Esopus Valley Biodiversity Assessment Report

City of Kingston
&
Town of Ulster

Cover Graphics: Nora Paul Budziak

ESOPUS VALLEY BIODIVERSITY ASSESSMENT REPORT

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Prepared by the Kingston/Ulster Hudsonia Biodiveristy Assessment Group

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Since 1981 Hudsonia has conducted environmental research, education, training and technical assistance to protect the natural heritage of the Hudson Valley and neighboring regions. A non-advocacy organization, Hudsonia serves as a neutral voice in the challenging process of land use decision making.

ABOUT THE HUDSON RIVER ESTUARY PROGRAM

The Hudson River Estuary Program of the New York State Department of Environmental Conservation leads a unique regional partnership to restore the Hudson in ways that support the quality of life so valued by Hudson Valley residents. The mission of the program is to:

- conserve the natural resources for which the Hudson is legendary
- promote full public use and enjoyment of the river
- clean up the pollution that affects our ability to use and enjoy it

The Estuary Program implements the Hudson River Estuary Action Agenda through numerous partners in government, the non-profit and business sectors, and concerned citizens. The program is built on sound science and principles of ecosystem-based management. It is guided by the Hudson River Estuary Management Advisory Committee, which includes representatives of the commercial fishing industry, recreational anglers, utility companies, local government, educators, researchers, conservationists and other river users. The intent is to engage many representatives of the public in working together toward common goals.

ABOUT BIODIVERSITY

Biological diversity or "biodiversity" can be defined most simply as "the variety of life and its processes." The term refers to all the variation in nature, including ecosystems, biological communities, species, and their genes. It also refers to the interactions of organisms with each other, and with the non-biological components of their environments, such as soil, water, air, and sunlight. Intact ecosystems help to create and support the world as we know it by providing such basic services as climate moderation, oxygen production, soil formation, nutrient transformation, and production and decomposition of organic matter. We have come to believe that ecosystems containing their full natural complement of species and processes are best able to withstand both "normal" environmental extremes and catastrophic events, such as diseases, droughts, floods, fires, and climate change. Thus, protecting native biodiversity is a means to the larger goal of preserving the integrity and resilience of ecosystems.[1]

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[1] Kiviat, E. & G. Stevens. 2005. Biodiversity Assessment Manual for the Hudson River Estuary Corridor, Hudsonia Ltd., Bard College, PO Box 5000, Annandale, NY 12504, 508 p.

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EXECUTIVE SUMMARY

A ten-month Biodiversity Assessment Training, conducted by Hudsonia Ltd. in partnership with the NYS Department of Environmental Conservation's Hudson River Estuary Program, concentrated on a 3,200 acre study area straddling the Esopus Creek as it flows through the City of Kingston and Town of Ulster bounded on the west by the foothills of the Catskill Forest Preserve. An eight member group, comprised primarily of representatives from the City of Kingston and the Town of Ulster who serve active roles as Conservation Advisory Council (CAC) members and community planning affiliates developed new skills and expertise that will enable them to practically and collaboratively apply conservation principles and best practices in support of planning initiatives and to meet decision-making responsibilities for their communities.

Through remote sensing using aerial photograph interpretation, soil, geological, wetland and topographical map analysis, and subsequent field verification, a large format map and interpretive report was created which delineates the location and configuration of significant habitats throughout the study area. This report includes a description of each of the habitat types identified and mapped in the study area and their ecological attributes, vulnerabilities and the detrimental impact and consequences that human disturbance may have. Associated conservation issues and applicable conservation measures and recommendations are also referenced in this report.

Conservation priorities identified in the study applicable to the Esopus Valley include establishment of conservation zones for priority habitats, protection of sensitive habitats, maintenance of corridors between sensitive habitats, increase of vegetative buffers along stream banks, reevaluation of zoning regulations as they pertain to land use in the identified floodplains, and review of municipal comprehensive plans as they should relate to biodiversity conservation initiatives.

The habitat map and this report can assist the City of Kingston and the Town of Ulster to identify areas of greatest ecological importance, and establish conservation objectives and policies that will encourage the protection of biodiversity resources and which will concurrently address cultural, social and economic requirements of the respective communities.

INTRODUCTION

The City of Kingston and the Town of Ulster share something in common – the Lower Esopus Creek and its watershed. This river valley, bounded on one side by the beautiful Catskill Forest Preserve and the historic and densely populated City of Kingston on the other, is shaped by the Lower Esopus Creek, a class B stream, that meanders along the shared border between the City of Kingston and the Town of Ulster before passing on to the north and into the Hudson River at Saugerties. This area has been in agricultural use since at least the 1400's and continues today. This fertile valley allowed Native American and European settlers to provide food for their communities in the upland portions of our study area.

The study area is approximately 3,200 acres in size, bounded by the Catskill Forest Preserve on the Western flank, the Sawkill Creek to the North, Albany Avenue and the City of Kingston on its East side and the old railbed of the New York, Ontario and Western Rail Line on the South. This area is comprised of some of the largest contiguous tracts of open space as well as the most densely populated and largest commercial and industrial centers in Ulster County. Farming also is a key factor on the banks of the Lower Esopus today. Fields are mostly corn, and help to provide the region with sweet corn during the late summer months.

The Lower Esopus Creek is the major feature of our study area extending from the Ashokan Reservoir to the Hudson River with a length of approximately 30 miles and a watershed of approximately 163 square miles. The Kingston/Ulster Study area contains almost 5 miles of the Esopus Creek, which almost annually

floods its banks during spring rains and other flooding events. These floods are a natural part of the creek's geomorphology and have led to the fertile land now farmed today. This also has had a dramatic impact on the habitats surrounding the creek, as will be discussed in this report.

Another important feature is evident from bedrock geology maps. The Onondaga limestone formation on the eastern side of the Esopus Creek forms a ridge extending southward to Rosendale and northward to Saugerties creating a barrier and resulting in the likelihood of calcareous soils in our study area. The Esopus Creek is constrained to flow north by the ridge and is channeled over the undifferentiated lower Hamilton group bedrock which is comprised of softer sedimentary materials including the shale and sandstone that provides the substrate over which the creek flows. As a result of glaciations and, later, the erosion caused by the creek itself, the gently sloping valley not only retains sediment in its floodplain but allows the creek to meander and oxbow lakes to be formed over time.

Figure 1: The boundary line between City of Kingston and Town of Ulster runs along Esopus Creek shown here near Kingston Plaza - Photo by Gregg Swanzey

Much of the study area has been disturbed by human activity such as mining (shale, crushed stone, limestone), farming, recreational use and development. In some instances where active use has been discontinued, habitats are reemerging, reconfiguring and readjusting commensurate with existing conditions. In the vicinity of the Esopus Creek the land forms are largely floodplains and floodways thus rendering an expansive wetland complex characterized by microhabitats such as hardwood swamps, marshes, springs and seeps, floodplain forests and wet meadows. Most of the upland forests, especially west of Sawkill Road and Route 209 have experienced some form of disturbance and fragmentation.

Significant disturbance has occurred with the construction of major highways that intersect in our study area including the north-south running Route 209 and NY State Thruway and the east-west running Route 28 and Route 209 as it turns for the Kingston-Rhinecliff Bridge. Not only do these roadways use the Esopus Valley as a corridor, they interrupt tributaries flowing into the Esopus at the Sawkill, further south near the Kingston Thruway exchange, and at numerous other locations.

This study area was chosen to facilitate a long-term collaboration between the City of Kingston and the Town of Ulster for the protection of valuable upland and floodplain habitat in this valley, while providing the necessary tools to local decision makers. The Biodiversity Assessment Team was made up of Ulster, Kingston and Red Hook residents, representatives from the Town of Ulster Planning Board, City of Kingston Conservation Advisory Council, the Kingston Land Trust, the Kingston Planning Department, and the Kingston Parks and Recreation Department. The team of eight brought together a variety of backgrounds, values and skills to create this valuable tool to be used here in the local communities.

This report should provide a glimpse into some areas often overlooked by the public and decision makers alike. It will outline the study methods, key habitats and predictions, recommendations for biodiversity protection as well as final conclusions, pertaining to land use decisions in the Kingston/Ulster Study Area.

METHODS

We used methods outlined in Hudsonia's Biodiversity Assessment Manual for the Hudson River Estuary Corridor (Kiviat and Stevens 2005)[2] and the Guidebook for Biodiversity Assessment (Heady and Stevens 2009)[3] for identifying and assessing ecologically significant habitats. We began the process of creating a habitat map for the study area by gathering important preliminary resources:

- 1:40,000 scale color-infrared aerial photograph prints 8077-88, 8077-89, and 8077-90 from the USGS National Aerial Photography Program series taken April 20, 1994.
- USGS 7.5 minute topographic maps including the Kingston East Quadrangle (1963, photo revised 1980) and the Kingston West Quadrangle (1997)[4]
- Bedrock geology maps produced by the New York State Geologic Survey. 1970.[5]
- Soil Survey of Ulster County, New York. 1979. [6]
- US Fish and Wildlife Service National Wetland Inventory (NWI) map on USGS Quads with NWI data 2009 and DEC data 2001 overlays.[7]
- New York Natural Heritage Program (NYNHP) records of known occurrences of rare species
- Color-infrared aerial orthophotos from the NYS GIS Clearinghouse taken in 2001[8]
- New online mapping resources such as Ulster County Parcel Viewer at http://gis.co.ulster.ny.us/ , Google Earth at http://maps.google.com/ , and Bing Maps at http://www.bing.com/maps/

We analyzed USGS topographic maps to identify physical features, such as elevation contours, steep slopes, and depressions that are useful for predicting the occurrence of certain habitats. We consulted the county soil survey for information pertaining to drainage, pH, depth to bedrock, parent material, texture, and slope and consulted the bedrock geology map for general bedrock types and chemistry in the study area.

Following the map analysis, we used pocket stereoscopes to view paired color-infrared aerial photographs of the study area, giving us a three-dimensional view of the landscape. The map analysis and stereoscopic

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[2] Kiviat, E. & G. Stevens. 2005. Biodiversity Assessment Manual for the Hudson River Estuary Corridor, Hudsonia Ltd., Bard College, PO Box 5000, Annandale, NY 12504, 508 p.

[3] Heady, L. & G. Stevens. 2009. Guidebook for Biodiversity Assessment, Hudsonia, Ltd., Bard College, P.O. Box 5000, Annandale, NY 12504, 86 p.

[4] See Finding and Ordering USGS Topographic Maps at http://topomaps.usgs.gov/

[5] Fisher, D.W., Y.W. Isachsen, and L.V. Rickard. 1970. Geologic map of New York 1970. New York State Museum and Science Service, Map and Chart Series 15, 5 sheets, 1:250,000, 100 ft contour.

[6] Tornes, L.H. 1979. Soil survey of Ulster County, New York. Soil Conservation Service, U.S. Department of Agriculture, Washington, DC. 273 p. + maps.

[7] Available through the US Fish & Wildlife Service National Wetland Inventory at http://www.fws.gov/wetlands/Data/Mapper.html

[8] Available through the NY Geographic Information Systems Clearinghouse at http://www.nysgis.state.ny.us/gateway/mg/

photo interpretation enabled us to predict where certain habitats are likely to occur within the study area. We traced the outline of each predicted habitat onto printed orthophotos to create a preliminary habitat map of the study area.

Upon completing the preliminary habitat map, team members visited sections of the study area to verify or correct the preliminary habitat map and to assess the character and quality of the habitats. We obtained landowner permissions through letters, emails, phone calls, or personal contact before visiting each site. We selected sites for field visits according to where we had landowner permissions, and where we had questions about habitat boundaries or habitat characteristics that could only be answered by field observations. For places where we could not get access permission, wherever possible we made observations from adjacent parcels, and from roadsides and other publically-accessible areas. During field visits, we recorded information on vegetation, wildlife, surface water characteristics, invasive species, evidence of disturbance, and evidence of current and past land uses. Many portions of the study area were not visited, however, due to time and permission constraints, but were nonetheless mapped using our remote analysis methods. We estimate that we field-checked approximately 50% of the study area.

It should be noted that some habitats such as Wet Clay Meadow (wcm), Calcareous Wet Meadow (cwm), Springs and Seeps, Crest, Ledge, and Talus (clt), and Calcareous Crest, Ledge, and Talus (cclt), highlight important limitations to our habitat mapping methods. These habitats are difficult to predict remotely, and must ordinarily be identified in the field so are likely under-represented on our final map. Also, because the mapped habitat boundaries for habitats are sketched and sometimes not directly field checked, the habitat map is suitable for general planning purposes and does not diminish the need for onsite observations for site-specific planning.

Hudsonia reports, DEC documents, municipal comprehensive plans, and EISs of projects in the vicinity, when available, were consulted for biodiversity and habitat observations that may be relevant to the study area. A number of indicator species for the various habitats were prevalent in our study area and New York Natural Heritage Program confirmed the existence of threatened Green Rock-cress in one specific portion of our study area.

The final habitat map of the City of Kingston and Town of Ulster study area was created by transcribing a preliminary map onto a large-format black and white orthophoto printout of the entire study area (1:6000 scale). Colors and symbols for each habitat type approximate those in Hudsonia's standard color palette for habitat maps.

RESULTS

GENERAL DESCRIPTION

The team conducted three field trips on July 9th, July 15th, and August 19th as a group and went back in smaller teams through the fall to field check specific areas with the intent of gathering observations in areas of particular interest based on the predictions. The first trip was to an area in the Town of Ulster adjacent to the Sewage Treatment Plant off Dogwood Lane and also to the northwest of the plant. The second was to Woods Road off Sawkill Road just to the west of the NY State Thruway, the City of Kingston reservoir off Sawkill Road, and a wetland at the intersection of Sawkill Road and Route 209. Finally, we explored the floodplain forest off Albany Avenue from an access point near Col. Chandler Drive (NYS 587) and other locations in the Town of Ulster in Lincoln Park and other access points on the eastern side of the Esopus Creek floodplain.

Thanks to the guidance and expertise of Hudsonia staff along with local knowledge and expertise of the members of the team, we gathered observations on data sheets that are the basis for the observations and conclusions, habitat by habitat, included in this section. We also photo documented our work and present recommendations for steps to be considered for each habitat.

HABITAT DESCRIPTIONS

UPLAND FORESTS

"Upland forests" are wooded areas comprised of hardwoods, conifers, or a mixture of the two. We estimate that between 15 and 20 percent of our study area is upland forest primarily along the ridges west of the NY State Thruway and Route 209 as it borders the Catskill Forest Preserve.

Figure 2: Upland Hardwood Forest - Photo by Nora Budziak

The forest patches in our study area range from a few acres to well over 250 acres. These areas are largely undisturbed (at least in recent memory) with the exception of social trails which seem to be used by ATVs and other recreational uses such as hunting, hiking and the like. There are also areas where mining has taken place and some where it is now being done. Some of the old sites are recovering and developing a signature habitat.

Forests of all kinds are important habitats for a great variety of mammals, birds, reptiles, and amphibians. Large unfragmented forests are especially important for certain organisms, but are increasingly rare in the region. Upland forests provide habitat for raptors such as red-shouldered hawk, sharp-shinned hawk (both NYS Special Concern), and broad-winged hawk. Many songbirds such as black-throated blue warbler (NYS Species of Greatest Conservation Need [SGCN]), cerulean warbler (NYS Special Concern), Kentucky warbler (NYS SGCN), and scarlet tanager (NYS SGCN) require large forested landscapes for successful nesting in the long-term. Upland conifer and mixed forests, even small ones, can be used by long-eared owl (NYS SGCN) and barred owl and other raptors such as Cooper's hawk (NYS SGCN) for roosting and nesting habitat. Songbirds of conservation concern such as pine siskin, red-breasted nuthatch, Blackburnian warbler (all regionally rare breeders), and black-throated green warbler nest in conifer or mixed forests.

