Threats to Resources of Conservation Concern

Climate Change

The climate has been changing measurably in the Northeast for decades, and the effects are likely to be felt more acutely in the coming years—larger and more frequent floods, higher temperatures, droughts, wildfires, and severe storms, as well as some less dramatic symptoms such as increases in invasive pests, in pathogens affecting humans, livestock, and wildlife, and depletion of native biological diversity (Rosenzweig et al. 2011). The future effects on local biological and water resources could be large, but the specific nature and magnitude of those effects are still difficult to predict.

Over the past 50 years the Northeast has experienced a 74 percent increase in precipitation falling in very heavy events (Small-Lorenz et al. 2016). New York's average annual air temperatures have risen 2° F since 1970, and winter temperatures have risen by 5° F in that period. The average annual temperature in Columbia County is expected to increase 4-6° F by mid-century and 11° F by the end of the century (Horton et al. 2014).

Precipitation during heavy storms has increased by 74% in the Northeast in the last 50 years.

More frequent and intense heat waves pose threats to human health, wildlife, and native plants, and will alter many aspects of the natural landscape. Warmer, shorter winters are predicted to increase the occurrence of rainfall while the ground is frozen, hastening snowmelt, reducing **groundwater recharge**, and increasing the likelihood of flooding. Changes in snowmelt may reduce groundwater infiltration and increase the frequency and consequences of droughts. Warmer winters with less snow will alter the habitat suitability for native plants and animals. The frequency of extreme precipitation will continue to increase and may dramatically affect the quality and quantity of water supplies as well as the plants and animals of upland, wetland, and aquatic habitats. Alterations to air temperatures, snow cover, and freeze/thaw patterns are likely to disrupt the seasonal synchrony between pollinators and plants, and predators and prey. Warming temperatures are likely to significantly affect the composition and distribution of habitats and wildlife, and force many species to migrate as former habitats become unsuitable.

Below are brief discussions of some of the expected effects of climate change to agriculture, water resources, ecosystems, and human health.

Climate Change and Agriculture

Climate change is likely to affect agriculture in a variety of ways—some even beneficial; for example, warmer summers, warmer winters, longer growing seasons, and higher atmospheric carbon dioxide (CO_2) levels will favor some crops. But the mechanisms will be complex, with differential effects on crop growth, weeds, invertebrates, and pathogens. For example, higher CO_2 levels may benefit aggressive weeds even more than the crops, and may increase their resistance to herbicides (Ziska and Runion 2006). Higher CO_2 concentrations may also reduce the nutritional content—especially of protein and essential minerals—in crops such as wheat, rice, and potatoes (USGCRP 2011).

Warmer temperatures will be harmful to many existing crops and livestock adapted to cool climates, and will require adjustments to longstanding farm practices. For dairy cows heat stress can lead to lower milk production, reduced calving, and increased risk for health disorders. Heat stress similarly affects the well-being and productivity of other livestock, including beef cattle, pigs, and chickens (Klinedinst et al. 1993).

Increased frequency of summer droughts will stress many crops, and increased frequency of large rainstorms and flood events will lead to direct losses of crops, soils, and nutrients, and to costly delays in field access for farm equipment due to wet soils. Some insect pests, pathogens, and weeds will be favored by less severe winters. Rising winter temperatures are already allowing the northward expansion of agricultural pests that reduce crop production. Disruption of heat/thaw patterns may be especially harmful to woody plants (e.g., fruit trees) and perennial herbs. (Wolfe et al. 2011). Warming temperatures may have the effect of uncoupling the activity periods of insect pollinators from the flowering periods of both crop plants and native plants that rely on those pollinators.

Frequency and intensity of droughts and floods are predicted to increase due to climate change.

Disruption of the late winter/early spring freeze-thaw cycles will reduce the quality and quantity of maple syrup production. Indeed, sugar maples may be entirely displaced from the region by 2100, with suitable cool moist habitat remaining only on the highest peaks in the Adirondacks (Wolfe et al. 2011).

Perennial fruit crops are affected by the climate year-round, and the stresses experienced in one growing season may affect growth and productivity for two or more years afterward (Quarles 2017). While apple trees may benefit from longer growing seasons and increased atmospheric CO_2, warm winters may reduce fruit production the following summer, especially for the cold-adapted varieties, and summer heat stress and drought may harm the fruit quality. The fruit yield and wine quality of many of our grapes may benefit from warmer winters and longer growing seasons, but could be

harmed by late-summer droughts, and by damage to vines when winter warm spells are followed by very cold spells (Quarles 2017).Transitioning to warm-climate fruit varieties is an appropriate response, but will nonetheless be costly to farmers. These kinds of effects will put additional financial strain on farm operations whose profitability is already marginal.

Climate Change and Water

A warming climate is expected to affect both the quantity and quality of New Lebanon's groundwater and surface water resources, as well as the habitat quality of streams and ponds. Flooding hazards may increase due to the increased intensity of large rainstorms, although the timing of those storms and the condition of the land will determine the magnitude of flooding at any location. Parts of County Route 9 and US Route 20 in West Lebanon are within the 100-year flood zone identified by FEMA (Figure 14).

Both total annual rainfall and rainstorm intensity are predicted to increase in New York in the coming years, with multiple consequences to the land, to water resources, and to agriculture. The flooding hazards at any particular location depend on the rainfall intensity, the ability of the land to absorb large water volumes at the time of the storm, as well as the structures or other obstacles in the flood zone that may act to divert, concentrate, and accelerate floodflows.

FEMA flood maps for this region are based on old data, and do not take into account recent large storms such as Irene, Lee, and Sandy.

