blue-winged warbler, brown thrasher, prairie warbler, and willow flycatcher. Extensive young forests and those that form large complexes with meadow habitats may be particularly important for nesting in these species, as well as for grassland nesting bird species.

Grasslands and young forests including small habitat patches may also host other species of conservation concern. The uncommon plant species little bluestem occurs in old field habitat in Germantown and locally-rare partridge pea was historically documented on dry, shaly hillsides in the town. The Farmscape Ecology Program has also documented uncommon butterfly species in these habitats in Germantown including the meadow fritillary, giant swallowtail, grey hairstreak, and juniper hairstreak. In addition, the Farmscape Ecology Program recently discovered a nest of an extremely rare ant species, *Lasius murphyi*, in a hayfield at Keep Conservation Foundation Preserve. This species was previously not known to occur north of Bronxville, NY and is unknown in New England.

Figure 1: Regional Context of Germantown, NY



Legend

- Germantown
- Municipal Boundary
- County Boundary
- New York State Boundary
- Roeliff Jansen Kill
- Hudson River
- Roeliff Jansen Kill Watershed

Significant Biodiversity Areas

- Dutchess County Wetlands
- Harlem Valley Calcareous Wetlands
- Hudson Valley Limestone & Shale Ridge
- Taconic Mountains
- Upper Hudson River

This map shows the location of the Town of Germantown, Columbia County in relation to its watershed and other major natural areas. This map was produced as part of a Habitat Summary for the Town. For more information, please contact NYSDEC's Hudson River Estuary Program Conservation and Land Use Specialist Ingrid Haeckel at ibhaecke@gw.dec.state.ny.us or (518) 402-8954.

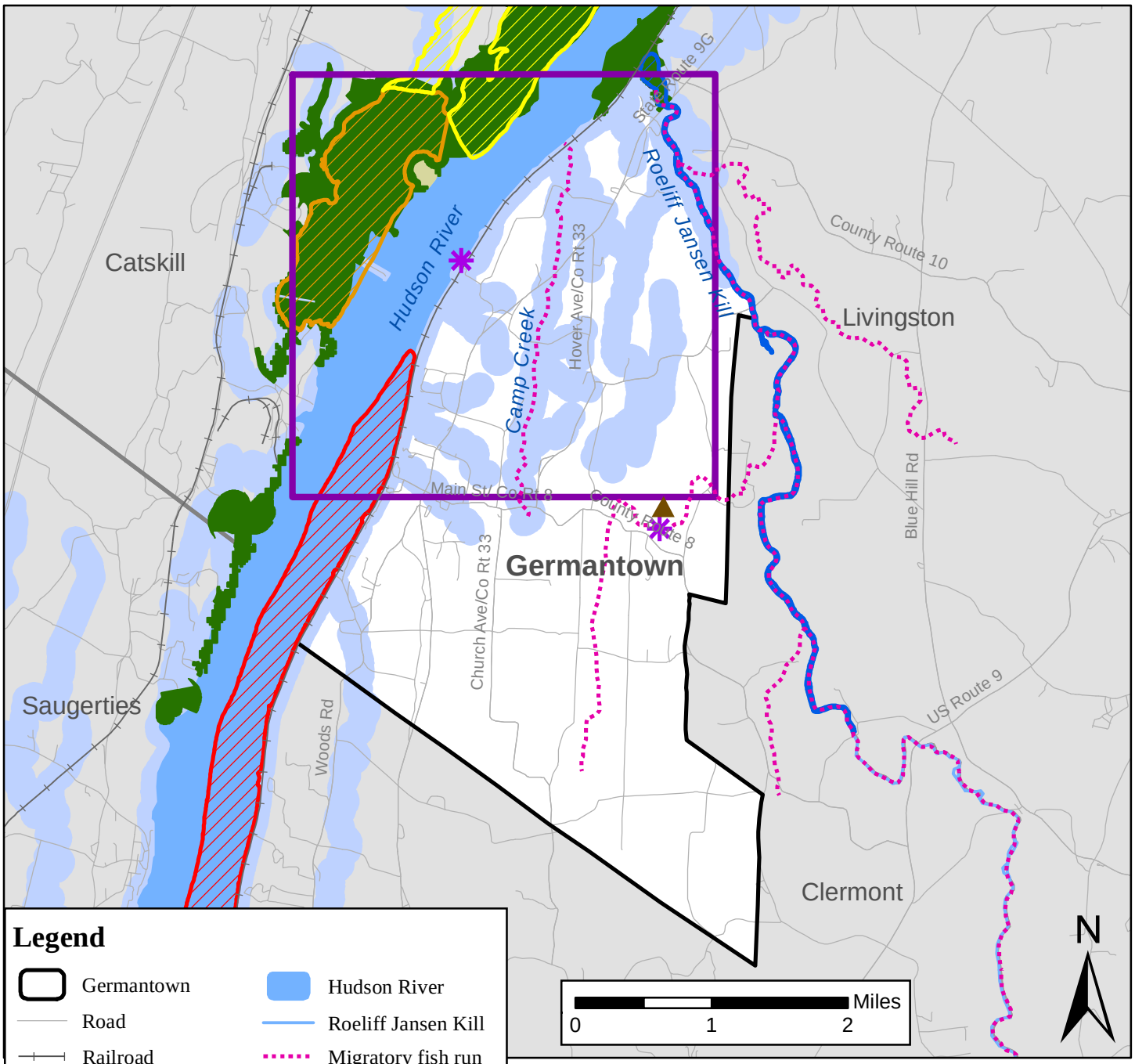
Data Sources:
US Geological Survey
New York State Department of Environmental Conservation
New York Natural Heritage Program
New York State Office of Cyber Security and Critical Infrastructure Coordination