Figure 3: Red-Shouldered Hawk - Photo by Nora Budziak

Pool-breeding amphibians such as Jefferson, marbled (both NYS Special Concern) and spotted salamanders and wood frog spend most of their adult lives in upland hardwood forests. Many snakes forage widely in upland forests and meadows, and eastern box turtle and spotted turtle (both NYS Special Concern) spend much of their time in upland forests and other upland habitats. Upland forests are also important for many large mammals such as black bear, bobcat, and fisher which require large expanses of forest to sustain local populations.

Hardwood trees greater than 5 inches dbh (diameter at breast height) and with loose flaky bark, such as shagbark hickory, black locust, and old sugar maples, can be used by Indiana bat (NYS Endangered) and eastern small-footed myotis (NYS Special Concern) for summer roosting and nursery colonies.

The New York Natural Heritage Program has historic records of rough avens (Geum virginianum) and woodland agrimony (Agrimonia rostellata) in the Town of Ulster. These are both plants of moist upland forests, and could occur in such forests in the study area and elsewhere in Kingston or Ulster.

The Hemlock woolly adelgid is a non-native invasive insect that is weakening and killing many of our eastern hemlocks in the lower and mid-Hudson Valley. Many of the hemlock forests in the region may disappear or change dramatically over the next few decades. This magnifies the importance of conserving stands of healthy hemlocks; if some possess natural protections against the adelgid they may survive.

Further fragmentation by residential or other development is one of the greatest threats to forest habitats in the region. Roads, driveways, and other corridors that cut into forest interiors provide access for nest predators such as raccoons and skunks, nest parasites such as the brown-headed cowbird, and invasive non-native plants that would otherwise be confined to forest edges. Forest fragmentation seems to be a significant factor in the decline of many species of interior-forest songbirds in the Northeast. Soil compaction or other disturbance to the forest floor can destroy habitat for salamanders and other amphibians that need the loose organic duff and coarse woody debris typical of an intact forest.

Figure 4: Indian Pipe in Upland Forest – Photo by Nora Budziak

In addition to the wildlife habitat values, upland forests of all kinds provide essential protections to the quality and quantity of our surface and groundwater resources. They promote maximum infiltration of precipitation and snowmelt to the soils, thereby reducing sheet runoff at the surface—a major cause of soil erosion, stream scouring, and damaging floods—and increasing groundwater recharge, thus helping to insure adequate groundwater volumes available to feed streams and wetlands during drier periods of the year. Also, forests are among the most effective kinds of land cover for long-term carbon sequestration in above-ground and below-ground biomass. Maintenance and expansion of forested areas helps to offset carbon emissions to the atmosphere from other human activities.

We recommend that large forests be maintained intact, without fragmentation wherever possible, and that the vegetation and floors of forests of all sizes remain undisturbed to protect their values for habitat, for water resources, and for carbon sequestration. Forests adjacent to other sensitive areas, such as streams, woodland pools, other wetlands, and ledges have particular importance for supporting the ecology of those habitats. A healthy forest provides protection essential to the quality and well being of our surface and ground water providing a maximum ratio of precipitation and snowmelt to erosion stream scouring and floods. The forest along our waterways is imperative for flood control as well as maintaining a healthy temperature in this period of climate change. Nutrients are both retained and collected from flooding and runoff that would be otherwise washed away.

Logging should be restricted to winter months minimizing the damage to the soil, vegetation and the wild population. Steep slopes should be avoided to retain erosion control and conserve soil fertility. Traffic should be minimized especially that of ATVs and bikes possibly using forest edges. Placement of large forested tracts in Land Trust or economic incentive programs such as forest banking for the preservation of upland forest is recommended. Also conservation easements should be considered.

Trees keep our homes warmer in the winter and cooler in the summer. They provide a buffer for noise and light pollution as well as providing habitat for many birds and mammals. Communities should establish incentives to plant trees in residential areas--One tree does not a forest make but it is a beginning!

UPLAND HARDWOOD FOREST (uhf)

"Upland hardwood forests" are forests with hardwood trees representing more than 75% of the canopy. In our study area, the largest percentage of forest is of this type. Some of the most common trees making up the canopy of the hardwood forest in this region include the oaks and hickories i.e. the red, black, chestnut, white and pin oaks and shagbark and pignut hickories, along with red maple, sugar maple, American beech, tulip tree, basswood, and black birch. Black cherry, sassafras, American chestnut, hop-hornbeam, dogwood, and witch-hazel are often found in the understory. Maple-leaf viburnum, serviceberry, and others make up the shrub layer. The ground layer often has a variety of forest herbs such as Christmas fern, hay-scented fern, New York fern, lady fern, wild sarsaparilla, starflower, trillium, wild ginger, foam flower, jack-in-the-pulpit, Canada mayflower, and many others.

The largest forests tracts are on the ridges in the area west of the NYS Thruway and Route 209 which are contiguous with the Catskill Forest Preserve. The forests in the study area are fairly undisturbed in recent years, allowing the trees to reach larger sizes. Canopy trees, typically oak and hickory, range from 12 inches dbh to several feet.

Figure 5: A large solitary tree in upland forest near Esopus Creek in the Town of Ulster taken earlier in the year - Photo by Brandi Budziak

Embedded in the forested areas are many unique and remarkable habitats each with their individual footprint. There exist many woodland pools, some of the intermittent type, and others that stay full throughout the seasons. Hardwood swamps are common throughout the study area, especially in the Esopus floodplain.

Figure 6: Mixed Forest above Sawkill Road - Photo by Andrew Meyer

Within many of the forests we observed the occasional large, older tree. These trees, often an oak or sometimes a cottonwood, seem to have survived an earlier clear cutting for firewood, charcoal production, or to make way for agricultural uses and stand out as we explore the woodlands today. We presume they are evidence of some very intentional use, such as shade trees for houses or dairy cattle, in the past.

UPLAND MIXED FOREST (umf)

The term "upland mixed forest" refers to upland (non-wetland) forests with 25-75% deciduous vs. coniferous cover. This habitat has various combinations of the species of hardwood and conifer forests described above, including oaks, maples, American beech, eastern white pine, and eastern hemlock. We observed this habitat primarily in the upland areas west of the NYS Thruway and Route 209. It was sometimes difficult to differentiate between what we might call coniferous upland and mixed.

UPLAND CONIFER FOREST (ucf)

"Upland conifer forest" is an upland (non-wetland) forest with more than 75% cover of conifers in the canopy. The native conifers common in this region are the eastern hemlock, white pine and red cedar. The Upland Conifer Forest is the forest type least represented in the study area with rather small patches of conifers of less than an acre to ten acres along route 209 and others represented in plantations around the Kingston reservoir, Manor Lake and many residences. It is possible that these trees were planted in the early 1950s when trees were being provided as seedlings by agricultural agencies to the general populous. Many of these trees are non-native species i.e. blue and Norwegian spruce, in addition to those indigenous to the area.

The conifer forest is denser than other forest types with a sparse understory of woody and herbaceous vegetation. The cool and well shaded forest floor has a dense mat of compacted material of an undesirable chemical nature that is not conducive to the establishment of many plants. There is an abundance of shade loving species i.e. moss, lichen, fungi, ferns and a few select flowers, Indian pipe, trailing arbutus, and the like. The largest stands of conifers are embedded in the hardwood and mixed wood forest all west of the NYS Thruway. The remaining conifers are planted in and around developed areas. Even still, they provide a much needed habitat for specific species since many birds prefer to nest in conifers.

FLOODPLAIN FOREST (ff)

"Floodplain forests" are forested areas on the floodplains of perennial streams. Some are flooded only occasionally (every few years or few decades), while others are flooded annually or more frequently. Those that are flooded frequently or have saturated soils for prolonged periods during the growing season are wetlands or hardwood swamps. Those forests that go for extended periods between flooding and have drier soils would more likely be referred to as upland forest. Because the wetland and non-wetland areas of the forest are often hard to distinguish and are often intertwined in very complex configurations in the floodplain, we mapped the "floodplain forest" as a single habitat type, intending to include the likelihood of both upland and wetland areas.

Floodplain forests often have well developed forest canopies of species such as red maple, sugar maple, silver maple, American sycamore, eastern cottonwood, river birch, American elm, pin oak, red oak, and shagbark hickory. The understory is variable and contingent on the degree and amount of flooding. Those areas with less frequent flooding tend to have an array of native shrubs and small trees such as the American hornbeam, hackberry, spicebush as well as non-native shrubs like Bell's honeysuckle and Japanese barberry. The forest floor may be densely or sparsely vegetated.

Figure 7: Exploring the Floodplain Forest led by Tom Pfeffer - Photo by Steve Noble

Floodplain forests provide habitat for a tremendous array of resident and transient wildlife (both common and rare), and are known to support numerous rare plant species, such as Davis' sedge, diarrhena, and cattail sedge (all NYS Threatened). The wood turtle (NYS Special Concern) uses floodplain forests and other habitats within and outside the floodplain for foraging and estivation (also known as "summer sleep", a state of animal dormancy somewhat similar to hibernation but observed during the warmer months). The red-shouldered hawk (NYS Special

Concern) often nests in large forested areas along perennial streams, and the cerulean warbler (NYS Special Concern) often nests in large hardwood trees near streams. American woodcock (NYS SGCN) forages in moist forests, shrublands, and meadows along streams and elsewhere. The river otter (NYS SGCN) uses floodplain forests and other riparian habitats for travel corridors and cover.

Organic detritus from floodplain forests contributes very significantly both to the physical structure of stream habitats and to the food webs of streams, and forested floodplains help to maintain the cool stream water temperatures that are so important to stream organisms of conservation concern. Well-vegetated forests along streams can be extremely effective at removing nutrients from sheet runoff before it enters the stream, and at absorbing floodwaters and dampening downstream flows during flood events. Because of their great importance to maintaining stream water quality and habitat quality, and their habitat values in their own right, we recommend that floodplain forests be maintained and restored wherever possible, and protected from human activities that would significantly disturb the vegetation, organic debris, or soils.

INTERMITTENT WOODLAND POOL (iwp)

"Intermittent woodland pools" are small temporary pools of water that generally appear in the spring from snow melt or heavy spring rains and sometimes also form in the fall of the year. The hydroperiod varies from year to year depending on precipitation, soils, and other factors. Some IWP's are flooded through summer and fall in the wettest years, but dry up early to mid-summer in a normal precipitation year. These pools are usually well under .2 to perhaps 1.2 acres and are typically isolated from other bodies of water and wetlands, but may also be part of wetland complexes or larger swamps. They are found in small depressions or swales in the forest and generally have no defined inlet or outlet. During the dry season these depressions will be characterized as having a floor of matted and dark-stained leafpack, and sometimes waterline marks can be seen on the adjacent trees. The leafpack usually remains wet or damp during seasonal drawdowns. There is usually a fringe of large trees at the pool edge and the bordering trees are most often hardwoods but may also, in few instances, be conifers. The pool is moderately to heavily shaded when woody plants are in full leaf and the perimeter is substantially wooded. The pool often has little or no vegetation and some pools have scattered trees and shrubs on woody hummocks, and other plants such as ferns, sedges and mosses. The surface water is usually neutral to moderately acidic, usually 10-50 inches deep and often moderately to heavily stained by organic substances from decaying leaves.

Figure 8: An Intermittent Woodland Pool east of the Esopus - Photo by Andrew Meyer

Because these temporary pools do not support fish populations, they provide excellent amphibian habitat that allows for amphibian eggs to develop without high losses due to fish predation. Intermittent woodland pools provide critical breeding and nursery habitat for Jefferson and marbled (both NYS Special Concern), and spotted salamanders as well as wood frogs. These amphibians spend most of their adult lives in the surrounding upland forest and often travel 750-1500 feet and more from the breeding pool. During the non-breeding season, these amphibians are exclusively terrestrial and require the deep shade and deep leaf litter, fallen logs and uncompacted soil of the surrounding upland forest for shelter and foraging. The habitat

complex of pool and forest is essential to the perpetuation of these amphibian populations, which are themselves an important part of the food base and general ecology of the upland forest. Intermittent woodland pools are also important habitat for spotted and wood turtles (both NYS Special Concern), which range widely over the landscape using a complex of wetland and upland habitats. Wood duck (regionally vulnerable) and American black duck (NYS SGCN) and many other birds as well as regionally rare invertebrates such as black dash (a butterfly) and springtime physa (a snail) use intermittent pools as well.

Figure 9: An Intermittent Woodland Pool in Floodplain Forest near the Town of Ulster Sewage Treatment Plant - Photo by Gregg Swanzey

We mapped two intermittent woodland pools in our study area and because these pools are typically small and often difficult to identify from aerial photographs, it is expected that there may be others that may have been missed, especially in the upland hardwood forests at the western end of our study area. The first pool we located was in a floodplain forest in the middle of a flat terrace above the Esopus just northwest of the Town of Ulster sewage treatment plant (Figure 9). This 50x100 foot pool was compliant with most of the typical characteristics of a woodland pool but there was also evidence that perhaps it may have been constructed for the purpose of providing water for cattle as part of a farming operation that once existed at this site. The pool was surrounded by mature oaks, there were few plants in the pool and there was no inlet and outlet, however due to intermittent flooding of the nearby Esopus, it is likely that fish intrusion exists. Because fish prey on the eggs and larvae of pool breeding amphibians, this particular pool is unlikely to support significant populations of those species. A springtime visit will be planned to observe the dynamics of this pool during a normal hydroperiod. Although intermittent woodland pools are generally excluded from state and federal maps and protection laws because of their small size, their isolation from other wetland habitats and the intermittent nature of surface water, this particular pool is designated as PEM1E on the Federal Wetland map.

The second pool was located in an upland hardwood forest located northwest of the Cherry Hill subdivision. It is approximately 35x70 feet with a narrow 20 foot long swale and is located approximately 600 feet north of a constructed pond which has a marshy periphery. There was an absence of standing water but the characteristic matted and water stained leafpack was evident throughout the floor bed of the pool. There was no vegetation in the pool and it was surrounded by mature black oak, blueberry and some fern understory.

The function and value of intermittent woodland pools is often misunderstood, misrepresented or ignored in environmental reviews of development proposals and during project review processes. To help protect pool-breeding amphibians and the habitat complex they require, intermittent woodland pools must be protected from any disturbance and development and the surrounding forest must be protected within a minimum of 100 feet of the pool. Additionally, wherever possible, the upland forest within 750 feet of the pool, serving as critical terrestrial habitat, should be protected from development disturbance. The surface and subsurface water sources which feed these pools must be maintained and protected from pollution and sedimentation. Intermittent pools should not be utilized for stormwater detention. Consider design features in developed areas which will prevent entrapment of migrating amphibians such as window wells, storm drain

catch basins, etc. Fragmentation of upland forests must be avoided as a means of preserving migration corridors between pools.