The "100-year flood zone" shown on maps created by the Federal Emergency Management Agency (FEMA) is the extent of area that, based on historical flood data, has a 1% chance of flooding in any given year. The FEMA flood maps for this region (Figure 14), however, are extremely outdated (from a 1986 baseline), and do not take into account the large storms of the last 30 years, including hurricanes Irene and Sandy and tropical storm Lee in 2011-2012. Large floods can damage roads, bridges, and other infrastructure, destroy agricultural crops, wash away farmland soil, carry pollutants and large volumes of sediments into streams, and damage or destroy buildings and other structures in the flood zone.

Climate Change and Ecosystems

While floods and droughts are normal and expected events in this region, extreme floods and droughts can add to the multiple stresses on ecosystems from human activities. Floods and droughts, as well as increases in water temperatures are likely to adversely impact populations of trout and other sensitive stream organisms that rely on cool, clear streams and unsilted stream substrates. Warming in the region is predicted to significantly affect the composition and

distribution of habitats and wildlife, and will force many species to migrate to cooler microclimates, higher elevations, or higher latitudes as former habitats become unsuitable. Cold-adapted species such as sugar maple, brook trout, spring salamander, and fisher are especially at risk. Together with non-climate stressors such as habitat fragmentation, water pollution, invasive species, and overharvesting, climate change may have synergistic effects that magnify the stresses and hazards to wildlife (Hannah et al. 2005).

Already, many plant species now bloom 4-8 days earlier on average than in the early 1970s Wolfe et al. 2011)—an effect that may have far-reaching ecological consequences. For example, insect pollinators whose activity periods are closely tied to the particular flowering periods of their food plants may find that their pollen and nectar food is unavailable at critical times in the pollinators' life cycles. This would add to the existing stresses from more frequent and more severe weather events, and could severely harm regional populations of these insects. Shorter, warmer winters and longer, hotter summers have been aiding the spread of pathogens and invasive non-native species. Pathogens that are encouraged by less-severe winters will also take advantage of the weakened condition of trees and other plants stressed by rising temperatures and droughts. Forest pests such as the hemlock woolly adelgid and the emerald ash borer are likely to transform our forest communities with wide-ranging ecosystem consequences. Invasive plants such as mile-a-minute-weed are expected to thrive under elevated atmospheric levels of carbon dioxide (Wolfe et al. 2011).

Warmer summer and winter temperatures, longer growing seasons, and elevated levels of atmospheric carbon dioxide will favor certain plants and disfavor others, and are thus likely to alter the composition of plant communities. The changing climate conditions may also allow some insect pests and insect disease vectors to complete more generations per season and to allow greater winter survival (Rodenhouse et al., 2009).

Surface water temperatures will rise along with air temperatures. Higher water temperatures reduce the concentrations of dissolved oxygen—a key habitat component for fish and other aquatic organisms—in streams, lakes, and ponds. The life cycles of many stream invertebrates are closely tied to water temperatures and the seasonal patterns of water temperature fluctuations. Alterations to water temperatures will have large effects on the fish, salamanders, turtles, and other biota of streams and ponds—organisms that are already stressed by water pollution, siltation, and competition from non-native fish.

Heat stress effects on native plants and animals will be similar to those on livestock and crop plants (see above), and may eliminate some of the cold-adapted species and communities from our landscapes (Wolfe et al. 2011). Warmer, shorter winters and prolonged winter thaws may make some perennial plants more vulnerable to mid-winter freeze damage by disrupting their accustomed dormancy period, and may subject the early leaves and flower buds to frost damage (Wolfe et al. 2011). Reduced snow cover will harm small mammals and other animals that depend on snow for insulation and protection from predators, but may favor white-tailed deer—already over-abundant—whose intense grazing pressure has been transforming our forests for several decades.

Many of our native plants and animals have adapted over thousands of years to the seasonal temperature ranges of the Northeast, and are ill-equipped to adapt quickly to the present-day pace of warming—several orders of magnitude faster than the temperature changes experienced during the most recent ice age (Wolfe et al. 2011). The widespread fragmentation of today's landscape by roads and land development poses additional obstacles to adaption and migration.

Plants and animals with specialized habitat needs may be most affected by climate change.

In general, most at risk will be the plants, animals, and communities with more specialized habitat or food requirements, or specialized interactions with other species (e.g., butterflies and their host plants) that are likely to be disrupted by climate change, those with poor dispersal ability, and those with already-low population levels, including endangered, threatened, and special concern species. Plants and animals likely to benefit from climate change are those that are habitat- and food-generalists, such as white-tailed deer, warmwater fishes (e.g., bass, pickerel, sunfish, white perch), adaptable songbirds (e.g., northern cardinal, American robin, house sparrow, and European starling); and non-native invasive plant species (Wolfe et al. 2011).

Climate Change and Human Health

Climate-related health risks stem from heat events, extreme storms, disruptions of water supply and water quality, degraded air quality, changes in timing and intensity of pollen and mold seasons, and increased prevalence of infectious disease vectors and organisms. Expected health effects include increases in heat-related illness and death, respiratory disorders from exposure to increased air-borne allergens and air pollution, physical injuries from large flood events, and a range of infectious diseases (Kinney et al. 2011). The actual extent of these health effects is difficult to predict, as are the magnitudes of the various changing climate factors.

People with pre-existing disease or otherwise compromised health may be among the most vulnerable to the impacts of climate change. Those with diseases such as asthma, cardiovascular diseases, or infectious diseases may be especially sensitive (Kinney et al. 2011).