Map Created Dec 2013

Hudson River Estuary

Cornell University

Figure 2: Major Ecological Features in Germantown, NY



Legend

- Germantown
- Road
- Railroad
- Hudson River
- Roeliff Jansen Kill
- Migratory fish run

Areas of known importance for:

- rare plants
- rare aquatic animals
- rare ant occurrence
- rare dragonfly occurrence
- bald eagle, osprey, peregrine falcon

Significant Coastal Fish and Wildlife Habitat

- Germantown - Clermont Flats
- Inbocht Bay & Duck Cove
- Ramshorn Marsh
- Roeliff Jansen Kill

This map shows the most significant *known* ecological features in the Town of Germantown, Columbia County based on limited information. This map was produced as part of a Habitat Summary for the Town. For more information, please contact NYSDEC's Hudson River Estuary Program Conservation and Land Use Specialist Ingrid Haeckel at ibhaecke@gw.dec.state.ny.us or (518)402-8954.

Data Sources:

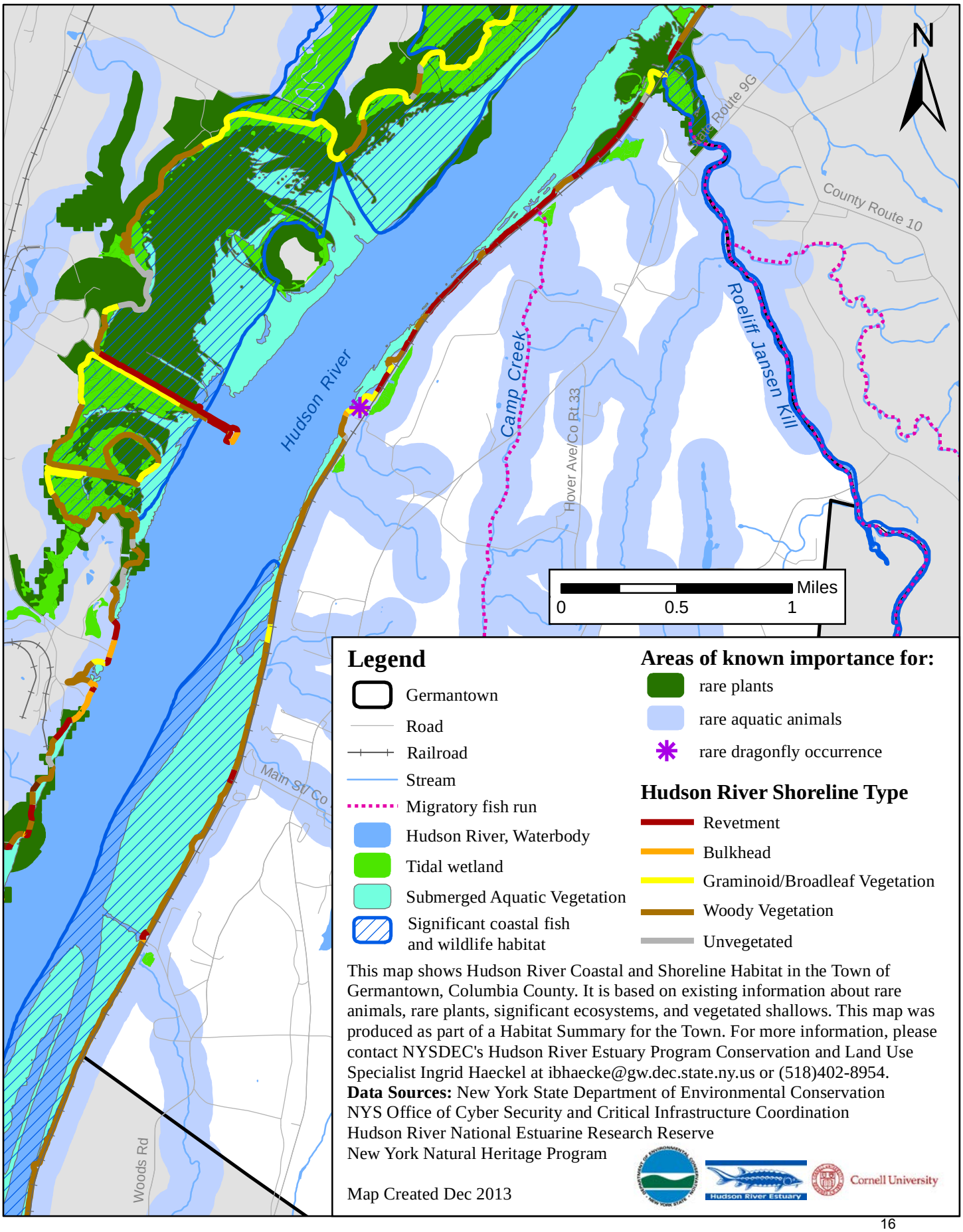
New York State Department of Environmental Conservation
New York Natural Heritage Program
NYS Office of Cyber Security and Critical Infrastructure Coordination
Hawthorne Valley Farmscape Ecology Program

Map Created Dec 2013

Hudson River Estuary

Cornell University

Figure 3: Hudson River Coastal and Shoreline Habitat in Germantown, NY



This map shows Hudson River Coastal and Shoreline Habitat in the Town of Germantown, Columbia County. It is based on existing information about rare animals, rare plants, significant ecosystems, and vegetated shallows. This map was produced as part of a Habitat Summary for the Town. For more information, please contact NYSDEC's Hudson River Estuary Program Conservation and Land Use Specialist Ingrid Haeckel at ibhaecke@gw.dec.state.ny.us or (518)402-8954.