HARDWOOD SWAMP (hs)

A "hardwood swamp" is a wetland dominated by deciduous trees or shrubs. For the purposes of this report, both forested swamps and shrub-dominated swamps will be included in this category due to the difficulty of distinguishing between the two using remote sensing methods. Swamps can be extremely variable in their structure, hydroperiod, and vegetation. The most common trees of hardwood swamps in the region are red maple, green ash, American elm, and swamp white oak. Typical shrubs and herbs are highbush blueberry, northern arrowwood, silky dogwood, alder, tussock sedge, marsh fern, royal fern, and skunk cabbage.

Figure 10: Hardwood Swamp just west of Tech City off Route 209 - Photo by Gregg Swanzey

Hardwood swamps are used by a great variety of resident and transient wildlife, including reptiles, amphibians, birds, and mammals, and often support many species of conservation concern. For example, four-toed salamander (regionally scarce) occurs in swamps with moss-covered hummocks, logs, and rocks. Small swamps or woodland pools may provide breeding habitat for mole salamanders such as blue-spotted and marbled salamander (both NYS Special Concern), though they spend most of their adult life in the surrounding upland forest. Spotted turtle and wood turtle (both NYS Special Concern) use swamps and other wetlands for foraging, resting, and rehydrating. Prothonotary warbler (NYNHP S2), white-eyed vireo (regionally scarce breeder), and hooded warbler (regionally rare breeder) nest in swamps.

Figure 11: Hardwood Swamp behind the Town of Ulster Sewage Treatment Plant - Photo by Gregg Swanzey

We found numerous hardwood swamps throughout the study area, especially on the eastern side of the Esopus Creek in the floodplain forest areas characterized by oxbow lakes and tight meanders of the creek. Other areas were at the base of the Onondaga limestone bedrock formation where tributaries drained into the Esopus from the higher ground along Albany and Ulster Avenue and Boices Lane.

The structure, vegetation type and size of these swamps varied depending on location and whether shrubs or hardwood trees were the dominant vegetation type. Swamp size generally ranged from several acres to 12 acres or more. Standing water and wetland plants were present in the shrubby swamp areas. Swamps dominated by trees also contained standing water in pools interspersed with areas of ground cover (jewelweed and other wetland plants) with no visible standing water. One of the larger hardwood swamp areas appeared to have contained an area of standing water immersed with dead trees, although, it was viewed from a distance and would need a field check for verification.

All swamps in the study area were located by remote sensing techniques and then verified with field trips to specific locations.

Remote sensing allows for the identification of shrubby or hardwood areas that contained water, while field trips allowed for the identification of vegetation and wildlife. Shrubby vegetation included plants such as Bell's honeysuckle, hollow Joe-Pye weed, pokeweed, multiflora rose, field horsetail, soft rush, sensitive fern, lurid sedge, deer-tongue grass, reed canary grass, common jewelweed, purple loosestrife, fringed loosestrife, Canada thistle, rough-stemmed goldenrod, grass-leaved goldenrod, and a few staghorn sumac and tree-of-heaven individuals. Other wetland indicator plants that were found in the hardwood swamps in study area included pin oak, northern arrowwood, and fowl mannagrass.

The species composition of swamps varied through the study area. Some hardwood swamps were dominated by red maple trees which contained eastern cottonwood, green ash, hop-hornbeam, spicebush, northern arrowwood, Bell's honeysuckle, skunk-cabbage, and phragmites. Other areas of hardwood swamp had a species composition of river birch, American elm and pin oak with silky dogwood and Bell's honeysuckle in the shrub layer and skunk cabbage below. (River birch is uncommon in the Hudson Valley, except along the larger streams in Ulster County and South.) Throughout much of the hardwood forest areas in the riparian corridor where elevation was lower we found wet areas with a dense cover of jewelweed. In other instances, along the floodplain areas of the Esopus, we found areas of forest that were lower in elevation and significantly wetter where the understory was sparse due to a very thick canopy above. Theses hardwood swamp areas were dominated by American elm, red maple, sugar maple, river birch, and black cherry. A few areas mapped as hardwood swamp contained small trees and shrub dominated wetlands where vegetation included shagbark hickory, eastern cottonwood, butternut, silky dogwood, common buckthorn, staghorn sumac, golden rods, a fleabane and sensitive fern.

There were two areas in the floodplain hardwood swamp habitats that contained pools thought to be IWPs. Upon further investigation we decided these areas were likely to support fish in flooding years and therefore could equally well be categorized as hardwood swamp. These were areas of ~6 inches of standing water where the dbh of the vegetation was about 6-15 inches. However in years when the Esopus does not flood, these two woodland pools may have the characteristics of an intermittent woodland pool and support breeding amphibians.

For the most part the trees were relatively young, measuring between 6-12 inches dbh, unless the area was shrub dominated, in which case the trees present were even less mature. There was one area of hardwood swamp that could have contained more mature trees and it also contained a stand of dead trees, which looked to be less disturbed than the other areas. Most of the areas along the Esopus Corridor have been disturbed at one time or another, however, they still appear to be intact and the placement next to other wetland and upland areas makes them structurally complex. In most cases, the areas of hardwood swamp were adjacent to areas of marsh, wet meadow, upland meadow, upland shrubland, and upland forest. The fact that there is a matrix of habitat types and that the areas next to the Esopus were relatively large tracts of undeveloped land contribute to the significance of these habitats despite the human disturbance that does prevail in most areas in the study area.

Small swamps embedded in upland forest are often overlooked in environmental reviews, but can have extremely high biodiversity value, and play similar ecological roles to those of intermittent woodland pools. Swamps in general can be very sensitive to changes in water quality, quantity, and the timing of water level fluctuations. Development such as roads, driveways, and houses in the watershed of a swamp often alters the water quality through inputs of pesticides and fertilizers, as well as modifying the volume and timing of water flowing into the swamp. In addition, many of the species of conservation concern that use swamps need access to a variety of other habitats nearby, so the fragmentation caused by development can render the landscape unsuitable for these species. Direct disturbance, such as logging, can damage soil structure, plant communities, and microhabitats, and provide access for invasive plants. Ponds for ornamental or other purposes are sometimes excavated in swamps, but the habitat values of the pre-existing swamp are usually far greater than those of the new, artificial pond environment.

We recommend that new roads, driveways, and other development be concentrated in areas already fragmented or otherwise altered, and that road engineering and management, such as road size, ditch and

culvert design, and de-icing applications be altered to reduce harm to nearby swamps. As with other wetlands, we recommend that broad conservation zones be established around swamps to help protect the habitat quality of the swamp, the connectivity with other wetland and upland habitats, and safe travelways for mobile wildlife moving between habitats. Stormwater runoff from impervious surfaces or from fertilized turf should be directed away from the swamp and a broad zone of undisturbed soils and vegetation should be established and maintained around the swamp.

UPLAND SHRUBLAND (us)

"Upland shrubland" is a term for non-wetland areas dominated by a mix of shrubs and herbaceous (non-woody) vegetation. Upland shrubland typically occurs as a successional stage between an upland meadow and young forest. Shrubland also commonly occurs along utility corridors, and establishes quickly on clearcut logging sites, and after forest fires or blowdowns. A good example of shrubland can be seen along power line corridors in the western part of the study area above the Route 209 corridor on both sides of the highway.

Figure 12: Upland Shrubland - Photo by Gregg Swanzey

Upland shrubland habitats are used by a wide variety of animals including mammals, birds, reptiles, and invertebrates. Predators such as owls, hawks, eastern coyote, and foxes hunt in open shrublands, where populations of small mammals (e.g., meadow vole) are often large. Songbirds of conservation concern that nest in shrublands and adjacent meadows include golden-winged warbler (NYS Special Concern), blue-winged warbler (NYS SGCN), prairie warbler (NYS SGCN), yellow-breasted chat (NYS Special Concern), brown thrasher (NYS SGCN), and northern harrier (NYS Threatened). American woodcock (NYS SGCN) uses these habitats for nesting and foraging. Upland shrublands and other non-forested upland habitats may be used for nesting by painted turtle, snapping turtle, wood turtle, spotted turtle, and eastern box turtle (the latter three are NYS Special Concern). Regionally rare butterflies such as Aphrodite fritillary, dusted skipper, and Leonard's skipper may occur in shrublands where their host plants are present.

We found upland shrubland in the cleared areas amidst the upland hardwood and mixed hardwood forest areas, especially where corridors have been created and maintained for power lines. In addition, some of the agricultural fields off Sawkill Road and areas in the floodplain that were in agricultural are no longer in agricultural use and so are reverting to shrubland. In some cases, these areas are regularly inundated by flooding over the banks of the Esopus Creek.

Shrubland areas ranged from < 1 acre to over hundreds of acres. Most were on abandoned farmland or in the many utility corridors transiting the study area from north to south along the forested ridges west of the Thruway or crossing the Esopus Creek just south of Route 209 near the Town of Ulster sewage treatment plant. Typical species included common elder, basswood, staghorn sumac, pussy willow, multiflora rose, Bell's honeysuckle, nannyberry, blackberry, poison-ivy, deer-tongue grass, smooth brome, common milkweed, fringed loosestrife, daisy fleabane, Canada goldenrod, Canada lily, mugwort, groundnut and many other species.

The occurrence of upland shrubland at any particular location is usually short-lived and is often a transitional habitat between meadow and forest. Without continued maintenance or natural disturbance, most shrublands will develop into forest—another valuable habitat. Also, like meadows, shrublands are often attractive for land development. Any shrubland known to support rare species may require special protection from development and/or active management if it is to continue to provide habitat for those species. Mowing every 3-5 years and late in the season prevents the development of forest and allows for successful fledging of ground-nesting birds. Also, prescribed burning under the right conditions or mowing in rotation may promote suitable habitat for shrubland birds and butterflies. We recommend that the habitat values of shrublands be considered during the environmental reviews of development proposals and that, wherever possible, large shrublands remain unfragmented, and with broad connections to other intact habitat areas.

Figure 13: Canada Lily in an Upland Shrubland - Photo by Steve Noble

UPLAND MEADOW (um)

An "upland meadow" is any non-wetland area dominated by herbaceous (non-woody) vegetation. The term encompasses hayfields, pasture, crop fields, herbaceous old fields, large, mowed grasslands, and similar non-forested areas. The flora of meadows can be extremely variable depending on land use history, soil characteristics, and other factors. Some typical plants of abandoned agriculture fields, for example, are grasses such as timothy, orchard grass, sweet vernal grass, and little bluestem, and forbs such as clovers, goldenrods, asters, wild madder, common buttercup, and common milkweed.

Figure 14: The Team explores an upland meadow near the Town of Ulster Sewage Treatment Plant that was reverting from agricultural use - Photo by Andrew Meyer

Upland meadows can be important habitats for many invertebrates, reptiles, mammals, and birds. Weedy old fields, in particular, can be especially valuable for invertebrate diversity. Butterflies, moths, bees (including many native wild species), dragonflies, damselflies, ground beetles, and many other groups take advantage of a diverse plant community and the microhabitats that develop over time in the soils and above ground in an unmanaged meadow. Regionally-rare butterflies such as Aphrodite fritillary or dusted skipper may occur where their larval food plants (in these cases, violets or little bluestem) are present. Old fields and other kinds of unmanaged meadows can support many of the native pollinators essential to local agriculture and native plant communities alike. Upland meadows can be used for nesting by wood turtle, spotted turtle, box turtle (all are NYS Special Concern), painted turtle, and snapping turtle. Upland meadows often have large populations of small mammals (e.g., meadow vole) and are thus important hunting grounds for predators such as raptors, foxes, and coyote. Extensive upland meadows can serve as critical habitat for grassland-breeding and foraging birds such as northern harrier, upland sandpiper, sedge wren (all are NYS Threatened),

bobolink, and eastern meadowlark (both NYS SGCN). Grasshopper and vesper sparrows (NYS Special Concern), upland sandpiper, and Henslow's sparrow (both NYS Threatened) require particularly large meadow habitats for sustainable populations.

Figure 15: Upland Meadow near the Floodplain Forest behind Tech City just off Route 209 - Photo by Gregg Swanzey

The NY Natural Heritage Program (NYNHP) reported an historic occurrence of rattlebox (Crotallaria sagittalis) in the study area. Rattlebox is a plant of dry, disturbed, non-forested areas and could occur in dry meadows of the study area, including abandoned soil or rock mines where vegetation is becoming reestablished.

The largest meadow complexes in the study area are found in the floodplain along the Esopus Creek and typically continue to be farmed. These are active or recently abandoned agricultural fields comprising hundreds of acres, and are well-connected to undeveloped upland hardwood forests as well as floodplain forests and other habitats such as marshes. Many smaller meadows are well-distributed throughout the study area; most are hayfields, pasture, and small crop fields. In those fields where agricultural use had been discontinued recently and where many herbaceous species were taking hold we observed many scattered individuals of blackberry, a great variety of grasses and forbs typical of old fields in the region – timothy, red clover, white clover, hop clover, alsike clover, common cinquefoil, common plantain, English plantain, Queen Anne's lace, purple loosestrife, common mugwort, daisy fleabane, common daisy, and several species of goldenrod including rough-stemmed goldenrod and Canada goldenrod. Staghorn sumac and gray birch also become established. Some of the many common bird species are tree swallows, blue jays, northern cardinals, and song sparrows.

Many meadows in the Hudson Valley have been lost due to widespread abandonment of farming in the region and subsequent development of former farmland or transition to shrubland and forest. Grassland breeding birds have been declining in the Northeast for several decades, apparently due to the loss of meadow habitats. Most of these grassland breeders require meadows of 25 acres and larger, and several require more than 100 acres of contiguous upland meadow unfragmented by roads or hedgerows to sustain breeding populations in the long term. For this reason, large meadow complexes deserve special conservation attention and development and human disturbances should be minimized. However, upland meadows of any size can be important for other plants and animals, and especially those meadows that are substantially contiguous with other intact habitats.

Some of the biodiversity values of upland meadows can be enhanced by certain kinds of management. Abandoned meadows that are not developed tend to revert rapidly to shrubland and then forest (these are also valuable habitats, though more common than large [>100 acres] meadows in the Hudson Valley). Where landowners are able to manage meadows for their habitat values, certain practices will help to reduce harm to sensitive bird species. For example, mowing late in the season (e.g., August or later) inhibits woody plants while still protecting ground nests until the young have fledged. Burning or mowing in rotation may promote suitable conditions for birds and butterflies (but prescribed burning should only be planned and undertaken by experts). Light grazing by livestock can be compatible with nesting grassland birds, but overgrazing is likely to expose the nests to harm. Overgrazing can also severely damage the soils, and degrade the future agricultural and habitat values.

We recommend that large meadows and meadow complexes, meadows in active agricultural use (crop fields, hayfields, pasture, orchards), and meadows underlain by Prime Farmland Soils or by Farmland Soils of Statewide Importance receive special conservation attention. Any new development proposed for such areas

should be designed such that the meadows are not fragmented by roads, driveways, or structures. Instead, new developed features should be located at the meadow edges and close to existing roads and other developed uses, so that the meadows remain substantially intact. In addition to the habitat values of large meadows, maintaining our ability to produce food locally has obvious advantages to the Kingston and Ulster communities as a whole.

Although we recommend conservation of existing upland meadows with high biodiversity value or agricultural potential, we also recommend avoiding further conversion of forest to meadow and perhaps even allowing some meadows (particularly smaller ones, or those that are contiguous with areas of upland forest) to revert to shrubland and forest. Most upland meadows in this region were once forested, and forests have tremendous value for maintaining water resources, storing carbon, and supporting biodiversity.