Heat

Heat-related health effects may disproportionately affect the elderly, the poor, the sick, those with limited mobility and social contact, those belonging to nonwhite racial/ethnic groups, and those lacking access to public facilities and public transportation or otherwise lacking air conditioning. The combined effects of extreme temperature and air pollution are likely to increase the incidence of illness and death during heat waves (Cheng 2005).

Cardiovascular disease—already the single greatest killer of New York State residents (Kinney et al. 2011)—can reduce a person's ability to regulate temperature in response to heat stress, so the predicted increases in summer temperatures and heat waves may pose particular risks to those with compromised cardiovascular systems.

Air pollution

Increasing temperatures and increasing frequency of stagnant air events are likely to produce more days with high ozone levels—a risk factor for respiratory irritation and damage. The risks are greater for people who work or exercise outdoors, for children, and for those with respiratory disease (Kinney et al. 2011). Breathing ozone can cause lung inflammation and decrease lung function, and has been found to increase asthma episodes and cause respiratory failure leading to death.

Airborne particulate matter originates from a variety of sources, but some of the most important sources are combustion of fuels by motor vehicles, furnaces, and power plants, wildfires, and windblown dust. Particulates have been associated with premature deaths related to heart and lung diseases, and increased hospital visits for respiratory problems. The risk of wildfires increases with higher temperatures, reduced soil moisture, and extended periods of drought. Wildfires produce fine airborne particulates that can be carried long distances from the fire where they originate.

Changing patterns and timing of temperature and precipitation can alter the timing and intensity of allergy triggers such as pollens and molds. Warming temperatures and higher CO_2 levels may create extended pollen seasons, and spur greater pollen production and allergen potency in plants such as common ragweed (Ziska et al., 2003). Warm temperatures and rising air moisture, especially after extreme storms, may also spur the growth of indoor and outdoor molds.

Pathogens

Mosquitoes, ticks, and fleas are among the animals that can transmit pathogens—such as viruses, bacteria, and protozoa—from other animals to humans. A warming climate and large rainstorms are likely to increase mosquito and tick populations in the region along with the risk of diseases carried by those organisms. Many pathogens for human disease that are carried by ticks and mosquitoes—such as Lyme disease, erlichiosis, and malaria—have increased their geographic range in recent decades in part due to warming winter temperatures (Quarles 2017). Other infectious pathogens may also be climate-sensitive, including those spread by contaminated food and water (Kinney et al. 2011).

Droughts may also provide breeding sites for mosquito larvae, and warmer temperatures will spur mosquito reproduction and speed the growth of mosquito-borne pathogens (Quarles 2017). These conditions may help to explain instances of malaria and expansion of the West Nile virus in New York. West Nile is carried by certain species of *Culex* mosquitoes and spread by birds and humans.

Droughts act to bring birds and mosquitoes together at reduced water sources, and also to reduce populations of dragonflies and other predators of mosquitoes (Epstein 2000, 2001). These phenomena together may hasten the spread of the virus. Warmer temperatures may also make this region hospitable to the *Aedes* mosquitoes that spread the Zika virus.

Even small increases in average temperatures can increase rates of population growth and average population densities of mosquitoes (Kinney et al. 2011). In addition, the biting rates of mosquitoes and the replication rates of the parasites and pathogens they transmit has been found to increase with increasing temperatures (Harvell et al., 2002).

Ticks do not survive prolonged periods of very cold temperatures. Warming temperatures are a significant factor in the northward spread of Lyme disease (Leighton et al. 2012) and the increased numbers of Lyme-infected ticks in the Northeast (Levi et al. 2015). Climate models predict that their populations will continue to expand northward into areas now considered to be too cold to support them (Brownstein et al. 2005, Ogden et al. 2005).

Increased precipitation and accompanying flood events and large volumes of runoff may increase the risk of water-borne illnesses from bacteria, viruses, and parasites, from toxins produced by blooms of algae and cyanobacteria, and from chemical contaminants from human activities. Warmer temperatures may also increase the incidence of *Salmonella* and other bacteria-related food poisoning.

A common green darner (dragonfly) on iris. . Moy Wong © 2017

Habitat Loss and Degradation

The concept of habitat loss is simple to understand: construction of a new house, driveway, lawn, parking lot, or road in an undeveloped area will destroy the habitats in the footprints of those built features. In some cases the ecological consequences of those losses may be minor, especially if the new features do not encroach on sensitive habitats.

Habitat degradation, however, is often less obvious but is responsible for much greater harms to biological resources in this region. That same new house, lawn, and driveway whose footprint may seem small—perhaps an acre or less—can negatively affect habitats in a large area of the landscape by means of light and noise pollution, chemical pollution, the spread of non-native species, and habitat fragmentation.

Lakes and ponds for example, are degraded by shoreline development, aquatic weed control, use of motorized watercraft, and polluted runoff from roads, lawns, and agricultural areas. Springs are easily disrupted by disturbance to up-gradient land or groundwater, altered patterns of surface water infiltration, or pollution of infiltrating waters. Pumping of groundwater for human or livestock water supply can deplete water available to nearby springs and seeps.

Disruption of Stream Flows, Water Quality, and Stream Habitat

Removal of trees or other shading vegetation along a stream can lead to elevated water temperatures that adversely affect aquatic invertebrate, amphibian, and fish communities. Clearing of floodplain vegetation can reduce the important exchange of nutrients and organic materials between the stream and the floodplain. It can also diminish the floodplain's capacity for **flood attenuation**, leading to increased flooding downstream, scouring and bank erosion, and siltation of downstream reaches. Any alteration of flooding regimes, stream water volumes, timing of runoff, or water quality can profoundly affect the habitat characteristics and species of streams and riparian zones.