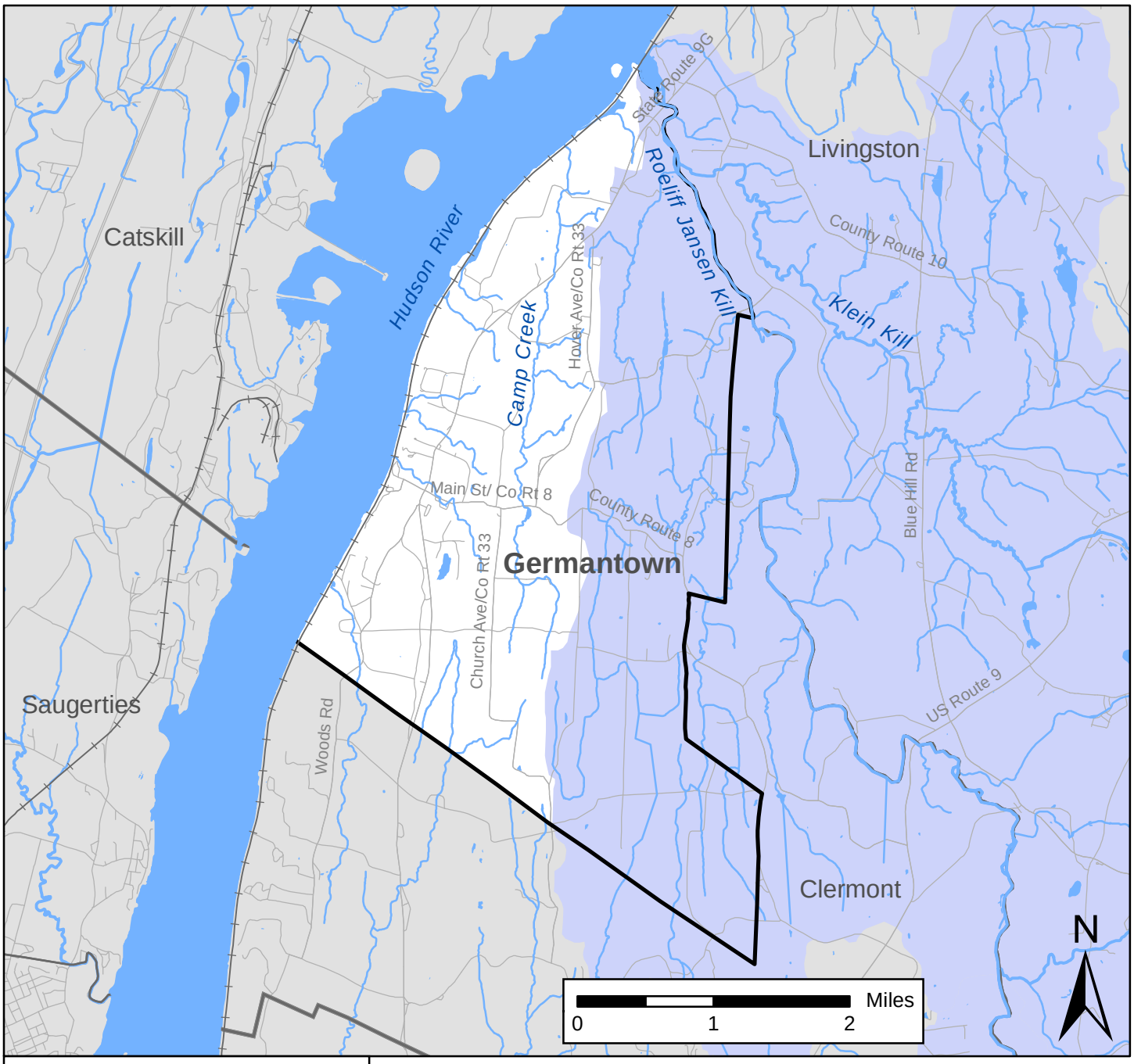
Data Sources: New York State Department of Environmental Conservation
NYS Office of Cyber Security and Critical Infrastructure Coordination
Hudson River National Estuarine Research Reserve
New York Natural Heritage Program

Map Created Dec 2013

Hudson River Estuary

Cornell University

Figure 4: Streams and Watersheds in Germantown, NY



Legend

- Germantown
- Road
- Railroad
- Named stream
- Other stream
- Hudson River, Waterbody
- Roeliff Jansen Kill Watershed

This map shows streams, waterbodies, and watersheds for the Town of Germantown, Columbia County. This map was produced as part of a Habitat Summary for the Town. For more information, please contact NYSDEC's Hudson River Estuary Program Conservation and Land Use Specialist Ingrid Haeckel at ibhaecke@gw.dec.state.ny.us or (518)402-8954.