Figure 16: Wet Meadow off Woods Road - Photo by Andrew Meyer

WET MEADOW (wm), CALCAREOUS WET MEADOW (cwm), AND WET CLAY MEADOW (wcm)

A "wet meadow" is an open unforested wetland, dominated by herbaceous (non-woody) vegetation, and inundated for only brief periods, if at all, during the growing season. Our study area has many wet meadow habitats on active or abandoned farmland.

Figure 17: Swamp Dodder common on Woods Road - Photo by Andrew Meyer

We identified three categories of wet meadows: calcareous wet meadow (cwm), wet clay meadow (wcm), and wet meadow (wm). A "calcareous wet meadow" is a wet meadow with calcareous (calcium-rich) soils that supports a calcicolous (calcium-loving) plant community. A "wet clay meadow" is a wet meadow on clayey soils with a distinctive plant community. We use the term "wet meadow" as a catch-all to include any wet meadows that were lacking indicators of either of those two habitats, as well as any that we did not visit.

Figure 18: Blue Vervain off Woods Road, a calcicole - Photo by Andrew Meyer

Typical plants of wet meadows of all kinds includes sensitive fern, reed canary-grass, cattail, soft rush, woolgrass, spotted Joe-Pye weed, late goldenrod, wrinkle-leaved goldenrod, grass-leaved goldenrod, and many other wetland graminoids and forbs. Calcareous wet meadows are likely to have any of those species, but also calcicolous plants such as pendulous bulrush, yellow sedge, sweet flag, angelica, blue vervain (figure 18), New York ironweed, and rough-leaved goldenrod. Wet clay meadows could have any of the above-listed plants, but also may have such species as pineapple sedge, Bush's sedge, (abundant) fox sedge, beardtongue (figure 19), and small-flowered agrimony.

Wet meadows of all kinds can provide habitat for a large array of invertebrates, reptiles, birds, and mammals of conservation concern. Butterflies such as black dash, meadow fritillary, and two-spotted skipper (all regionally rare) may occur if their larval host plants are present. Spotted turtle, wood turtle (both NYS Special Concern), and eastern ribbon snake (NYS SGCN) use wet meadows as part of their larger habitat complexes. Sedge wren (NYS Threatened), Virginia rail, and American woodcock (NYS SGCN) use wet meadows for a variety of purposes including nesting, foraging, or courtship displays. Calcareous wet meadows may have rare plants such as bog valerian or ovate spikerush (both NYS Endangered), and rare butterflies such as Dion skipper (NYNHP Watch List) or Baltimore (regionally rare). Wet clay meadows may have rare plants such as Frank's sedge (NYS Endangered) and small skullcap (NYNHP Watch List). The New York Natural Heritage Program has an historic record of prairie wedgegrass (Sphenopholis obtusata) in the Town of Ulster. This is a grass of moist meadows, stream banks, and the shores of ponds and lakes, and it could occur in wet meadows of the study area and elsewhere in Kingston and Ulster.

The central portion of the study area, along either side of the Esopus Creek, consists of large upland meadow agricultural areas. In these areas are portions of land that remain wet due to their location in the floodplain. These areas are considered wet meadows, containing a variety of vegetation and common animals: Joe-Pye weed, goldenrod, red-winged blackbird, garter snake, etc. Invasive species are also present in abundance, including common reed and purple loosestrife. The group researched the soil surveys taking notice of areas of calcareous soils and clayey soils, however, did not find any instances of these habitats in the field. The soil surveys are included as an appendix in the report and should be given careful consideration on a parcel by parcel basis during any review process.

Wet meadows of all types rely on the continuation of their water regime; changes in the water quality, quantity, or timing can significantly alter their value for rare and common species. Increased impervious surfaces and surface runoff containing fertilizers, pesticides, or road de-icing chemicals in the watershed of a wet meadow is likely to degrade the habitat. Low-intensity grazing and hay production can be compatible with the biodiversity values of these habitats, but overgrazing or other high-intensity uses can cause long-term damage to the soils, eliminate sensitive plant species, and invite non-native weeds. Large stands of invasive species such as purple loosestrife or common reed (Phragmites) may reduce the habitat quality of wet meadows for an array of native organisms, but small stands or scattered individuals of these plants appear to be harmless.

Figure 19: Beardtongue, a wet clay meadow indicator species observed on the edge of a mowed utility corridor near the Town of Ulster Sewage Treatment Plant– Photo by Andrew Meyer

Wet meadows that are part of larger complexes of meadow and shrubland habitats are prime sites for development, are often drained, filled, or excavated, and are frequently overlooked in environmental reviews due to their small size, the absence of standing water, and their possible isolation from other wetlands or streams. We recommend that wet meadows be carefully delineated and mapped onto site plans, and that their habitat values be considered along with those of other wetlands in the course of project reviews. We recommend that broad buffer zones of undisturbed soils and vegetation be maintained around wet meadows, and that broad contiguity with other habitats be maintained as much as possible. Where wet meadows are part of large meadow complexes, we recommend that the complex be maintained intact as much as possible, without fragmentation by roads, driveways, or other developed uses. Also, for wet meadows that are part of large, mowed meadow complexes, we recommend that mowing be postponed until late in the season (e.g., August) to minimize harm to ground nests of grassland birds.

MARSH (m)

A "marsh" is a wetland dominated by herbaceous (non-woody) plants and characterized by standing water throughout most or all of the growing season. During our field visits we observed a typical marsh in the area at the foot of Woods Road just off Sawkill Road west of the NY State Thruway and also off Sawkill Road near the Route 209 exchange in the northern part of study area. Marshes are also numerous in areas nearer to the Esopus Creek. The plant communities of marshes can be quite variable, but often contain plants such as tussock sedge, cattail, common reed (Phragmites), bur-reed, pickerelweed, and purple loosestrife. There may also be scattered shrubs such as silky dogwood and trees such as green ash and American elm.

Figure 20: Lily Pads - Photo by Nora Budziak

Marshes are used by a great variety of rare and common wildlife species. American bittern (NYS Special Concern), least bittern (NYS Threatened), Virginia rail (regionally scarce breeder), sora (regionally rare breeder), American black duck (NYS SGCN), wood duck (declining), and marsh wren (regionally scarce breeder) use marshes for nesting or nursery habitat. Pied-billed grebe (NYS Threatened) nests in marshes bordering large open water areas. Many raptor and mammal species use marshes for foraging. Reptiles such as spotted turtle (NYS Special Concern) and amphibians such as blue-spotted salamander (NYS Special Concern) use marshes at certain times of the year.

Figure 21: A Rose-breasted Grosbeak was spotted off Woods Road at the edge of the Marsh - Photo by Steve Noble

The NYNHP has a record of pied-billed grebe (NYS Threatened) elsewhere in the City of Kingston. This is a small waterbird whose typical breeding habitat is a marsh with plenty of emergent vegetation adjacent to an open water body. Small, narrow oxbows, originally part of the Esopus Creek, now cut off from the creek's flow exist in the study area and appear to be suitable for this species.

We found a dozens of marshes in the study area, ranging from a small fraction of an acre to 20 acres or more. Often they were part of larger wetlands that included swamps or wet meadows and some were fringing open water bodies such as the oxbow lakes mentioned above. Marshes were generally dominated by cattails, purple loosestrife, and silky dogwood, and with scattered willows. At least one marsh was dominated by yellow pond lily (figure 20). Common jewelweed, purple loosestrife, mugwort, Bell's honeysuckle, evening primrose, bittersweet nightshade, late goldenrod, Buttonbush, staghorn sumac, and American elm are common along the edges. As for bird species, we heard gray catbird, song sparrow, and the "wichity, wichity, wichity" of a common yellowthroat. Redwing blackbirds called from the cattails and we were lucky to observe a rose-breasted grosbeak (figure 21). In one location off Woods Road we observed blue vervain, a calcicole, on higher ground at the edge of the marsh (figure 18). It was not unexpected since there is a limestone CCLT habitat nearby.

Figure 22: Marsh off Woods Road created as a result of the construction of the NYS Thruway - Photo by Andrew Meyer

Human activities near a marsh can disturb sensitive wildlife, degrade the water quality, and alter the water volumes feeding the marsh. Nearby roads, residential development, and motorized recreation can contaminate marshes with fertilizers, pesticides, de-icing chemicals, petroleum hydrocarbons, and heavy metals, and disturb wildlife with noise and lights. Soil erosion in the watershed of a marsh can introduce sediments that degrade the habitat quality of marshes for rare and common species, and increased impervious surfaces nearby can disrupt the volumes and flow patterns of surface water and groundwater feeding the marsh.

We recommend that broad conservation zones be established around marshes to help protect the habitat quality of the marsh itself, the connectivity with other habitats, and safe travelways for mobile wildlife moving between habitats. Any land development near marshes should be designed so that stormwater runoff from impervious surfaces or from fertilized turf does not enter the marsh, and the marsh is well-buffered from other human disturbances by a zone of undisturbed soils and vegetation. Wherever possible, existing roads and developed lots should be retrofitted with stormwater management infrastructure that directs surface water to detention basins or other appropriate places instead of into wetlands or streams.

CONSTRUCTED POND (CP) AND OPEN WATER (ow)

We use the term "constructed pond" for a water body that was created by excavation in an upland or wetland area, or by damming a stream, and that is substantially unvegetated, and has a managed shoreline zone. We use the term "open water" for naturally formed ponds, and for ponds that may have originally been constructed by humans but have since reverted to a more natural state (e.g., unmanaged, and surrounded by unmanaged vegetation).

Figure 23: Constructed pond - Photo by Steve Noble

The habitat values of constructed ponds and open water habitats vary tremendously according to the landscape context, the intensity and kinds of management, and the extent of other human disturbance. In general, the habitat value is higher when the ponds have undeveloped shorelines, are relatively undisturbed by human activities, have more vascular vegetation, and are near other intact habitat areas. Because many constructed ponds are not buffered by sufficient natural vegetation and soil, they are vulnerable to the adverse impacts of agricultural runoff, septic leachate, and runoff laden with pesticides and fertilizers from lawns and gardens. We expect that many of those maintained as ornamental ponds are treated with herbicides and perhaps other toxins, or contain introduced fish such as grass carp and various game and forage fishes.

Constructed ponds that are not intensively managed by humans can be important habitats for many of the common and rare species associated with natural open water habitats, including invertebrates, fishes, amphibians, reptiles, waterfowl, wading birds, songbirds, and mammals.

American bittern (NYS Special Concern) and pied-billed grebe (NYS Threatened) use wetlands with open water areas adjacent to large emergent marshes. Wood duck (regionally vulnerable) and American black duck (NYS SGCN) may use vegetated ponds of any size for foraging and nursery areas. Osprey and bald eagle may hunt over large water bodies. Spotted turtle and wood turtle (both NYS Special Concern) can use open water habitats for a variety of purposes, including rehydrating during nesting migrations and drought refuge. Bats often forage over open water habitats, and river otter use such areas for foraging and nursery habitat. The New York Natural Heritage Program has a record of swamp smartweed (NYS Endangered) in

the Town of Ulster within one mile of the study area, and of prairie wedgegrass elsewhere in Ulster. Either of these plants could occur on the banks of constructed ponds and open water habitats in the study area.

Constructed ponds should not be ignored as potentially important components of the ecological landscape. But high-quality natural habitats – such as upland meadows, wet meadows, marshes, swamps, or streams – are often destroyed to create ponds. The lesser habitat values of constructed ponds (and especially intensively managed ornamental ponds) do not ordinarily justify altering streams or destroying natural wetland or upland habitats to create them. In most cases, the loss of ecological functions of natural habitats far outweighs any habitat value gained in the new artificial environments.

Our study area has approximately ten constructed ponds and areas that we classified as "open water." One constructed pond in the study area was created as a drinking water reservoir for the City of Kingston and others for ornamental/recreational purposes. There are "open water" bodies throughout the site that are the result of years of mining followed by years of sitting dormant. There are also large excavation areas that have since filled with rain and runoff creating standing water bodies.

Where they already exist, constructed (and other) ponds should be protected from septic leachate, surface runoff contaminated with fertilizers or pesticides, and direct applications of herbicides or other toxins, which can dramatically lower the pond habitat quality. Any land development in the watersheds of ponds and other open water bodies should be designed to prevent surface runoff from impervious surfaces and lawns entering the ponds. The habitat values of ponds will be enhanced if natural vegetation is allowed to develop in and near the pond, and if human disturbances are minimized.

STREAM (s)

A "perennial stream" flows year-round under normal precipitation, although some may dry up during periods of extended drought. Perennial streams feed many of our wetlands, lakes, and ponds, provide essential water sources for wildlife throughout the year, and are critical habitat for many species of invertebrates, fishes, amphibians, reptiles, mammals, and birds.

Figure 24: Esopus Creek as it meanders through the City of Kingston and approaches the Town of Ulster line - Photo by Steve Noble

Perennial streams can be a few feet wide to hundreds or thousands of feet wide, and the kinds of habitats they provide and the species they support depend a great deal on the size, depth, substrate, and water quality, and the condition of the banks, floodplain, and entire watershed. The quality of stream water, the volumes of stream flows, and the timing of stream flow fluctuations can be affected by land uses (such as forest clearing, groundwater withdrawals, paving) occurring far from the stream itself. Siltation, elevated water temperatures, contamination from polluted runoff and subsurface leachate, and alterations of nearby habitats have impaired the habitat quality of most of the perennial streams in the region. For this reason, many of the more sensitive species of fish, for example, have disappeared from certain reaches. Slimy sculpin and native brook trout (both regionally scarce) are fishes that require clear, cool streams with unsilted substrates; stream habitat impairment and competition from brown trout (stocked in many streams by the

New York State Department of Environmental Conservation) have eliminated these species from many of the stream reaches where they once occurred.

The largest perennial streams in the study area are the Esopus Creek, which flows through the center of the study area, and the Sawkill, which defines the northern border. There are several small tributaries to the Esopus in the study area, most notably the small tributary called Bear Kat Kill that flows from the Hudson Valley Plaza near Home Depot and meets up with the Esopus near the Town of Ulster sewage treatment plant. Their rate of flow is highly seasonal and in many cases these smaller tributaries are likely to be intermittent (see below). Many of the small tributaries in the urbanized portion of our study area are buried in culverts and are channelized in ditches. They are likely highly impacted by stormwater runoff and serve to convey stormwater to the Esopus.

Figure 25: Army Corps of Engineers Levee behind Kingston Plaza from Col. Chandler Drive. This is the control gate to release water back to the Esopus if it collects behind the levee. - Photo by Gregg Swanzey

The lower Esopus Creek runs from the Ashokan Reservoir to the Hudson River with a length of approximately 30 miles and a watershed area of 163 square miles, (not including the 256 square miles of watershed in the upper Esopus Creek watershed above the reservoir). In our study area, the Esopus Creek flows northeast through a broad, flat valley. The portion of the Esopus Creek in the study area is bounded by urban development, including a Corps of Engineers levee protecting a shopping center in the City of Kingston at the upstream end and by 1-87 along the west side of the valley. The east side of the Esopus Creek valley bottom is partially developed and is adjacent to the most urbanized portion of our study area. It is therefore the most prone to further development in high flood risk areas. Floodplain meander scrolls and oxbow ponds throughout the study area indicate that this is and has been an active floodplain. Malone and McBroome in their assessment of the Lower Esopus (2009) for the Lower Esopus found no net riverbed slope in the Esopus Creek for a distance of over five miles in our study area. They also indicated that the stream channel is oversized, low gradient (slope), and the water flow is at a very low velocity, tending to result in a river that that cannot efficiently transport sediment and is susceptible to flooding that does not dissipate quickly during high water events. At the confluence of the Sawkill Creek with the Esopus Creek, a short distance downstream of the Ulster Town Hall, a sedimentary delta extends halfway across the Esopus Creek channel indicating that there are, in fact, high sediment loads coming from the Sawkill Creek and low capacity in Esopus Creek to carry the sediment.