Hardening of stream banks with concrete, **riprap**, **gabions**, or other materials reduces the biological and physical interactions between the stream and floodplain, and tends to be harmful to both stream and floodplain habitats. Channelized streams have higher velocities which can be destructive during large snowmelt and rain events. Removal of snags from the streambed degrades habitat for fishes, turtles, snakes, birds, muskrats, and their food organisms.

The habitat quality of a stream is affected not only by direct disturbance to the stream or its floodplain, but also by land uses throughout the watershed—that is, the entire land area that drains

into the stream. Activities in the watershed that cause soil erosion, changes in surface water runoff, reduced groundwater infiltration, or contamination of surface water or groundwater are likely to affect stream habitats adversely. For example, an increase in impervious surfaces (roads, driveways, parking lots, and roofs) may increase runoff, leading to erosion of stream banks and siltation of stream bottoms, and a consequent degradation of the habitat for invertebrates, fish, and other animals. Road runoff often carries contaminants such as petroleum hydrocarbons, heavy metals, de-icing salt, sand, and silt into streams. Applications of fertilizers and pesticides to agricultural fields, golf courses, lawns, and gardens in or near the riparian zone can degrade the water quality and alter the biological communities of streams. Construction, logging, soil mining, clearing for vistas, creating lawns, and other disruptive activities in and near riparian zones can hamper riparian functions and adversely affect the species that depend on streams, riparian zones, and nearby habitats.

Fragmentation of streams from dams and poorly-sized or poorly-installed culverts is a widespread cause of degraded stream habitats, and has led to the loss of whole populations of fish unable to navigate those barriers (see sidebar). Figure 9 shows the locations of barriers identified on New Lebanon streams. Over the last several years the Hudson River Estuary Program has been conducting surveys to identify culverts that are too small to carry expected flood flows, or are perched above the streambed. The survey results are provided to local, county, and state agencies to help them prioritize culverts for replacement so that risk to infrastructure is reduced and stream continuity is restored.

Stormwater management on land development sites is usually inadequate to maintain the patterns, volumes, and quality of surface runoff and groundwater recharge that occurred prior to development. Groundwater aquifers are vulnerable to **point source** and **non-point source pollution**, and to the expansion of impervious surfaces preventing groundwater infiltration and recharge.

Disturbances to soils in the course of forest clearing, mining, and construction of new houses and roadways often result in the spread of non-native invasive species. Seeds and vegetative propagules carried by vehicles and machinery readily spread invasive plants from one site to another.

Culverts, Bridges, and Stream Continuity

From headwaters to mouth, a stream is a continuous ecosystem dependent on upstream and downstream movement of nutrients, organic materials, sediments, and animals.

For example, many of our fishes need different parts of a stream for feeding, spawning, nursery areas, drought refuge, and overwintering, and sometimes need to make larger journeys for population dispersal and genetic exchange. Access to cool pools in summer, deep pools in winter, suitable substrates for spawning, shallow nursery areas inaccessible to certain predators, and invertebrate drift from upstream reaches can be essential to maintaining fish populations. Invertebrates, amphibians, reptiles, and other animals similarly need to move freely to take advantage of various stream habitats and materials in different seasons, life history stages, and stream conditions.

Dams are an obvious impediment to these movements, but bridges and culverts, if improperly sized, designed, and installed, can also act as partial or total barriers. severely altering stream flows, and disrupting the stream ecology.

Culverts that are suspended above the stream bottom prevent the movement of organisms and materials. Undersized bridges or culverts disrupt natural flow patterns, causing upstream impoundment and increased downstream velocities, often leading to streambed scouring and bank erosion, and damage to bridges, roads, and other infrastructure.

A culvert should be large enough so that stream flows are unimpeded, even during flood events, and the lower invert should be buried in the stream bottom so that water depth is similar within and outside the culvert. The DEC's recommended standards are that 1) bridges or open-bottomed arches are preferred; but, where culverts are used 2) the culvert is 1.25 times wider than the stream channel itself, and 3) the lower invert is buried in the stream bottom to 20 percent of the culvert height.

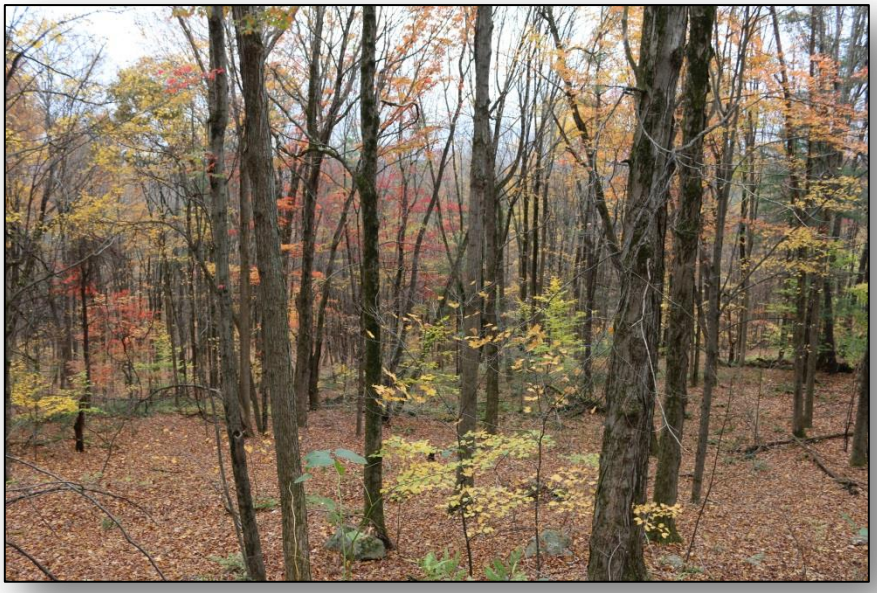
These measures will help ensure that stream continuity is maintained and the culvert can accommodate the large water volumes of future flood events.