Data Sources:
US Geological Survey
New York State Department of Environmental Conservation
Natural Resources Conservation Service
New York State Office of Cyber Security and Critical Infrastructure Coordination

Map Created Dec 2013

Hudson River Estuary

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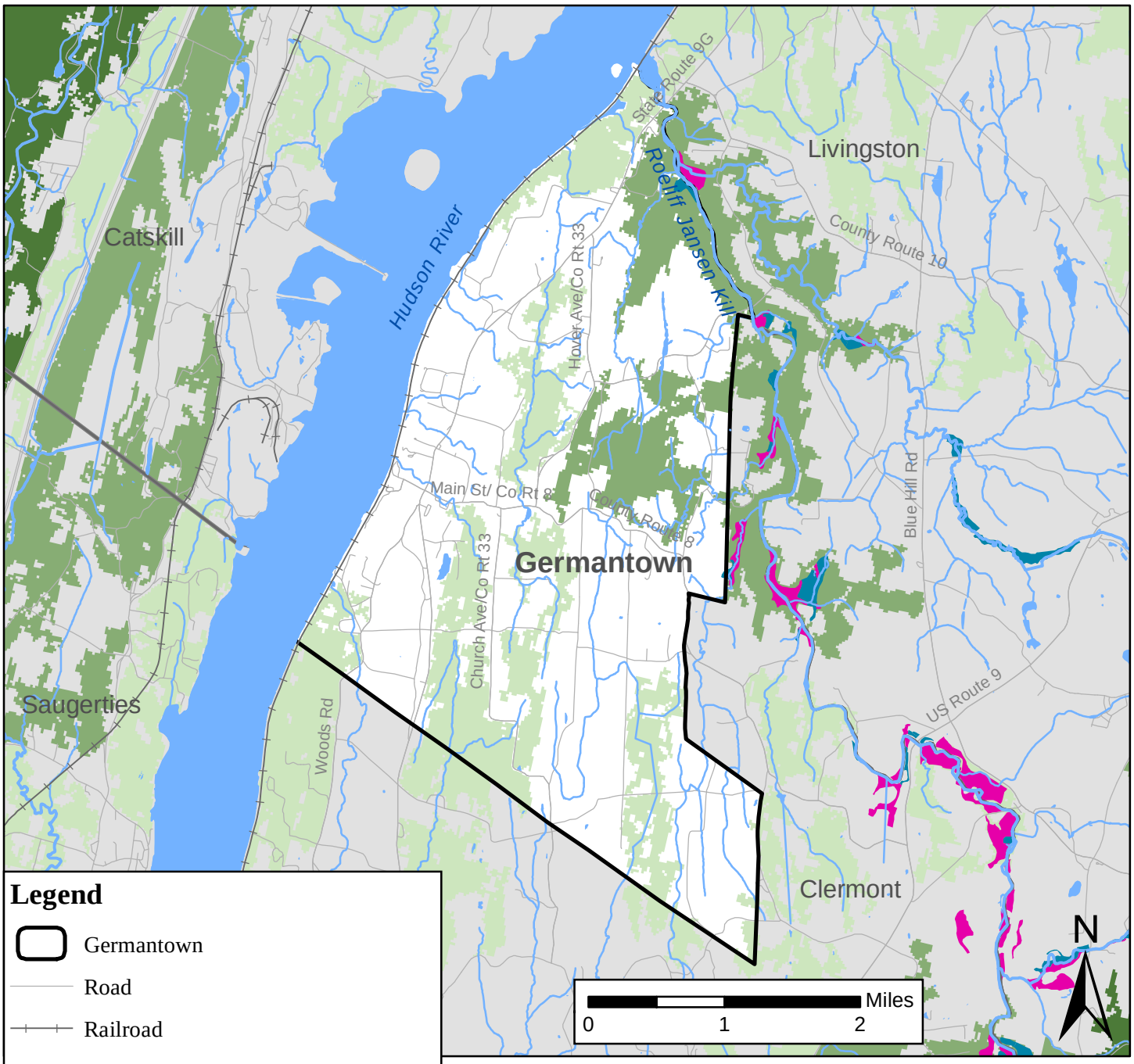
Figure 5: Large Forests (200 acres and larger) in Germantown, NY



Legend

- Germantown
- Road
- Railroad
- Stream
- Hudson River, Waterbody
- Legacy floodplain forest
- Reforested floodplain

Forest Patch Size (acres)

- Stepping Stone (200 - 1999)
- Locally Significant (2000 - 4999)
- Regionally Significant (5000 - 14999)
- Globally Significant (15000)

This map shows continuous forested patches of New York State by acreage for the Town of Germantown, Columbia County. The patches were developed using forest cover data from the Coastal Change Analysis Program and buffered roads. The map also shows floodplain forests identified by the Farmscape Ecology Program. This map was produced as part of a habitat summary for the town. For more information, please contact NYSDEC's Hudson River Estuary Program Conservation and Land Use Specialist Ingrid Haeckel at ibhaecke@gw.dec.state.ny.us or (518)402-8954.