The Esopus Creek generally has a broad terrace and floodplain, however, the river is generally incised (cut down) in a deep channel which allows it only limited connection to its floodplain, except in large flood events. Because the stream is incised, the riverbanks are generally fairly steep. They do support shrub and hardwood vegetation. Although some portions of the Esopus Creek and its tributaries have extensive forest land along the riverbanks, portions of the Esopus lacked adequate trees in the riparian buffer with either agricultural land or developments very close to the river. Riparian buffer zones are an undeveloped portion of the larger floodplain immediately adjacent to the stream or river. Riparian buffers help to absorb and filter surface runoff, provide infiltration, trap sediment, reduce flow velocities, and temporarily store local runoff. In addition, buffers with trees are particularly important because they help to reinforce riverbanks and minimize channel erosion. Their vegetation helps to shade and cool the water in the summer. Recommended buffer zone widths are usually between 25 to 200 feet in size, with a common recommended width of 100 feet. In the northern part of the study area, there were many areas where there was not an adequate riparian buffer.

Portions of the lower Esopus Creek in the study area have accumulated coarse woody debris in the form of blown down trees, logs, and brush that partially obstruct the channel. Large woody debris provides shelter and habitat for aquatic species. In the Esopus Creek woody debris provides one of the few habitat variations. However in some places the woody debris blocks the channel, limiting access to recreation. Malone and McBroome, in their assessment did not find that large woody debris was a significant contributor to flooding in the Lower Esopus and they recommended that woody debris be maintained for habitat to the extent possible.

The Sawkill Creek runs for 19.5 miles linking the Towns of Woodstock, Kingston and Ulster and flows into the Esopus Creek at the Town of Ulster in the northwest portion of our study area. The Sawkill is a drinking water source for the city of Kingston. In total, the Creek drains a watershed area of 42 square miles. In contrast to the Esopus, the Sawkill is a much steeper (higher gradient) stream, particularly in the study area. It comes down from the foothills of the Catskills into the Esopus Creek. Although it does not flow through as urbanized an area as the Esopus Creek, in the Town of Woodstock and Town of Kingston it is adjacent to and impacted by Hwy 212 and Sawkill Road as well as residential development. The 2007 Stream Corridor Assessment undertaken in part by the Sawkill Watershed Alliance found that the upper reaches of the Sawkill in the Town of Woodstock had significant erosion and sediment and debris deposition problems. The study found a strong correlation between human activities to protect property and increased erosion which is contributing greatly to downstream sediment volumes. This sediment is ultimately ending up in the Esopus.

Figure 26: The Esopus Creek as it flows behind Kingston Plaza just off Col. Chandler Drive - Photo by Gregg Swanzey

The New York Coastal Management Program has identified the Esopus Creek Estuary as an important site for fishery resources with a wide range of freshwater and brackish water species in the section between the falls in Saugerties and the Hudson River. Listed species include marine and anadromous fish such as striped bass, white perch, shad, alewife, blueback herring, and smelt, while freshwater species include largemouth and smallmouth bass. The adjacent segment of the Hudson River has short nose sturgeon habitat. The habitat and recreational value of this estuary is closely related to upstream water quality, sediment loads, and water flow rates. In addition many kinds of wildlife use perennial streams as part of a whole complex of habitats that encompasses large areas of the landscape. For example, the wood turtle (NYS Special Concern) uses perennial streams in the fall, winter, and spring, and intermittently through the summer, when it also uses a wide variety of other upland and wetland habitats for foraging, resting, and nesting, often moving several hundred feet and more from the core stream habitat. The Indiana bat (NYS Endangered) forages along perennial stream corridors, roosts in trees in upland settings, and overwinters in caves that may be as much as 30 miles from these summer habitats.

The New York Natural Heritage Program (NYNHP) reports a 1990 record of Davis' sedge (*Carex davisii)* in the City of Kingston. This is a plant typically found on forested stream terraces, and it could occur in such habitats in the study area or elsewhere in Kingston or Ulster.

An "intermittent stream" dries up at some time during a year of normal precipitation. Some flow for several months or much of the year, and others flow only for brief periods such as during snow melt or after rain. Intermittent streams sometimes contain small pools that hold water even when the stream is not flowing, and can provide habitat for small fish or aquatic invertebrates.

Figure 27: Intermittent stream- Photo by Nora Budziak

Northern dusky, two-lined, spring, and red salamanders (the latter two are regionally rare) occur in intermittent streams with clear, cold water, and adjacent forest habitats. Some intermittent streams are used by fish for spawning and nursery habitat, due in part to the absence of certain predators and competitors found in larger streams. Intermittent streams can have a diverse invertebrate fauna, including rare species such as arrowhead spiketail and mocha emerald (both NYNHP S2S3), dragonflies that are especially associated with small forested streams. In addition to providing important in-stream habitats, intermittent streams provide water sources for wildlife throughout the landscape, provide organic detritus, nutrients, insect drift, and other foodweb support for larger water bodies, and are a primary source of water for perennial streams, wetlands, ponds, and lakes. Maintaining water quality, quantity, and flow patterns in these streams is essential to maintaining healthy wetlands and streams downstream.

Intermittent streams occur in many locations throughout the study area. As stated above many of the small streams flowing into the Esopus and Sawkill are likely to be intermittent. Our field observations were done during a period of unusually high summer precipitation so it was difficult to determine which of the smaller streams observed in the field were actually intermittent.

Management and Policy Recommendations – Maintaining undisturbed forested watersheds seems to be the most effective means of maintaining the water quality and habitat quality of streams. Intact forests provide a high quality detritus food base, help to prevent soil erosion and minimize stream siltation, maximize groundwater recharge, and help to maintain cool stream water temperatures. Increased areas of impervious surfaces (e.g., driveways, buildings, swimming pool, etc.) in the watershed of an intermittent or perennial stream may create a flashier surface water regime with higher flood flows and lower base flows. Impervious surfaces reduce water infiltration to the soils and thus reduce the volume of groundwater available to streams and wetlands during the drier seasons. They also lead to larger volumes of surface water runoff during storms and snowmelt, and thus increase the potential for downstream flooding and stream bank erosion. Some of these effects can be lessened if new development sites are designed to minimize impervious surfaces and maximize onsite infiltration of precipitation and snowmelt.

We recommend that broad buffer zones of undisturbed soils and vegetation be established and maintained along all intermittent and perennial streams. We also recommend that forested stream banks and stream corridors be maintained and restored, that forested watersheds be maintained wherever possible, and that forest clearing be minimized. To protect groundwater, stream habitats, and stream flows, any new

development should be designed such that surface runoff from the site during and after construction does not exceed pre-construction runoff volumes during normal and extreme events.

We also recommend that large woody debris in the stream be managed in such a way that it can continue to provide aquatic species habitat and (in the case of higher slope streams) help to reduce and regulate the force of stream flow. Removal of woody debris should only be undertaken when it is significantly impairing recreational use, contributing to flooding or stream bank or critical infrastructure failure. In these cases, realignment and cutting the debris into smaller sections may be sufficient and preferable to complete removal.

GRAVEL BAR (gb)

A "gravel bar" is a place where coarse sediments (sand and gravel) have been deposited in a stream channel by alluvial forces. The sediments tend to be unstable, and may be frequently relocated and reorganized during large flooding events or by forces associated with debris dams. Gravel bars can be harsh habitats subject to extreme wetting and drying, rapid heating and cooling, ice scouring, flooding, and wind disturbance. Vegetation is often sparse, but fairly dense thickets of shrubs and small trees may develop on gravel bars that have remained in place for long periods. The gravel bars in our study area supported many small river birch (3-5 inch dbh), and had wild-rice and dotted smartweed along the water line.

Gravel bars provide foraging habitat for birds such as spotted sandpiper, green heron, and great blue heron, and feeding stations for river otter. Those with woody vegetation may provide hunting and resting perches for belted kingfisher and other birds that forage along streams. Tiger beetles sometimes inhabit the sandy substrates of gravel bars; regionally rare species of tiger beetles could occur on gravel bars in the study area.

Gravel bars can be harmed by direct disturbance (as from earth-moving machinery operating in the stream channel), and indirectly by alterations of stream flows by upstream or downstream dams.

SPRINGS AND SEEPS

Springs occur where groundwater emerges at the surface at a single point, and seeps occur where groundwater emerges diffusely. Springs and seeps are very difficult to identify remotely; we have mapped those that we observed in the field, but there are likely others in our study area that we have not mapped. These habitats can occur anywhere in the landscape, bubbling up into constructed ponds, seeping into fens, and springing from ledgy areas in upland hardwood forest. We have mapped only those that were discharging into non-wetland habitats, however.

Figure 28: Clayey bank on the far side of Bear Kat Kill with a seep just down the embankment from the road - Photo by Andrew Meyer

Springs are often a water source for streams and wetlands. Those from deep groundwater sources tend to emerge at a fairly constant temperature throughout the year, and act to moderate local temperatures at the surface, maintaining habitat for cold-water aquatic organisms in the summer and warmth for plants and animals in the winter. Springs and seeps that remain unfrozen can be important sources of water and food for wildlife in winter. These groundwater

discharges can also provide streams with a constant flow of water during dry periods when rainfall and runoff are scarce.

Golden saxifrage is an indicator plant of these habitats; it rarely grows outside of spring holes or seepage habitats. Two rare species of dragonfly, gray petaltail (NYS Special Concern) and tiger spiketail (NYS SGCN), are known to use spring habitats in the Hudson Valley. Northern dusky salamander (regionally declining) uses springs, seeps, and cool-water streams.

We observed two springs in the study area. There is a spring located at the Ulster County tourism trolley on Washington Avenue (GPS Coordinates 41.94179, -74.02807) in an area that is otherwise developed as a parking lot. The site is adjacent to the Esopus Creek and the land is owned by the Ulster County. We also observed a likely spring during our first field observation at the Town of Ulster sewage treatment plant (GPS Coordinates 41.96659, -74.00725) in an area that was in between the Esopus Creek and a smaller perennial tributary and otherwise was an upland meadow.

The seeps we observed were generally found where roads cut through hills, exposing rocky ledges, particularly in areas that are adjacent to other bodies of water. They are particularly plentiful in the northwest portion of our study area where the slopes are steeper and there were more road cuts through bedrock. In the field, we observed a seep in a ledgy area at the entrance to the Town of Ulster Sewage Treatment Plant. Another place where seeps were observed in the field, (and at certain times of the year there are probably intermittent streams) was along the entrance road to the Kingston City reservoir, which was up a steep hillside through a mixed forest.

Springs and seeps are rarely documented on existing maps or site plans, so they are often overlooked in environmental reviews, and altered or destroyed during construction activities. They are important habitats in their own right, and can be critical to the quality of stream and wetland habitats. In fact, many of the springs and seeps we observed were adjacent to stream and wetland areas. We recommend that broad buffer zones of undisturbed soils and vegetation be maintained around springs and seeps, as well as broad landscape connections with other intact habitats. We also recommend that stormwater management, stream restoration or bank stabilization efforts and septic leach fields be carefully designed to prevent any interference with the groundwater quality or volumes feeding springs and seeps.

CREST, LEDGE, AND TALUS (clt) AND
CALCAREOUS CREST LEDGE AND TALUS (cclt)

"Crest, ledge, and talus" are terms for three different rocky habitat types that often (but not always) occur together in the landscape. We use the term "crest" for more-or-less level or gently-sloped areas of exposed bedrock at low or high elevations, but often at the summits of knolls or hills. Ledges are steeper areas of exposed bedrock, including but not limited to vertical cliffs. Talus is the zone of fallen rocks that collect below ledges and other steep rocky areas. In our study area, CLT habitats can easily been seen along Route 199, on both the East and West Side between Sawkill Road and Route 28 intersections.

Figure 29: Crest, Ledge, and Talus habitat off Woods Road, Geology Map suggests calcareous soils in this area - Photo by Steve Noble

Figure 30: Exposed shale off Sawkill Road in the northern part of our study area - Photo by Gregg Swanzey

In this project we use plant indicators to distinguish calcareous from non-calcareous CLT. We looked for calcicoles—plants with an affinity for calcium-rich environments—to identify calcareous crest, ledge, and talus (CCLT). We classified as CLT all other crest, ledge, and talus areas including those where we found no calcicoles as well as those we were not able to field-check.

Common plant species of CLT areas include paper and black birch, chestnut oak, red maple, lowbush blueberries, rock cresses, and goldenrods. Many rare plants are known from CLT areas (Kiviat and Stevens 2005), such as whorled milkweed, Torrey's mountain-mint, and downy arrowwood. Other species of conservation concern that use CLT habitats are Blackburnian warbler, winter wren (both regionally rare breeders), cerulean warbler (NYS Special Concern), and worm-eating warbler (NYS SGCN). Eastern hognose snake (NYS Special Concern), northern copperhead, northern black racer, and black rat snake (all NYS SGCN) use rocky ledges for shelter, basking, and breeding. Northern slimy salamander uses forested talus areas, and eastern small-footed myotis (a bat of NYS Special Concern) sometimes roosts in talus. Bobcat and fisher use high-elevation crests and ledges for travel, hunting, and cover.

Calcareous Crest, Ledge, and Talus are habitats on calcareous (calcium-rich) rock substrates, such as limestone, marble, or some of the Hudson Valley sandstones and shales. CCLT may also support many rare plant species, such as purple cliffbrake, walking fern (both regionally rare), and yellow harlequin (NYNHP Watch List). Many of the same invertebrates, reptiles, mammals, and birds that rely on CLT areas also use CCLT habitats. The olive hairstreak (butterfly) uses eastern red cedar as a larval host, and the tawny emperor uses hackberry. Eastern hognose snake (NYS Special Concern) and copperhead (NYS SGCN) use calcareous talus areas for winter habitat. The snakes of CLT/CCLT habitats travel widely to many other parts of the landscape for hunting, basking, and breeding, so large areas of forests and meadows around the ledgy habitats should be considered part of the habitat complexes for these species.

The NYNHP has a record of green rock-cress (Boechera missouriensis) on a shaly forested slope in the study area. This species was not located on our field visits; however areas of CLT were identified and could possess green rock-cress. This species could also occur in other such areas in Kingston or Ulster.

In our study area, we found crest, ledge and talus habitats along the western side of Route 209, in areas where human disturbances (mining) have created additional CLT area. These areas are identified on our habitat map. Potential CLT areas however could occur on the entire western Side of Route 209, which has steep slopes and shallow soils. These habitats are adjacent to the Catskill Forest Preserve. We classified most occurrences as non-calcareous CLT. Most of the obvious CLT was manmade though "natural" CLT in the area may have been severely enhanced by human activity in the Study Area.