Additional information can be obtained at http://www.dec.ny.gov/permits/49066.html.

Habitat Fragmentation and Rural Sprawl

Habitat fragmentation is a widespread form of habitat degradation, and among the primary threats to biodiversity worldwide (Davies et al. 2001) and in the Hudson Valley. While some species and habitats may be adequately protected in small patches, many wide-ranging species, such as black bear, barred owl, and red-shouldered hawk, require large, unbroken blocks of habitat. Many species such as wood turtle and Jefferson salamander need to travel among different habitats to satisfy their basic needs for food, water, cover, nesting and nursery areas, and population dispersal. Landscapes that are fragmented by roads, utility corridors, and development limit animal movements and interactions, disrupting patterns of dispersal, reproduction, competition, and predation.

Many species of wildlife require more than one kind of habitat to fulfill their life history needs; others are far-ranging and have territories spanning hundreds or thousands of acres. The fragmentation of habitats by roads, development, and other human disturbances inhibits the ability of wildlife to move across the landscape. Species that are able to cross human-created barriers (such as roads) face elevated mortality risk from vehicles and predators. Populations that become restricted to fragmented habitat patches may face local extinction. Over longer time scales, habitat connectivity is critical for maintaining genetic exchange among distant populations and facilitating the migration of species under deteriorating environmental conditions or climate change. Linking small or otherwise isolated habitat patches can help to ensure that the habitat, movement, migration, and behavior requirements of most native plant and animal species are conserved across a broad landscape.



Deciduous forest viewed from Old Gale Hill Road. Craig Westcott © 2017

Even a single house on a single long driveway through a forest or large meadow can have a severe impact on the forest or meadow ecology. Many "area-sensitive" wildlife species that require large habitat areas, and other "human sensitive" species are affected when a feature such as a driveway or a utility corridor cuts deeply into a large forest. Some animals do not tolerate, for example, the noise and lights around human activity areas; highly fragmented habitats; mortality and disruption of movement patterns posed by roads, driveways, mowed lawns and fields, and other such features; human-subsidized predators such as raccoons, skunks, and house cats; invasive plant species (often abundant near human-settled areas); and those that are otherwise affected adversely (directly or indirectly) by the proximity of humans. Area-sensitive and human-sensitive plants and animals include many of the rare and declining species in the region, and many that have already disappeared from our settled landscapes.

Fragmentation of forests increases the area of forest "edge" habitat with higher light and noise levels and often facilitates invasion by non-native plant species and by predators such as raccoons and domestic cats. Fragmentation makes the (formerly) deep interior forest areas newly accessible to nest predators and to brood parasites (such as the brown-headed cowbird) whose activities are ordinarily confined to forest edges. The cowbird is a non-native blackbird that makes no nest of its own, but lays its eggs in the nests of other species. The eggs are early to hatch and the nestlings develop quickly, outcompeting the young of the host species for food. The cowbird has been implicated in the decline of many forest songbird species in the Northeast.

Land development in the form of "rural sprawl" (low density, large lot size) is a growing threat to large contiguous habitat areas in the region, and could become a problem in New Lebanon. The town's *Comprehensive Plan* encourages the use of cluster designs for land development (Sect. III.A.3.b). New residential development often fragments or eliminates former meadow or forest habitat, for example, and often leads to the degradation of nearby streams, and the draining, filling, or pollution of unprotected wetlands, or conversion to ornamental ponds. Well-designed clustering of developed uses can be used to minimize the fragmentation of habitats and the influence of edge effects on nearby areas.

Roads, utility corridors, and other features dividing forests can also act as significant barriers to wildlife movement. Many animals avoid breeding near human activities, and the "edge effects" of human disturbance from roads, residential areas, and other development may reach hundreds of feet into forest patches (Findlay and Bourdages 2000, Forman and Deblinger 2000, Lampila et al. 1995, Murcia 1995, Trombulak and Frissell 2000). Fragmentation similarly reduces the habitat values of large meadows and many other habitat types for certain sensitive species.

In addition to the ecological problems described above, forest fragmentation also diminishes the economic viability of working forests, e.g., for timber production and harvest.

Other forms of habitat fragmentation occur along streams, where dams, poorly designed culverts, or improperly installed culverts create barriers to upstream or downstream movement of stream

organisms. Many organisms—such as dragonfly nymphs, mussels, fish, salamanders, and turtles—use streams and streamside areas as pathways between habitats. Barriers such as dams or suspended culverts can partially or completely obstruct their movements. Even a small dam on a small stream, or a culvert suspended just a few inches above the stream bottom, can create an insurmountable barrier for some organisms.

Damage to Habitats

Insects of all kinds are essential to the sound functioning of the ecosystems that support the human community, agriculture, and the natural world around us, but human activities inflict multiple stresses on insects. Directly or indirectly, urbanization, rural land development, and agriculture have led to the loss, degradation, and fragmentation of habitats. Also harmful to insects are introductions of non-native plants and animals, the spread of pathogens, applications of pesticides, light pollution, genetically modified organisms, and a host of other factors.

Bees, wasps, flies, butterflies, moths and beetles are the major pollinators of native plants and agricultural crops in North America. Of these groups, bees are the most important because they collect both nectar and pollen as food, and they have physical structures especially evolved for transporting pollen (Mader et al. 2011). Certain wasps, in addition to their pollinating services, are also the natural enemies of many agricultural pest insects.