Data Sources: NOAA 2006 Coastal Change Analysis Program
New York State Department of Environmental Conservation
New York State Office of Cyber Security and Critical Infrastructure Coordination
Hawthorne Valley Association Farmscape Ecology Program

Map Created Dec 2013

Hudson River Estuary

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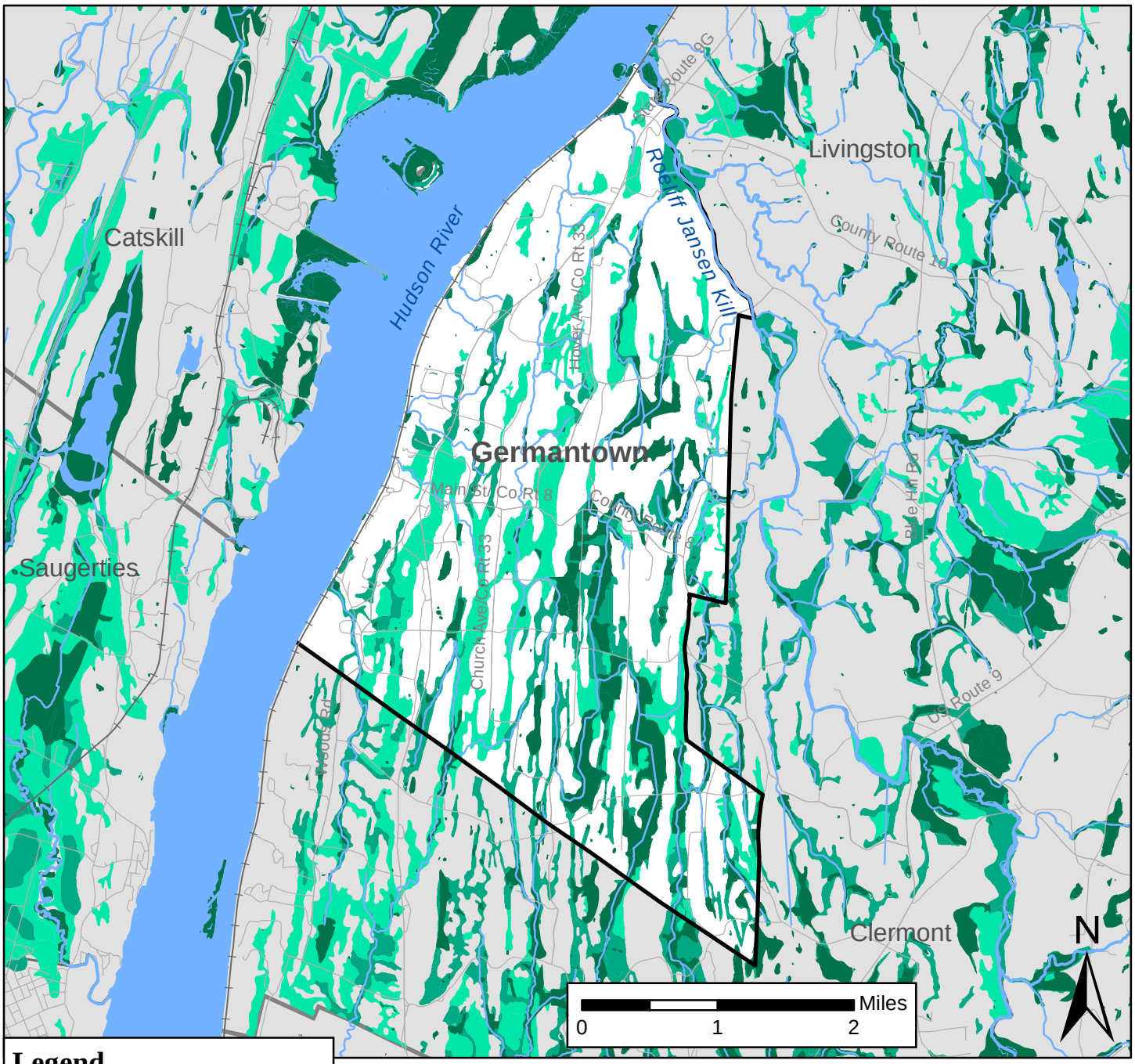
Figure 6: Wetlands in Germantown, NY



Legend

- Railroad
- Hudson River, Waterbody
- Germantown
- Road
- Stream
- Known wetland
- Probable wetland
- Possible wetland

This map shows *known* wetlands from the National Wetlands Inventory and NYS Freshwater Wetland Map and potential wetlands in the Town of Germantown, Columbia County, NY. Probable and possible wetlands were identified based on soil drainage class in the Columbia County Soil Survey; see habitat summary text for more details. This map was produced as part of a habitat summary for the town and is not intended for regulatory purposes. For more information, please contact NYSDEC's Hudson River Estuary Program Conservation and Land Use Specialist Ingrid Haeckel at ibhaecke@gw.dec.state.ny.us or (518)402-8954.

Data Sources:

US Fish and Wildlife Service, National Wetlands Inventory
New York State Department of Environmental Conservation
Natural Resources Conservation Service
US Geological Survey

Map Created Dec 2013

Hudson River Estuary

Cornell University

Species and Ecosystems of Conservation Concern in Germantown

The species and ecosystems of conservation concern that have been recorded from Germantown are listed in Tables 1-4. Table 1 lists state rare species and ecosystems (described in the Habitat Summary text and shown in Figure 2). Table 2 lists forest, young forest (including shrubland), grassland, wetland, and other bird species of conservation concern. In Tables 1 and 2, species are included if they are on the state or federal endangered and threatened species list, listed as Species of Greatest Conservation Need in New York's Wildlife Action Plan, recognized as a "priority species" for the Hudson Valley by Audubon New York, or there are other indicators of high quality habitat. Tables 3 and 4 list species of regional and local conservation concern, compiled from information provided by the Farmscape Ecology Program. All species and ecosystems in the lists are linked to a habitat described in the summary.