We found one occurrence of CCLT habitat in our field survey, but there may be others that we did not see. We field checked the area along Woods Road in the Town of Ulster. This area was small, however

allowed us to see CCLT habitat in our study area, where there is an approximately 8 ft high ledge with potential for calcicoles. The soil maps predicted many of the soil types in this area to be calcareous or somewhat calcareous. We found common jewelweed, boneset, Bell's honeysuckle, and poison-ivy. The short slope above the ledge had a diverse tree cover, including black cherry, shagbark hickory, American elm, and eastern red cedar. We identified no calcicoles here, but members of the group saw several Canada moonseed plants from the car on our way down Woods Road; this is a good indicator of calcium-rich conditions. The presence of moonseed, along with the mapped calcareous soils, and the disturbance in the area that could be masking the calcareous conditions at present, led us to identify the area as calcareous.

Other sections of CCLT may exist in other areas of our study area where CLT is underlain with Calcareous or somewhat calcareous soil types (See Soil Map in appendix).

CLT and CCLT habitats can be very sensitive to disturbance. Rare and common plants of crests are vulnerable to trampling and collecting, snakes are vulnerable to killing and collecting, and breeding birds of crests can be easily disturbed by human activities nearby. Construction of roads and houses destroys CLT habitats directly, and causes fragmentation of these habitats and the forested areas of which they are often a part. Fragmentation of surrounding habitats by roads and other developed uses can be especially detrimental to snakes of the CLT habitats which are vulnerable to road mortality and to collecting, harassment, and killing by humans. The shallow soils of the CLT/CCLT habitats are susceptible to erosion from construction and logging activities, and from foot and ATV trails. These areas also have been extensively mined and have the potential of continuing to be mined in the future. To protect fragile CLT habitats and the sensitive species that use them, development and recreation activities in the vicinity need to be carefully designed or avoided altogether.

ORCHARD/PLANTATION (or)

"Orchards and plantations" are areas of land dedicated to the cultivation of trees or plants. These are often monocultures where species diversity is low, nutrients are limited and turnover can be quick. However, orchards can resemble upland forests ecologically and can provide sufficient habitat for forest dwelling birds, mammals and beneficial insects.

The Kingston/Ulster Study Area has a few areas that are designated as orchard/plantation. There are a few land areas that are managed by Augustine's Landscaping that are planted with nursery plants in a grid pattern. These locations are in the Town of Ulster, spanning both sides of the Esopus Creek. There is also a small area of land that is planted for Christmas tree production, with evenly spaced conifers and two significantly small pieces of land that are coniferous plantations. One is at the Kingston Reservoir, and the other is along the Esopus Creek on the Newcombe estate, flanking an oxbow lake adjacent to the Esopus Creek. Coniferous plantations can be significant habitats for bird species such as long and short-eared owls and barred owls, which may roost in this area, as well as red-breasted nuthatches which may nest here. These specific areas are rather insignificant, however, due to their size.

Figure 31: Plantation in the Esopus floodplain with a pond and adjacent marsh in the foreground - Photo by Gregg Swanzey

We recommend that these habitats are maintained, but managed for maximum biodiversity. Also inorganic chemical fertilizer and pesticide use should be minimized if not eliminated and best management practices should be utilized to create an ecologically sustainable habitat.

CULTURAL (c)

Habitat areas designated as "cultural" are typically managed to be landscapes that are utilized frequently by people. Landscape management varies among cultural designations. Golf courses, for example, are managed to have closely cropped grasses with chemical fertilizers and pesticides. Athletic fields are closely cropped and highly trodden. School yards are often highly manicured. Cemeteries can be significant habitats, often hosting large, mature trees and a generally large area of grassland habitat with minimal foot traffic.

Figure 32: Golf courses and driving ranges are found in the floodplain on both sides of the Esopus Creek -Photo by Gregg Swanzey

These areas could be compared ecologically to upland meadows: large spans of open field habitat. Cultural areas do provide some of the same ecological benefits of upland meadows including sufficient habitats for butterflies, invertebrates, grassland-dwelling birds and mammals and some photosynthetic productivity. However, due to the nature of these locations, the quality of the habitat often suffers. The health of the soil and ground water is often compromised due to inorganic additives; there is a loss of the integrity of the habitat due to the increased edge effect and lack of large contiguous space; and often significant interference from buildings, parking areas and human activity.

The Kingston/Ulster Habitat study area is spotted with cultural areas. There are two significantly sized golf courses in the center of the study area, to the east of the NYS Thruway, spanning both sides of the Esopus Creek, one in Kingston and the other in Ulster. These are significantly large pieces of land that would naturally be suitable as Upland Meadow. Golf courses do provide large areas of open space, but compromise the integrity of the soil with chemical additives and also minimal biological diversity. The interference of human activity makes this and undesirable area for diverse flora and fauna to reside.

There is also one school, an armory and various playing fields in the Study Area. These areas have mixed uses depending on the time of day/year, so are not conducive to a broad range of plants and animals. We recommend that green space is maintained for photosynthetic productivity, and potential to attract beneficial insects and grassland birds. Impervious surfaces should be minimized to limit stormwater runoff and the heat island effect. Use of inorganic chemical fertilizers and pesticides should be minimized if not eliminated to protect groundwater quality and ecological integrity.

DEVELOPED (d)

Areas designated as "developed" include residential neighborhoods, commercial districts, homes, lawns, roads, highways, parking lots and non-significant habitats. These areas are often covered in impermeable surfaces including roofs, driveways and parking areas, which create a heat

Figure 33: Bank of America in Tech City - Photo by Nora Budziak

Figure 34: Screech Owl roosting in a Town of Ulster Barn - Developed areas provide habitat - Photo by Nora Budziak

island effect, increasing the air temperature in proximity to the developed property. Open space is often limited in size and scope, not to mention habitat quality. Homes often times host backyard gardens or landscaped plots, but with a lack of connectivity with surrounding open space, thus providing limited significant habitats for a variety of species. Most developed areas are limited in ecological diversity; though do support backyard bird species such as chickadees, jays, nuthatches, juncos, doves and robins as well as several human conditioned mammals such as squirrels, raccoons and skunks. Flora can vary widely, but can be especially compromised with the introduction of invasives introduced through landscaping.

The Kingston/Ulster Habitat study area is largely developed, with the entire eastern boundary falling into this designation. It is significant to note, however, that in the study area, development is generally clustered, creating a concentrated area of non-significant habitat, surrounded by more valuable habitats.

We recommend cluster development, and with that the utilities provided to those areas. Roadways open up an area for more development in the future as services go along with roadways. By clustering development, the edge effect is diminished as compared to sporadically placed development, which has an envelope of non-significant habitat that surrounds it. Efforts should be made to redevelop on existing abandoned developed areas when possible as a priority over using more ecologically significant habitats for new development. Property owners should also be encouraged to manage their developed areas with environmental integrity in mind: native plantings, minimal impervious surfaces and organic landscape practices that enhance biological diversity and limit degradation

WASTE GROUND (wg)

"Waste ground" is classified as highly altered habitats such as dumps, landfills, sand and gravel pits and quarry pits, post-construction areas, vacant lots, and unreclaimed surface mines, where the soil quality is poor and vegetation is dominated by weedy and often invasive plants. These areas often have exposed rock or bare soil, pavement, construction debris and trash. Nutrient levels in the soils are often low and the soils have a low capacity to hold water. There may be seeps present in road cuts. There may also be a presence of toxic substances due to past dumping or leaching. These areas are not significant habitats, lack the habitat quality and would not generally be of special concern for habitat conservation, unless it is to be reclaimed for a park or redeveloped for industry. Waste ground could sustain plants normally associated with rock outcrops or Crest, Ledge, Talus areas, however. These areas could grow into upland meadows or upland mixed forests if left undisturbed.

Figure 35: Waste Ground - Mining Operation - Photo by Brandi Budziak

The Kingston/Ulster Study area has a number of areas designated as waste ground. One of the

major sites is the shale road cut on the north side of Route 199 between Sawkill Road and Route 28. Just to the west of that area is also a quarry site, which is also designated as waste ground. There is a waste ground site just off the Kingston Traffic circle on Washington Avenue where construction and demolition debris has been dumped. Generally, the Kingston/Ulster Study Area has insignificant pockets of Waste Ground.

We recommend the potential for non-significant habitats such as waste ground to be minimized. Efforts should be made to redevelop on site, when appropriate, or to clean up the areas to allow native succession to maximize biodiversity.

CONCLUSIONS AND CONSERVATION RECOMMENDATIONS

This is a compilation of recommendations for specific habitat types as well as broad biodiversity recommendations in the Kingston/Ulster Study Area.

One of the first steps the City of Kingston and Town of Ulster need to do is recognize the significance of the Lower Esopus Valley and its surrounding uplands as a vital habitat for the health of the stream, both here in Kingston/Ulster as well as downstream and in the larger Hudson River Watershed. Officials should also recognize the significant contiguous natural habitat found in this area. Education and outreach need to be a top priority for community groups in and around this area so that officials and the general public are aware of the important biological communities at their "Back Door."

In the Fall of 2008 and early 2009, the Lower Esopus Watershed Partnership, made up of the towns and the City of Kingston between the Ashokan Reservoir and the Hudson River met and hired Milone and Macbroom, an Environmental Engineering firm, to prepare the "River Reconnaissance Report for Sustainable River Management of the Lower Esopus Creek," which was completed in July of 2009. This report studied the overall hydrogeologic health of the stream, while accessing possible problem areas and provided recommendations for future work on the Lower Esopus. This report focuses solely on water flow and geomorphic assessments, not biodiversity and habitats in the Lower Esopus Valley. However, many recommendations stated in this report have bearing on the study area. A copy of this report can be found at www.loweresopuswatershed.org .

Specific recommendations that come to bear on the Kingston/Ulster study area include:

1) "The River [Esopus Creek] is generally underfit and incised. This limits active floodplain inundation to rare great floods and creates a false sense of security. Small annual floods are general contained within the banks. Bedrock prevents further natural incision." This has led to building of a variety of housing and cultural type units in the Esopus Creek Floodplain.

2) "The report recommends that the Lower Esopus Watershed Partnership review floodplain zoning land use regulations and building codes to ensure compliance with current model codes and criteria. Low Gradient channels that overtop their bank on alluvial plains (upstream of Leggs Mill Road [the Kingston/Ulster Study Area]) are prone to meandering, with lateral migration or avulsions. We recommend use of broad buffer zones." The MacBroom report clearly states the need for broad buffer zones, not so much to protect habitat as to protect people and belongings. This recommendation also rings true when focusing on Biodiversity. The Study Area provides for a variety of steam side habitat types from Floodplain Forest to Hardwood Swamp to Upland Meadow. All of these habitats have specific species that frequent and require certain acreage. The riparian zone surrounding the Esopus Creek in the Kingston/Ulster Study Area do not at present have sufficiently protected buffer zones to protect and conserve biodiversity.

3) The report also states that "Portions of the Lower Esopus Creek have excellent vegetative buffers along stream banks, while other sections have little or none. We recommend that vegetative buffers along stream banks be created or expanded to shade water, reinforce banks, and filter runoff. Riparian buffers help trap agricultural sediments and nutrients." This recommendation does not fully encompass the need to

protect the ecological biodiversity of the Esopus Valley. It is recommended that the City of Kingston and the Town of Ulster assess buffer zones based on species and habitat needs in addition to the needs of water quality.

4) Generally speaking, the City of Kingston and Town of Ulster should not permit floodplain development. This action not only allows for the degradation of the floodplain habitats, but places people and property in jeopardy as the Esopus Creek frequently breaches its banks. It is recommended that a larger zoning overlay district be created for the Esopus Valley in the City of Kingston and Town of Ulster. This district would allow for development where feasible, in a clustered fashion, creating as little impact as possible on adjacent ecological biodiversity. This planning tool would allow for the creation of an inter-municipal agreement to manage these areas, with biodiversity as the number one priority.

When reviewing site plans in the City of Kingston and Town of Ulster, the following biodiversity procedures should be followed: See "General Conservation Measures for Protecting Biodiversity" published by Hudsonia.

1) Protect large, contiguous, unaltered tracts of land

2) Protect contiguous patches of undeveloped land in a large, circular or broadly shaped configurations

3) Preserve links between natural habitats

4) Restore or maintain broad buffer zones

    a) 300 feet for perennial streams

    b) 300-900 feet for wetland habitats

    c) 750 feet for intermittent woodland pools

5) Maintain Buffer Zones between development and land intended for Habitat

    a) 300-900 feet between development and habitat areas

6) Preserve Farmland whenever possible

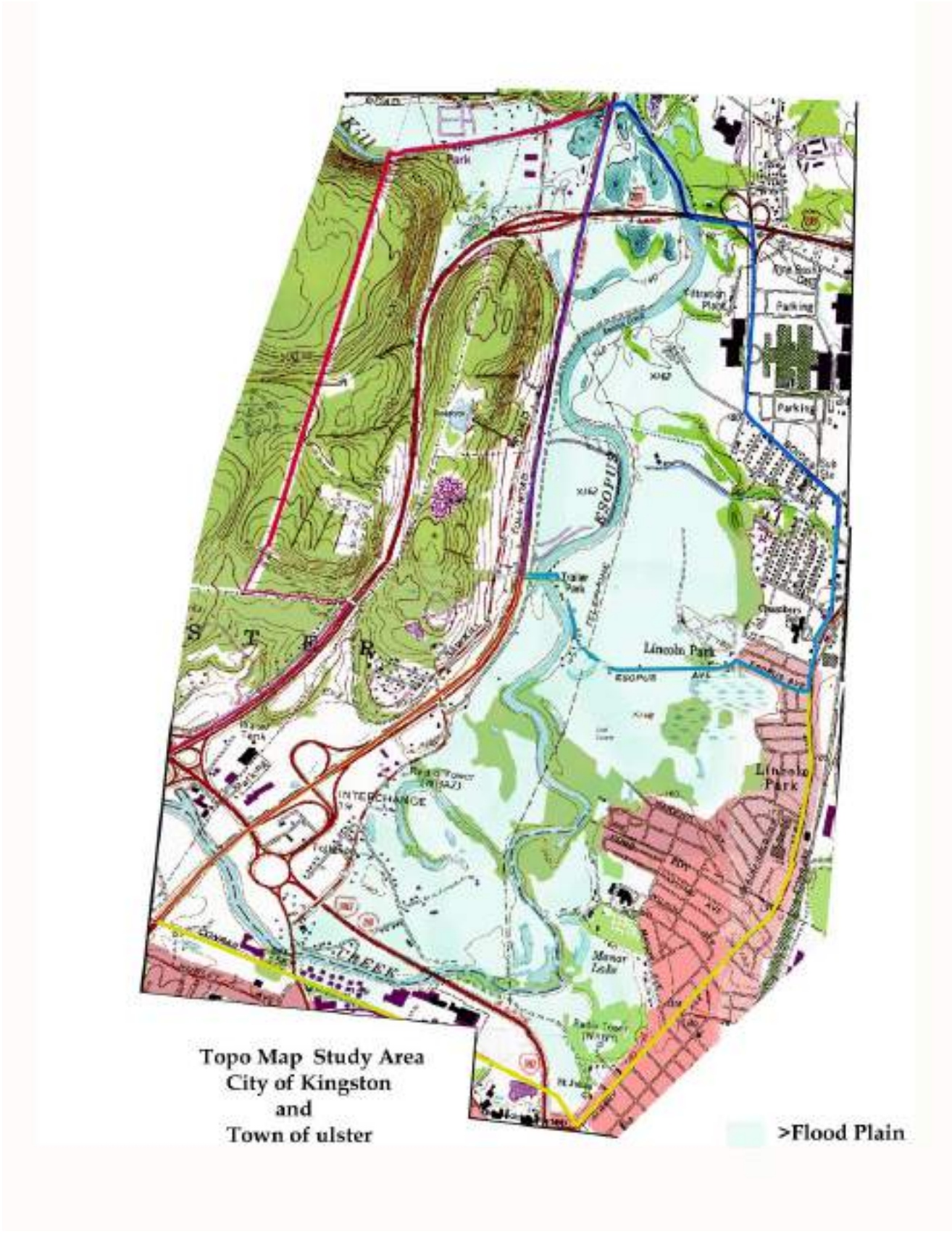
7) Restore degraded habitats

The City of Kingston and the Town of Ulster are lucky to have such a unique asset shared between the two municipalities. This acreage, situated in the Esopus Creek Valley, and largely impacted by human influences, still provides for a variety of flora and fauna. Much of it has been preserved, perhaps not intentionally, but because of the impending floodwaters of the Esopus Creek This Biodiversity Study will help shape the future of the Esopus Valley and will lead to better informed decision makers and in the long term, a healthier and more diverse habitat area.