Pesticide applications may have had large impacts on the populations of bees, butterflies, and other pollinating insects. Even some of the widely-used insecticides that are approved for organic farming certification have broad-spectrum effects and are very toxic to bees and hazardous to a large array of other insects. Effects of pesticides and other toxic substances can be acute, chronic, or sublethal, and can be caused by not only the "active" ingredients but also the "inert" ingredients in the formulations as well as interactions between different pesticides (Kiviat 2009). Contaminated pollen can remain toxic for long periods.

Native bee gathering pollen from hollyhock. Moy Wong © 2017

Different groups and species of pollinating insects have different habitat needs for feeding, nesting, and dormancy periods, but all can be much affected by land management. While intensive mowing and cultivation may be essential to some kinds of farm production, they are lethal to insects at many stages of their life cycles. But certain measures can help to support the insect community without interfering with farm productivity. For example, maintaining significant areas of unmowed vegetation will provide larval food sources (for butterflies) and nectar sources (for all pollinators) throughout the growing season. Maintaining hedgerows and forest edges with structural diversity (e.g., trees, shrubs, forbs, and **graminoids**, and woody and herbaceous debris) and plant species diversity will provide habitat for an array of important insects, for nesting, larval and pupa stages, overwintering, and foraging. Avoiding use of broad-spectrum or systemic pesticides will prevent contamination of the vegetation, pollen, and nectar foods of pollinators. Avoiding soil fumigants will help to protect the habitats of ground-nesting bees and the many other soil-dwelling insects and other invertebrates.

Specific habitat needs of grassland breeding birds vary by bird species, but there are some characteristics that seem universally important: 1) Large meadows tend to be more valuable than small meadows. 2) Meadows dominated by grasses or sedges tend to support higher densities of nesting birds than those dominated by other forage crops or row crops. 3) Grasslands embedded in generally agricultural landscapes tend to support higher densities of grassland birds than those surrounded by forests or developed land (NRCS 2010). Fragmentation of meadows by roads, driveways, and other developed uses eliminates the interior meadow areas that shield the nests of grassland birds from nest predators and nest parasites that frequent meadow edges.

Because many birds nest in the spring and the young do not fledge until late spring or summer, mowing or intensive grazing of meadows in the spring or early summer is likely to be fatal to eggs and nestlings. If nests are destroyed or depredated, some birds will nest again, and the young may not fledge until August, or even later. Delaying mowing until mid- or late summer can significantly improve bird survival rates (Zalik and Perlut 2008), as many of the young will have fledged by mid-July. Similarly, rotational grazing that reduces the grazing intensity and allows for regeneration of vegetation between grazing periods also improves the survival rates of bird eggs and nestlings.
For hayfields, multiple cuttings are essential to the economies of some farm operations, and late-cut hay tends to have lower protein content, so delayed cutting is not always a practical option. For farm operations that cannot afford to reduce the intensity of mowing or grazing, another alternative is to simply set aside certain areas—perhaps those with poorer soils or wetter soils—to accommodate bird nesting, while maintaining more intensive operations elsewhere. Delayed cutting in wet areas will also reduce damage to soils, which can be severely harmed by compaction and other disturbance when wet.

Forest wildlife can be harmed by selective or clearcut logging or other forest disturbance at any time of year. Winter is often favored as the less-disruptive season for logging, because some organisms—such as migratory songbirds and summer-roosting bats—are present only in spring through fall. But many other animals—such as overwintering songbirds, small mammals, amphibians, reptiles, and

soil invertebrates—are here year-round, occupying live and dead trees, downed logs, leaf litter, and forest soils. Some of these forest animals are in winter torpor and cannot easily move out of harm's way, and those that can move may be unable to find adequate winter shelter in nearby areas. Logging equipment and techniques that reduce disturbance to forest soils and to non-target trees and shrubs will also help to minimize the disturbance to forest animals.

Pollution

According to the DEC, in this region the most significant threats to groundwater resources include "inactive hazardous waste sites and industrial discharges, pesticide application, chemical spills, animal feeding operations, and inadequate on-site wastewater treatment systems" (Bureau of Watershed Assessment and Management 2008).

While many sources of pollution (such as direct industrial discharges to waterways) have been curtailed over the last several decades, pollution of water and soils still occurs widely but often in less obvious ways. For example, some air-borne pollutants are transported long distances through the air, before settling here in the forms of sulfur dioxide, mercury, and nitrogen from fossil-fuel-burning power plants in the Midwest, and nitrogen compounds from distant agriculture (Driscoll et al. 2001). But many of our pollutants originate here from sources such as agricultural and lawn chemicals, leachate from failing septic systems, salts and hydrocarbons in roadway runoff, industrial waste, fuel spills and leaking gasoline storage tanks, and smokestack discharges from commercial and residential oil burners and wood stoves. Pollutants such as these in water and soils often go undetected for long periods during which time they can cause widespread harm to organisms, communities, and habitats.

All of the above disturbances represent common types of habitat degradation that are often invisible to us, but the impacts to habitats and species can be severe. The depletion of sensitive species of plants and animals that we observe in urban, suburban, and suburbanizing landscapes is usually due to the cumulative effects of these kinds of impacts.

Invasive Species and Pathogens

Non-native invasive species often lack significant predators or diseases in their new environments and can outcompete native species for limited resources or space, resulting in the decline of native biological diversity. Land development has the potential to promote the spread of these species into many high quality habitats and reduce the overall value of those habitats to native plants and animals.

Non-native plants such as common reed, Japanese stiltgrass, Japanese knotweed, purple loosestrife, water-chestnut, Eurasian watermilfoil, multiflora rose, Bell's honeysuckle, Japanese barberry, common buckthorn, tree-of-heaven, and many others are now widespread in the region, usually spreading out from areas in and near human development and land disturbance.