Remember there may be additional rare species and habitats in Germantown not yet documented. Table 3 contains some historic records. It is useful to be aware of these records because populations may still be present.

Table 1. State Rare Plants, Animals and Ecosystems in Germantown

This information comes from the New York Natural Heritage Program biodiversity databases (NYNHP) and the Farmscape Ecology Program at Hawthorne Valley Farm (FEP). Data from the NY Natural Heritage Program are available to the public from New York Nature Explorer. More information can be found at http://guides.nynhp.org.

Common Name	Description	Scientific Name	Habitat in Summary	Source
tidal river	wetland/aquatic community		Hudson River coastal habitat	NYNHP
freshwater tidal marsh	wetland/aquatic community		Hudson River coastal habitat	NYNHP
waterfowl winter concentration area	animal assemblage		Hudson River coastal habitat	NYNHP
anadromous fish concentration area	animal assemblage		Hudson River coastal habitat	NYNHP
shortnose sturgeon[3]	fish	*Acipenser brevirostrum*	Hudson River coastal habitat	NYNHP
bald eagle[2]	bird	*Haliaeetus leucocephalus*	Hudson River coastal habitat	NYNHP

Common Name	Description	Scientific Name	Habitat in Summary	Source
russet-tipped clubtail[1]***	dragonfly	*Stylurus plagiatus*	Hudson River coastal habitat	NYNHP
mocha emerald[1]**	dragonfly	*Somatochlora linearis*	streams	FEP
	ant	*Lasius murphyi*	grassland	FEP
heartleaf plantain*	vascular plant	*Plantago cordata*	Hudson River coastal habitat	NYNHP
golden club[2]**	vascular plant	*Orontium aquaticum*	Hudson River coastal habitat	NYNHP
great St. John's-wort*	streams (floodplain forest and alluvial meadows)	*Hypericum ascyron*	streams	FEP
whorled milkweed*	forests, grasslands (rocky)	*Asclepias verticillata*	forests, grasslands	FEP

[1]NYS Species of Greatest Conservation Need (SGCN)

[2]NYS Threatened Species and SGCN

[3]NYS Endangered Species and SGCN

*Statewide status is rare

**Statewide status is very vulnerable

*** Statewide status is extremely vulnerable

Table 2. Significant Birds of Germantown

Data from the New York Breeding Bird Atlas 2000 [Internet]. 2000 - 2005. Release 1.0. Albany (New York): New York State Department of Environmental Conservation [updated 11 Jun 2007; cited 8 Aug 2013]. Habitat type and links from Audubon NY (2009); young forest and shrubland designation by NYSDEC Biologist Paul Novak. Species are from blocks that are more than 50% in Germantown. A subset of that list is shown here; we selected "priority birds" for the Hudson Valley identified by Audubon NY.

Common Name	Scientific Name	More information from...
Forest Birds		
American redstart	*Setophaga ruticilla*	
Baltimore oriole	*Icterus galbula*	
black-and-white warbler	*Mniotilta varia*	Audubon
broad-winged hawk	*Buteo platypterus*	Audubon
downy woodpecker	*Picoides pubescens*	Audubon
eastern wood-pewee	*Contopus virens*	
Louisiana waterthrush*	*Seiurus motacilla*	Audubon
magnolia warbler	*Dendroica magnolia*	
northern flicker	*Colaptes auratus*	Audubon
purple finch	*Carpodacus purpureus*	
rose-breasted grosbeak	*Pheucticus ludovicianus*	Audubon
scarlet tanager*	*Piranga olivacea*	Audubon
veery	*Catharus fuscescens*	Audubon
wood thrush*	*Hylocichla mustelina*	Audubon
worm-eating warbler*	*Helmitheros vermivorum*	Audubon
yellow-throated vireo	*Vireo flavifrons*	Audubon
Grassland Birds		

American kestrel	*Falco sparverius*	Audubon
bobolink*	*Dolichonyx oryzivorus*	Audubon
eastern meadowlark*	*Sturnella magna*	Audubon
savannah sparrow	*Passerculus sandwichensis*	Audubon
Young Forest and Shrubland Birds		
eastern kingbird	*Tyrannus tyrannus*	Audubon
blue-winged warbler*	*Vermivora pinus*	Audubon
brown thrasher*	*Toxostoma rufum*	Audubon
eastern towhee	*Pipilo erythrophthalmus*	Audubon
field sparrow	*Spizella pusilla*	Audubon
indigo bunting	*Passerina cyanea*	Audubon
prairie warbler*	*Dendroica discolor*	Audubon
willow flycatcher*	*Empidonax trailli*	Audubon
Birds of Other Habitats		
bald eagle (open water/forest)***	*Haliaeetus leucocephalus*	
belted kingfisher (open water)	*Megaceryle alcyon*	Audubon
chimney swift (urban)	*Chaetura pelagica*	
osprey (open water/wetland)**	*Pandion haliaetus*	
peregrine falcon (cliffs)****	*Falco peregrinus*	

* Denotes NYS Species of Greatest Conservation Need (SGCN)

** Denotes NYS Species of Special Concern and SGCN

*** Denotes NYS Threatened Species and SGCN

**** Denoted NYS Endangered Species and SGCN

Table 3. Plants of Regional or Local Conservation Concern in Germantown

Regional conservation concern means the species or habitat is rare or uncommon on the Hudson Valley, county, or town scale; detailed definitions are provided in the footnotes. The Farmscape Ecology Program has documented 13 plant species of regional or local conservation concern in the Town of Germantown since 2003 and provided 1930s rare plant records from McVaugh (1958). It is unknown which are still present; additional field work will probably reveal more records. The table shows examples of these plants from a variety of habitats. A complete list can be requested from the Farmscape Ecology Program, which continues to search for these rare plants (fep@hawthornevalleyfarm.org).