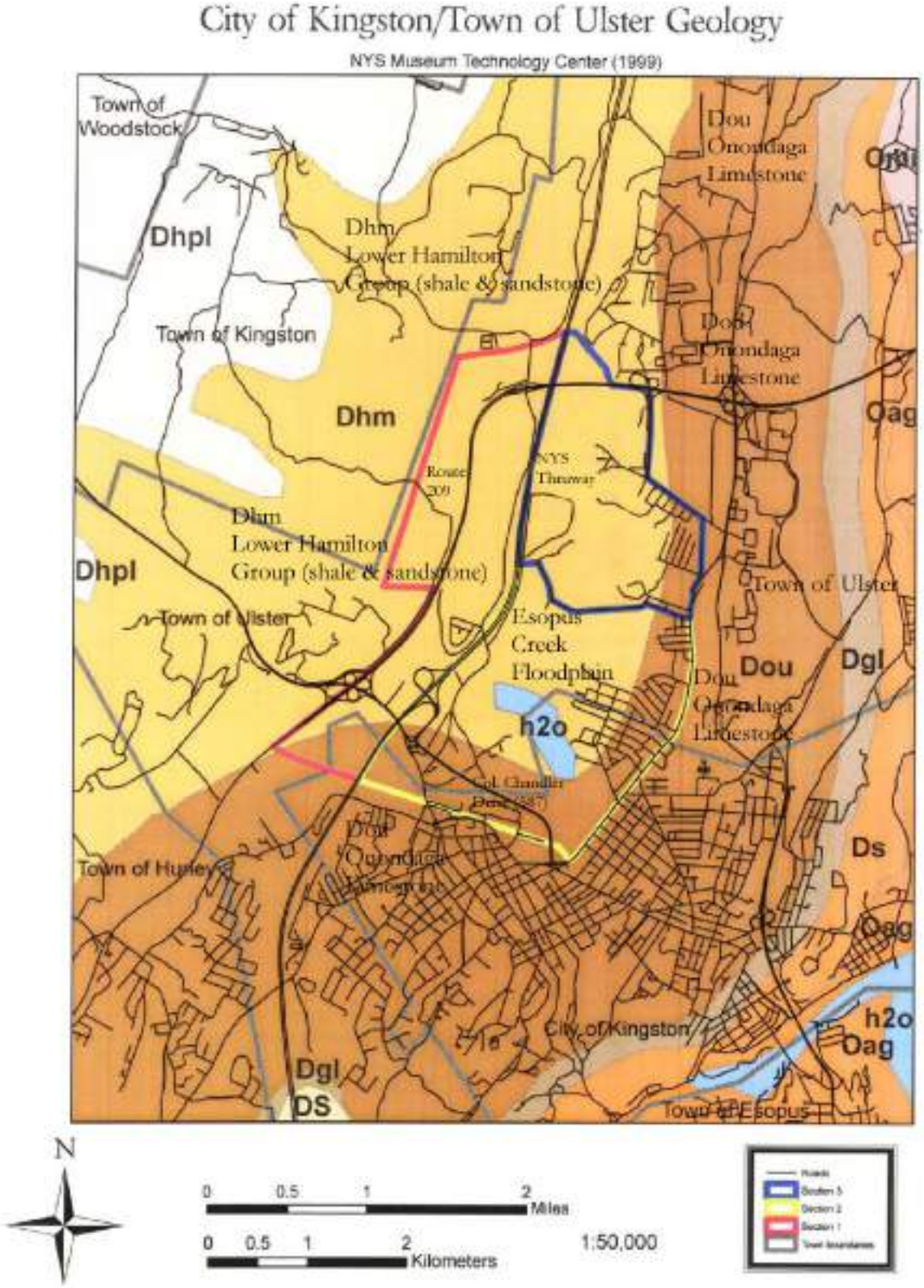
See Habitat Specific Recommendations in Appendix 7.

APPENDIX 1: BIODIVERSITY ASSESSMENT MAP OF STUDY AREA

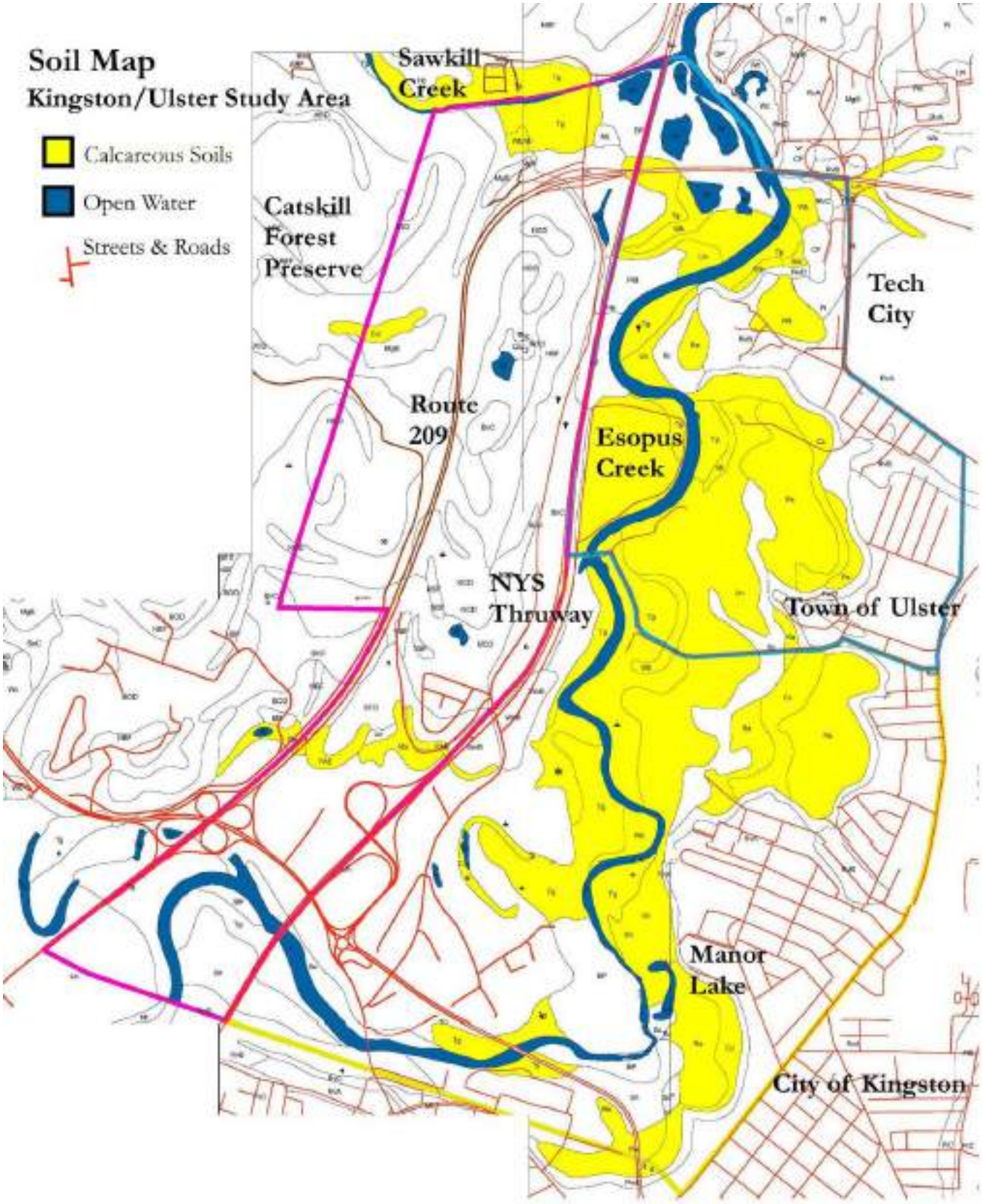
APPENDIX 2: TOPOGRAPHIC MAP OF STUDY AREA



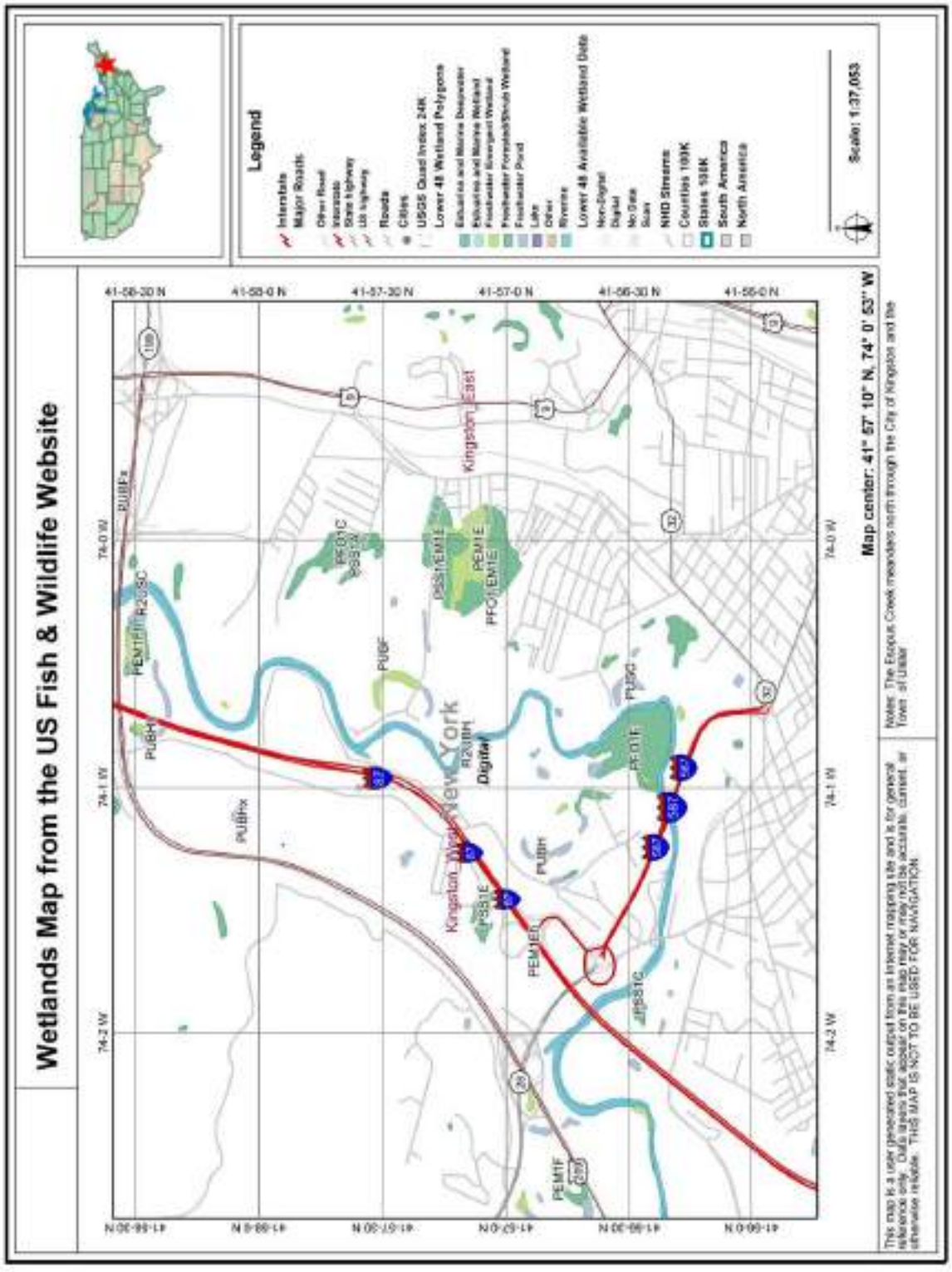
APPENDIX 3: GEOLOGY MAP OF STUDY AREA



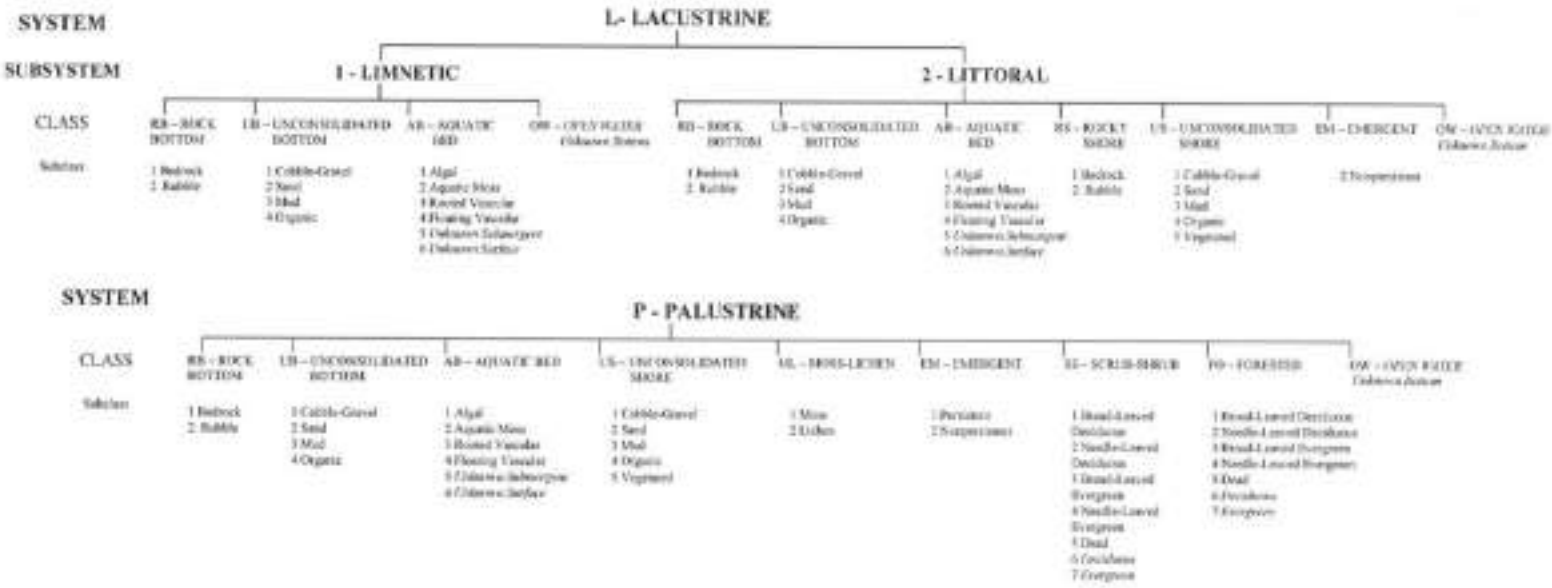
APPENDIX 4: SOIL MAP OF STUDY AREA HIGHLIGHTING CALCAREOUS SOILS



APPENDIX 5: WETLANDS MAP OF STUDY AREA



WETLANDS AND DEEPWATER HABITATS CLASSIFICATION



MODIFIERS

In order to more adequately describe the wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The water regime modifier may also be applied to the ecological system.