Non-native animals such as the rusty crayfish and the brown-headed cowbird have similar effects on native communities. The rusty crayfish (*Orconectes rusticus*) —native to the central and midwestern US—is large and aggressive, allowing it to displace native crayfish and escape predation. It may have arrived in our streams in fishermen's bait buckets, which can also carry other non-native animals, pathogens, and parasites.

The advance of the hemlock woolly adelgid and emerald ash borer, apparently hastened by the warming climate, promises to decimate our eastern hemlock and white, green, and black ash trees, greatly altering the forest communities of southeastern New York. The pear thrips, an insect native to Europe, attacks domestic (pear, apple, plum, cherry) and native (serviceberry, black cherry) fruit trees, and also native forest trees such as sugar maple, red maple, and American beech. A large outbreak can defoliate thousands of acres of forest, and can be triggered by warm, dry springs associated with climate change (Natural Resources Canada 2015). These are just a few of the climate-related stresses that may transform New Lebanon's forests in the coming decades.

Black swallow-wort, a non-native invasive vine related to native milkweeds. Claudia Knab-Vispo © 2017

Recreation

Outdoor recreation is essential to our physical and spiritual well-being, and is one of the amenities that attracts residents, businesses, and visitors to the region and contributes much to local economies. Expansion of opportunities for outdoor recreation is one of the goals set forth in the *New Lebanon Comprehensive Plan* and of this *Natural Resources Conservation Plan*.

Recreational activities can have various negative effects, however, on natural resources, depending on the kind of activity, how and when it is engaged in, and how the resources, uses, and impacts are managed. For example, lead sinkers used by anglers are often lost and later ingested as grit by waterfowl who may be sickened and die from lead poisoning. Discarded monofilament fishing line can entangle wildlife, and discarded lures and other litter be mistaken for prey or forage and cause injury or death when ingested. Motorized watercraft can harm aquatic animals, pollute waterways with leaking oil and gas, cause noise disturbance of wildlife, and introduce invasive aquatic plants to uninfested waters. All-terrain vehicles (ATVs) are also hard on trails and disruptive to wildlife due to direct damage to habitats, and to air pollution and noise. Mountain biking can quickly damage foot trails, and is particularly disruptive when soils are wet. Even a seemingly benign activity like hiking or birdwatching can disturb courting or nesting birds in forests or meadows, and reduce their nesting success. Walking trails in the deep interiors of large forests or large meadows can invite nest predators and nest parasites that would otherwise confine their activities to the habitat edges. Overuse or inadequate maintenance of trails can lead to concentrated runoff of rainwater and snowmelt, and consequent soil erosion and loss and damage to down-gradient streams and wetlands. Because many kinds of wildlife depend on darkness for hunting and cover, nighttime lighting of ballfields and other public spaces can disrupt the activities of both predators and prey.

These are just a few of the impacts of recreation on wildlife, habitats, water, and soils. At the same time, however, outdoor recreation is wholesome and restorative for children and adults of all ages, and especially important for children's physical development and their connections to the natural world. Outdoor recreation could even be considered a "birthright" for children growing up in a rural area like New Lebanon.

With some attention to the needs and potential sensitivities of nearby habitats and species, recreational facilities can be located, designed, and managed in ways that minimize harm to natural resources, and users can be educated in outdoor etiquette that respects the natural surroundings. Prior to siting new trails or other amenities, we encourage habitat assessments and biological surveys so that facilities and public education can be designed to be least disruptive and most compatible with the local environment.

Stormwater

In a well-vegetated landscape with undisturbed soils, a large proportion of the precipitation volume is captured in the organic duff and the soil. From there, some may run off along the ground surface, some evaporates, some is taken up by plants and animals at and near the soil surface, and some moves downward through the soil to replenish the groundwater. One of the consequences of land development with roads, driveways, parking lots, buildings, other structures, and lawns is that, unless carefully designed to promote onsite water infiltration to the soils, the movement of water overland and through the soils is often dramatically altered, to the detriment of groundwater and nearby streams and wetlands.

In conventional development designs, through grading, swales, ditching, and other means, precipitation and snowmelt are directed to run rapidly off the ground surface into the nearest ditch or stream. Stormwater from agricultural fields, lawns, and gardens carries fertilizers, pesticides, and sometimes sediments, and stormwater from paved areas and roofs carries petroleum hydrocarbons, heavy metals, salts, and other toxins. All of these substances can be damaging to the habitats and species of wetlands and streams.

The typical consequences of rapid runoff are that infiltration of rainwater and snowmelt to the soils is reduced or eliminated, groundwater recharge is reduced, soils are eroded and lost, stream flooding is increased, base flows of streams are reduced, and water quality of streams, lakes, ponds, and wetlands is degraded. These impacts are most pronounced where there are large areas of **impervious** surfaces (e.g., pavement, roofs), but the cumulative impacts of many smaller impervious areas can also be significant.

Roadside ditches are large contributors to the degradation of streams and wetlands. Ditches intercept rainwater and snowmelt from road surfaces and often from much larger watersheds, and convey it rapidly into nearby streams and waterbodies. Road runoff carries contaminants as well as sand from winter road treatments. Unvegetated ditches are especially susceptible to erosion, and carry additional sediments from the eroded banks.