Common Name	Habitat in Summary	Scientific Name	State Status[1]	Regional Status[2]	County Status[3]
flowering dogwood	forests (red cedar)	*Cornus florida*	S4S5		CCu
spotted wintergreen	forests (red cedar)	*Chimaphila maculata*	S4		CCr
fragrant sumac*	forests (rocky bluffs)	*Rhus aromatica*	S5	R	CCu
mountain maple*	forests (rocky bluffs)	*Acer spicatum*	S4S5	S	CCu
rusty woodsia*	forests (rocky bluffs)	*Woodsia ilvensis*	S5	R?	CCu
hackberry	forests (rocky)	*Celtis occidentalis*	S4	S	CCu
whorled milkweed*	forests, grasslands (rocky)	*Asclepias verticillata*	S3		CCu
little bluestem	grasslands (old field)	*Schizachyrium scoparium*	S5		CCu
partridge pea*	grasslands, forests (dry, rocky)	*Chamaecrista nictitans*	S4S5		CCr
great St. John's-wort*	streams (floodplain forest and alluvial meadows)	*Hypericum ascyron*	S3		CCu
eastern wild rice*	tidal wetlands	*Zizania aquatica*	S5		CCu
heartleaf plantain*	tidal wetlands	*Plantago cordata*	S3		CCu
swamp azalea	wetlands (swamp)	*Rhododendron viscosum*	S5		CCu
tufted loosestrife	wetlands (swamp)	*Lysimachia thyrsiflora*	S4		CCu
wild raisin	wetlands (swamp)	*Viburnum nudum*	S5	R	CCu
mermaidweed	wetlands (swamp), forests (floodplain forest)	*Proserpinaca palustris*	S4		CCu

Common Name	Habitat in Summary	Scientific Name	State Status[1]	Regional Status[2]	County Status[3]
water parsnip	wetlands (swamp), forests (floodplain forest)	*Sium suave*	S5		CCu
field milkwort	wetlands (wet meadow)	*Polygala sanguinea*	S5	S	CCu
ragged-fringed orchid	wetlands (wet meadow)	*Platanthera lacera*	S4	R	CCu
squarrose sedge	wetlands (wet meadow, swamp)	*Carex squarrosa*	S5	S	CCu
Canada lily	wetlands (wet meadow, swamp), forests (floodplain forest)	*Lilium canadense*	S5	R	CCu

*documented in the "Flora of Columbia County" (McVaugh 1958)

[1] S1=extremely rare in NYS, S2=very rare in NYS, S3=rare to uncommon in NYS, S4=common in NYS, S5=very common in NYS, as determined by the NY Natural Heritage Program www.nynhp.org

[2] R=rare in Hudson Valley, S=scarce in Hudson Valley, as determined in Kiviat and Stevens (2001)

[3] CCr=rare in Columbia County, CCu=uncommon in Columbia County, determined by FEP as of October 2013, subject to change as fieldwork continues

Table 4. County-rare Butterflies and Dragonflies in Germantown

Documented by FEP from Germantown since 2003, these observations are not the result of an exhaustive town-wide survey. More fieldwork will certainly document additional rare species. Status as of October 2013.

Common Name	Habitat in Summary	Scientific Name	County Status[1]	Larval habitat/food	Description
grey hairstreak	grasslands	*Strymon melinus*	uncommon	various field/brush plants	butterfly
meadow frittilary	grasslands	*Boloria bellona*	uncommon	violets	butterfly
giant swallowtail	grasslands, shrublands, young forests	*Papilio cresphontes*	uncommon	plants in the Rue family (or Rutaceae)	butterfly
juniper hairstreak	shrublands, young forests	*Callophrys gryneus*	uncommon	red cedar	butterfly
mocha emerald*	streams	*Somatochlora linearis*	very rare	aquatic invertebrates	dragonfly

Common Name	Habitat in Summary	Scientific Name	County Status[1]	Larval habitat/food	Description
broadwing skipper	wetlands	*Poanes viator*	uncommon	reeds, sedges, wild rice	butterfly

[1]Assessment as of October 2013 based on field work and historic and current regional literature

*Statewide status is very vulnerable - on New York Natural Heritage Program Active Inventory List and SGCN