WATER REGIME				WATER CHEMISTRY			SOIL	SPECIAL MODIFIERS	
Non-Tidal		**Tidal**		**Coastal Salinity**	**Inland Salinity**	**pH Modifiers for all Fresh Water**			
A Temporarily Flooded	H Permanently Flooded	R Irregularly Flooded*	*S Temporary-Tidal	1 Hyperhaline	7 Hypersaline		g Organic	h Beaver	k Diked/Impounded
B Saturated	J Intermittently Flooded	L Subtidal*	*B Semiperm-Tidal	2 Euhaline	8 Eusaline	a Acid	n Mineral	d Partially Drained/Ditched	r Artificial Substrate
C Seasonally Flooded	K Artificially Flooded	M Irregularly Exposed*	*E Semipermanent-Tidal	3 Mixohaline (Brackish)	9 Mixosaline	c Circumneutral		f Farmed	s Spoil
D Seasonally Flooded/ Well Drained	W Intermittently Flooded-Temporary	N Regularly Flooded*	*V Permanent-Tidal	4 Polyhaline	0 Fresh	i Alkaline			x Excavated
E Seasonally Flooded/ Saturated	Y Saturated/Semipermanent/ Seasonal	P Regularly Flooded*	U Unknown	5 Mesohaline					
F Semipermanently Flooded	Z Intermittently Exposed/Permanent			6 Oligohaline					
G Intermittently Exposed	U Unknown			0 Fresh					

*These water regimes are only used in tidally influenced, freshwater systems.

NOTE: Italicized terms were added for mapping by the National Wetlands Inventory program.

APPENDIX 7: HABITAT-SPECIFIC CONSERVATION RECOMMENDATIONS

(As derived from Hudsonia Habitat Fact Sheets and Biodiversity Assessment Manual)

Upland Forests:

- Keep large forests and mature forests, including floodplain forests, intact and unfragmented.
- Minimize construction of new roads, houses, and other forms of development in forests, and especially in large or mature forests. Concentrate any new developed uses at forest edges and near existing developed areas.
- Maintain intact habitats between forest patches to allow for migration and dispersal of plants and animals.
- Restrict logging to the winter months to minimize damage to soil, vegetation, and wildlife. Avoid logging on steep slopes and leave tree crowns in the woods to conserve soil fertility and increase habitat diversity. Minimize gap size and road construction to prevent the establishment of non-native species (e.g., tree-of-heaven). Avoid high-grading (selectively harvesting the largest and most valuable) to preserve genetic diversity and forest structure.
- Minimize ATV use, which can damage vegetation and soil and disturb wildlife.

Streams:

- Avoid direct disturbance of streams such as damming, filling, hardening of stream banks, or removing snags and natural debris.
- Minimize impacts from new and existing roads and stream crossings.
- Establish a protective buffer zone extending at least 160 ft. on either side of all streams in the watershed, including perennial and intermittent tributary streams. Buffer zones should remain naturally vegetated and undisturbed. Avoid or minimize applications of fertilizers and pesticides on existing lawns and agricultural areas within this zone.
- Protect large, contiguous blocks of habitat (e.g. forests, meadows, wetlands) within 650 ft. of large perennial streams. Wood turtles and many other stream-dependent species range widely and need a complex of different habitats. Wood turtles often nest in upland meadow or open shrubland--habitats that tend to be prime areas for development.
- Maintain broad, naturally vegetated travel corridors between habitats (e.g. between stream habitats, wetlands, and upland meadows and between neighboring habitat complexes.

Crest Ledge and Talus:

- Minimize construction of new roads and buildings on and near rocky ridges and hillsides.
- Protect crest, ledge, and talus areas from disturbances associated with high intensity human recreation, including soil compaction, trampling of sensitive plants, and disturbance of animals.
- Maintain intact habitats in the areas between crest, ledge, and talus locations to allow for dispersal of plant and animal populations.
- Avoid direct disturbance to dens of timber rattlesnake and other snakes of conservation concern, and restrict logging to winter months when the snakes are hibernating.
- Consult with the Endangered Species Unit of the New York State Department of Environmental Conservation about any activity proposed in the vicinity of a timber rattlesnake habitat.

Intermittent Woodland Pool:

- Avoid filling, draining, or excavating intermittent woodland pools.
- Minimize development and road construction in forests within 750 ft. of an intermittent woodland pool to protect the adult habitat and travelways of pool-breeding amphibians.
- Avoid fragmentation of upland forests and preserve migration corridors between pools.
- Avoid activities near intermittent woodland pools that would increase soil erosion, alter runoff volume, or contribute pollutants. These activities include logging, construction of roads or buildings, ATV use, or use of pesticides and fertilizers. Organisms of these pools are sensitive to changes in water quality.

Hardwood Swamps:

- Protect swamps from filling, draining, or conversion to ponds.
- Maintain broad buffer zones of undisturbed vegetation and soils around swamps .Minimize development and road construction to within 300+ feet.
- Preserve connectivity between swamp habitats and nearby upland and wetland habitats to provide safe travelways for amphibians, turtles and other wildlife that use a variety of habitats.
- Maintain existing water volumes and timing of groundwater and surface water inputs.
- Prevent nearby soil erosion, soil compaction, and contamination of surface waters from activities such as logging, construction, and ATV use.
- Restrict logging activities to seasons when the soils are frozen, and many wildlife and plant species are dormant.

Springs and Seeps:

- Retain broad buffer zones of undisturbed soils and vegetation around the periphery of springs and seeps.
- Maintain broad landscape connections with other intact habitats.
- Prevent storm water, septic leach field flows and other pollutants from infiltrating and disturbing groundwater feeding springs and seeps.

Marsh:

- Prevent human disturbance such as filling or draining.
- Prevent storm water infiltration and runoff from impervious surfaces and other sources of pollution and contamination into marshy areas.
- Retain broad conservation zones around marshes and maintain connectivity and travelways for mobile wildlife moving between habitats.

Upland Meadow:

- Large meadows and meadow complexes should be conserved and remain unfragmented by roads, structures, etc. to the extent that is practical.
- Proposed development should be limited to meadow edges and in proximity of existing roads and other existing development.
- Should mowing be necessary, it should be limited to August or later for the purpose of inhibiting growth of woody plants and protecting ground nests until young birds have fledged.
- Prevent overgrazing which can severely damage soils and degrade future agricultural as well as habitat values.

Wet Meadow:

- Retain broad buffer zones of undisturbed soils and vegetation around the periphery of wet meadows.
- Avoid fragmentation by roads and other forms of construction.
- Avoid draining, filling, and other forms of excavation.
- Postpone mowing until after August to minimize harm to ground nests.

Constructed Pond and Open Water:

- Shoreline development and aquatic weed control should be avoided.
- Broad zones of undisturbed vegetation and soils should be maintained around the shoreline.
- Development in watersheds should be designed to prevent contaminated surface water runoff from entering constructed ponds and open water.

Upland Shrubland:

- Large shrubland tracts should remain unfragmented to the extent that is feasible.
- Retain broad connections to other intact habitat areas.
- Mowing should only be conducted every 3-5 years and late in the season to prevent forestation and to preserve ground nesting habitats.

Orchard/Plantation:

- These habitats should be maintained but managed for maximum biodiversity.
- Inorganic chemical fertilizer and pesticide use should be minimized and eliminated if possible.

Cultural:

- Maintain green space for photosynthetic productivity.
- Minimize impervious surfaces to limit runoff and the heat island effect.
- Plant/replace trees!

Developed:

- Encourage cluster development as a means of diminishing edge effect.
- Redevelop existing abandoned developed areas when possible as a priority over using more ecologically significant habitats.
- Manage developed areas with environmental integrity in mind such as native plantings, minimal impervious surfaces and organic landscape practices that enhance biological diversity and limit degradation. Retain existing trees and replace those lost with like varieties.

Waste Ground:

- Effort should be made to redevelop on site, when appropriate, or to clean up the areas to allow native succession to maximize biodiversity.

Brief Biodiversity Summaries of Hudsonia Reports

Prepared for City of Kingston/Town of Ulster Biodiversity Assessment Training group
By Ryan Gardner, Hudsonia, February 2009

Kiviat, E. 2002. **Biological Reconnaissance, Shott Rock Mine, Town of Saugerties, Ulster County, New York.** Report to Citizens Action for Residential Environments in Saugerties. Hudsonia Ltd., Annandale, NY. 4 p.

Important species: small-flowered agrimony, spiny coontail, small bladderwort, winged monkeyflower,

Important habitats: calcareous habitats, wetlands,

Potential habitat for: rare mosses, green rock cress, violet bush-clover, falcate orange-tip (butterfly), wood turtle, eastern hognose snake, northern copperhead.

Stevens, G. 2000. **Rare Plant and Cricket Frog Surveys at Esopus and Mirror Lakes.** Report to ORDA Management, Inc. Hudsonia Ltd., Annandale, NY. 9p.

Important species: Bush's sedge, field dodder, southern dodder, round-leaved dogwood, river birch, olivaceous spikerush, globe-fruited ludwigia, creeping bladderwort, horned bladderwort, hiddenfruit bladderwort, spiny coontail, Virginia three-seeded mercury, lyre-leaved rock cress, Long's bittercress

Important habitats: hardwood swamp, circumneutral bog lake, wet meadow

Kiviat, E. 1995. **Biological Assessment, Shaupeneak Mountain, Town of Esopus, Ulster County, New York.** Report to Scenic Hudson, Inc. Hudsonia Ltd., Annandale, NY. 17p.

Important species: walking fern, yellow harlequin, Dutchman's breeches, red trillium, red-berried elder, American mountain-ash, gooseberry, Jefferson salamander, spotted salamander, wood frog,

Important habitats: cliff-scree-talus, woodland pools, pond

Possible habitat for: buckbean, land snails, falcate orange-tip, marbled salamander, northern cricket frog, black racer, black rat snake, eastern hognose snake, northern copperhead, American black duck, mallard, wood duck, ring-necked duck, northern raven

(continued)

Barbour, S. 1994. **Rare species at Anchorage Farm Town of Saugerties, Ulster County, New York.** Hudsonia Ltd., Annandale, NY. 2 p.

Important species: winged monke flower, Schreber's aster, strap leaf arrowhead, tawny emperor (butterfly)

Important habitats: tidal mouth, rocky gorge, wooded floodplain, perennial stream

Kiviat, E. 1993. **Sleightsburg Spit, Town of Esopus, Ulster County, New York: Preliminary Ecological Survey.** Report to Town of Esopus and Scenic Hudson, Inc. Hudsonia Ltd., Annandale, NY. 11 p.

Important species: eastern cottonwood, Frank's sedge, purple giant hyssop, strap-leaf arrowhead, kidneyleaf mud-plantain fish crow, black-crowned night heron

Important habitats: supratidal forest, supratidal swamp, supratidal pool

Possible habitat for: heartleaf plantain, smooth bur-marigold, bald eagle, osprey, anadromous fishes, Baltimore (butterfly), least bittern, waterfowl concentration area

Barbour, S. 1991. **Rare Plants and Significant Habitats Survey on the Lower Beaver Kill Corridor, Town of Saugerties, Ulster County, New York.** Report to Town of Saugerties. Hudsonia Ltd., Annandale, NY. 23 p.

Important species: squarrose sedge, hairy-fruit sedge, porcupine sedge, three-way sedge, small-flowered agrimony, winged monkeyflower, mud-hyssop, violet bush-clover, great lobelia, green dragon, Virginia germander, water stargrass, sneezeweed, cardinal flower, wild senna, whorled milkwort, broad-leaved tearthumb, Appalachian blue (butterfly), snout (butterfly), hackberry emperor (butterfly), wood turtle

Important habitats: floodplain meadow, floodplain forest, floodplain shrubland, old field, beaver pool

(continued)

Barbour, S. 1991. **Rare Plants and Significant Habitats Survey on the Ulster County Alternative Landfill Site 2 (Winston Farm), Town of Saugerties, Ulster County, New York.** Report to Town of Saugerties. Hudsonia Ltd., Annandale, NY. 24 p.

Important species: squarrose sedge, crested sedge, small-flowered agrimony, winged monkeyflower, green rock cress, wild germander, sneezeweed, Venus' looking glass, falcate orange-tip (butterlfly)

Important habitats: oldfields and hayfields, wet meadow, mesic cove, xerophytic shale crest, perennial stream

Possible habitat for: false hop sedge, Bush's sedge, small white aster, water arum

Barbour, S.1991. **Rare Plants and Significant Habitats Survey on the Ulster County Alternative Landfill Site 3 (Mount Marion), Town of Saugerties, Ulster County, New York.** Report to Town of Saugerties. Hudsonia Ltd., Annandale, NY. 22 p.

Important species: sensitive fern, marsh fern, squarrose sedge, crested sedge, hairy fruit sedge, seedbox, closed gentian, fragrant sumac, *Marsonia decepta* (aquatic snail), *Pisidium adamsi* (fingernail clam)

Important habitats: wetlands, stream, bluestem-blueberry uplands, clay meadow, oldfield, limestone outcrop

Possible habitat for: sedge wren, sedge skipper, wood turtle, box turtle, grasshopper sparrow, Henslow's sparrow, golden-winged warbler, eastern bluebird

Barbour, S. 1991. **Rare Plants and Significant Habitats Survey on the Ulster County Alternative Landfill Site 6 (Asbury), Town of Saugerties, Ulster County, New York.** Report to Town of Saugerties. Hudsonia Ltd., Annandale, NY. 24 p.

Important species: retrorse sedge, squarrose sedge, winged monkeyflower, mud-hyssop, green dragon, seedbox, spreading goldenrod, leafy bulrush, gerardia, crested sedge, spikemoss, fringed gentian

Important habitats: wetlands, hayfields and oldfields, floodplain, uplands

Possible habitat for: Baltimore (butterfly), Appalachian blue (butterfly), orange-tip falcate (butterfly), sedge skipper (butterfly), northern dusky salamander, spring salamander, eastern hognose snake, box turtle, spotted turtle, wood turtle, eastern bluebird, northern harrier, short eared owl, grasshopper sparrow, Henslow's sparrow, vesper sparrow, golden-winged warbler, sedge wren

(continued)

Kiviat, E. and K. Westad. 1989. **Ecological Survey of the Site of a Proposed Boardwalk at the Saugerties Lighthouse, Ulster County, New York.** A Report to the Heritage Task Force on the Hudson River Valley. Hudsonia Ltd., Annandale, NY. 11 p.

Important species: spongy arrowhead, strap-leaf arrowhead, mud-plantain, river birch, goldenclub, shortnose sturgeon, least bittern, king rail, diving duck, common barn-owl, marsh wren

Important habitats: intertidal marsh, jetty, tidal swamp, tidal flats

Possible habitat for: blunt spikerush, bur-marigolds, swamp lousewort, *Bidens bidentoides*, false-pimpernel, Appalachian blue (butterfly), broad-winged skipper (butterfly), Baltimore (butterfly), harvester (butterfly), osprey, red-shouldered hawk, harbor seal