General Conservation Measures for Protecting Natural Areas and Wildlife

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- **Protect large, contiguous, unaltered tracts** wherever possible.
- **Preserve links** between natural habitats on adjacent properties.
- **Preserve natural disturbance processes**, such as fires, floods, tidal flushing, seasonal drawdowns, landslides, and wind exposures wherever possible. Discourage development that would interfere with these processes.
- **Restore and maintain broad buffer zones** of natural vegetation along streams, along shores of other water bodies and wetlands, and at the perimeter of other sensitive habitats.
- In general, **encourage development of altered land** instead of unaltered land wherever possible.
- **Promote redevelopment of brownfields**, other post-industrial sites, and other previously-altered sites (such as mined lands), "infill" development, and "adaptive re-use" of existing structures wherever possible, instead of breaking new ground in unaltered areas.
- **Encourage pedestrian-centered developments** that enhance existing neighborhoods, instead of isolated developments requiring new roads or expanded vehicle use.
- **Concentrate development along existing roads**; discourage construction of new roads in undeveloped areas. Promote clustered development wherever appropriate, to maximize extent of unaltered land.
- **Direct human uses toward the least sensitive areas**, and minimize alteration of natural features, including vegetation, soils, bedrock, and waterways.
- **Preserve farmland potential** wherever possible.
- **Minimize area of impervious surfaces** (roads, parking lots, sidewalks, driveways, roof surfaces) and maximize onsite runoff retention and infiltration to help protect groundwater recharge, and surface water quality and flows.
- **Restore degraded habitats wherever possible**, but do not use restoration projects as a "license" to destroy existing habitats.

Source: Kiviat, E. & G. Stevens. 2001. Biodiversity Assessment Manual for the Hudson River Estuary Corridor. NYS Department of Environmental Conservation, Albany, NY.

References

Audubon NY. 2009. Hudson River Valley Conservation [website] Retrieved from http://ny.audubon.org/hudson-river-valley-conservation on 29 August 2013. Ithaca, NY.

Kiviat, E. and G. Stevens. 2001. Biodiversity Assessment Manual for the Hudson River Estuary Corridor. NYS Department of Environmental Conservation, Albany, NY. www.hudsonia.org

Knab-Vispo, C. and. C. Vispo. 2010. The Plant and Animal Diversity of Columbia County NY Floodplain Forests: Composition and Patterns. Report to the NYS Biodiversity Research Institute. Farmscape Ecology Program, Hawthorne Valley Farm. Ghent, NY. www.hawthornevalleyfarm.org/fep (accessed September 2013)

McVaugh, R. 1958. Flora of the Columbia county Area, New York. New York State Museum and Science Service Bulletin No. 360. The University of the State of New York, Albany, NY.
http://www.nysl.nysed.gov/scandocs/museumbulletin.htm

New York Amphibian and Reptile Atlas. 1990-1999. Albany (New York): New York State Department of Environmental Conservation. Website: http://www.dec.ny.gov/animals/7140.html

New York State Breeding Bird Atlas 2000 [Internet]. 2000 - 2005. Release 1.0. Albany (New York): New York State Department of Environmental Conservation. [updated 2007 Jun 11; data retrieved August 2013]. Available from: http://www.dec.ny.gov/animals/7312.html

New York Natural Heritage Program, New York State Department of Environmental Conservation. [cited 13 August 2013]. Biodiversity Databases, Element Occurrence Record Digital Data Set. Albany, New York. www.nynhp.org

New York Natural Heritage Program, New York State Department of Environmental Conservation. Biodiversity Databases, Important Areas Digital Data Set [updated 25 April 2013]. Albany, New York. www.nynhp.org

National Oceanic and Atmospheric Administration. 2006. Land Cover data for the Coastal Change Analysis Program. NOAA Coastal Service Center. Charleston, SC. http://www.csc.noaa.gov/

Orange County (N.Y.) Planning Department. 2004. Orange County Open Space Plan. Goshen, NY. www.co.orange.ny.us (accessed November 2009)

Penhollow, M. E., P. G. Jensen, and L.A. Zucker. 2006. Wildlife and Habitat Conservation Framework: An Approach for Conserving Biodiversity in the Hudson River Estuary Corridor. New York Cooperative Fish and Wildlife Research Unit, Cornell University and New York State Department of Environmental Conservation, Hudson River Estuary Program, Ithaca, NY.

Schmidt, R.E. and S. Cooper. 1996. A catalog of barriers to upstream movement of migratory fishes in Hudson River Tributaries. Hudsonia Ltd. Annadale, NY. 189 pp.

Smith, C. R., S. D. DeGloria, M. E. Richmond, S. K. Gregory, M. Laba, S. D. Smith, J. L. Braden, W. P. Brown, and E. A. Hill. 2001. An Application of Gap Analysis Procedures to Facilitate Planning For Biodiversity Conservation in the Hudson River Valley, Final Report. Part 1: Gap Analysis of the Hudson River Valley and Part 2: Atlas of Predicted Ranges for terrestrial vertebrates in the Hudson River Valley, New York Cooperative Fish and Wildlife Research Unit, Department of Natural Resources, Cornell University, Ithaca, N.Y.

Strong, K. 2008. Conserving Natural Areas and Wildlife in Your Community: Smart Growth Strategies for Protecting the Biological Diversity of New York's Hudson River Valley. New York Cooperative Fish and Wildlife Research Unit, Cornell University, and New York State Department of Environmental Conservation, Hudson River Estuary Program. Ithaca, NY.

White, E.L., J.J. Schmid, T.G. Howard, M.D. Schlesinger, and A.L. Feldmann. 2011. New York State freshwater conservation blueprint project, phases I and II: Freshwater systems, species, and viability metrics. New York Natural Heritage Program, The Nature Conservancy. Albany, NY. 85 pp. plus appendix.