Loss of Agricultural Land

Inactive farmland, if left undeveloped and unmanaged, usually reverts to oldfield, shrubland, and eventually forest. All of those stages offer valuable habitat for native plants and animals, and the land can be returned to agricultural uses at any time, although clearing shrubland or forests can be costly. Farmland is lost permanently only if it is developed with structures, pavement, roads, and driveways. Protecting active farms and areas with good farmland soils are fundamental requirements for maintaining the potential for viable local agriculture, which has obvious large benefits for New Lebanon's economy, local and regional food security, the scenic character of the landscape, and the culture of the human community.

Agricultural land is often considered prime real estate for development because it is often flat or gently sloped, well-drained, and cleared of woody vegetation. Many areas of the best agricultural soils in the Hudson Valley have been developed for non-agricultural uses. The growth in demand for high quality local and organic food in the Hudson Valley and the greater New York metropolitan region during the last decade comes at a time when escalating property values have made maintaining large farm properties unaffordable to many multi-generational farming families. Young farmers new to agriculture also face a critical shortage of accessible and affordable farmland in the region as old farms have been sold at high prices and converted into residential subdivisions and private estates. Moreover, even where conservation organizations have succeeded in acquiring **conservation easements** or development rights on important farmland parcels, keeping farms in active agriculture can be difficult. In many cases, land trusts are able to protect open space but unable to maintain working farms on protected land. Arrangements to lease land in private conservation easements to new farmers are limited by farmers' needs for permanence, housing, and equity. Farmland protection must go beyond open space protection to address access and affordability of farmland, and maintenance of opportunities for farming on protected agricultural lands.

The Columbia Land Conservancy (CLC) has partnered with the Dutchess Land Conservancy, in collaboration with the American Farmland Trust's Hudson Valley Farmlink Network, to operate the Farmer-Landowner Match Program which facilitates farm leases and helps farmers and private landowners find solutions to overcome some of the many challenges to leasing farmland, including building equity in a farm business, having security of land tenure, and farmer housing. Conservation organizations and partners in this region, including CLC, Scenic Hudson, and Equity Trust, are also trying out tools to keep conserved land in farming, such as the Preemptive Purchase Right, which aims to ensure that whenever a parcel of conserved farmland is sold in the future it will be sold to a qualified farmer at its agricultural value (Christine Vanderlan, pers.comm.). There may be ways for the Town of New Lebanon to collaborate in these programs with the Columbia Land Conservancy and other organizations to keep good farmland accessible and affordable for farming.

Some local policies and actions can have entirely unintended consequences relative to farmland and habitat conservation. For example, large-lot zoning can actually accelerate the loss of farmland, residential sprawl, and the fragmentation of habitats. When a 5+ acre farmland parcel is developed for a residential or other non-farm use, then the entire area is typically lost to potential farming. Also, extending the water and sewer systems of a hamlet farther into the countryside encourages the conversion of farmland to other uses. Still, keeping residential and commercial uses clustered in and near a hamlet may be the best way to minimize rural sprawl, maintain large areas of farmland, and minimize impacts to intact habitats.

Hayfield viewed from Kelly Road. David Farren © 2017

Protected Lands

The lands in New Lebanon with formal conservation status are fee-owned lands and conservation easements held by the Columbia Land Conservancy, and a state forest (Figure 22).

The Hand Hollow Public Conservation Area is owned and managed by the Columbia Land Conservancy for public recreation and education, and for natural resource conservation. It is open to the public for passive recreation and for fishing (by permit).

Hand Hollow State Forest is owned by New York State and is open to the public for hiking, biking, picnicking, horseback riding, primitive camping, skiing, hunting, fishing, trapping, non-motorized boating, and snowmobiling.

The Columbia Land Conservancy holds conservation easements on 1495 acres of privately-owned land in New Lebanon. A conservation easement is a voluntary legal agreement drawn up by the landowner and the land trust that ensures permanent protection of the land from unsuitable development. The landowner retains ownership with all its rights and responsibilities (including property taxes), and can sell the land or pass it on to heirs, but the conservation easement remains attached to the land in perpetuity. The easement is designed to serve the conservation goals of the landowner and land trust, and describes permissible and impermissible land uses and sometimes other restrictions on land management.

Together these protected lands contain many of the conservation targets of this *NRCP*. For example, the conservation easement properties represent elevation gradients from low to high, have three of the six major bedrock types in the town, and include large forests, large meadows and active farmland, and some are broadly connected to other protected lands. The eased properties also represent parts of the Taconic Mountains Significant Biodiversity Area and the beech-maple forest that has been designated a Significant Natural Community.

Large areas of forest in the northern and eastern parts of New Lebanon are eligible for the federal Forest Legacy Program (FLP) (Figure 22)), and funds are available to conserve land within that area with the assent of willing landowners. The FLP is a federal grant program, initiated in the 1990 federal Farm Bill (16 U.S.C. Sec. 2103c) to protect important forest land from conversion to non-forest uses. Participation in the program is entirely voluntary, and is intended to relieve some of the financial pressure on landowners who might otherwise feel the need to sell their land for development purposes. More information is at http://www.dec.ny.gov/lands/63117.html.

There are many other parts of New Lebanon with important resources that deserve conservation attention, such as woodland pools, floodplain forests, small streams, and many of the large forests, large meadows, other unusual habitat areas, and good farmland soils. Recruiting landowners as long-term stewards of the special natural features of their land is the most important means of conserving the ecologically significant features of New Lebanon's landscape, but an array of other tools—regulatory and non-regulatory—are also available to municipal agencies, conservation organizations, and New Lebanon citizens (see the Achieving Conservation Goals section, below).

Looking east from McGrath Hill Road, Darrow School students Rianna, Matt, Marco, and Riley use the CAC tablet to geolocate scenic views into the scenic viewshed database. Craig Westcott © 2017

22. Protected Lands

(and Forest Legacy-eligible Area)

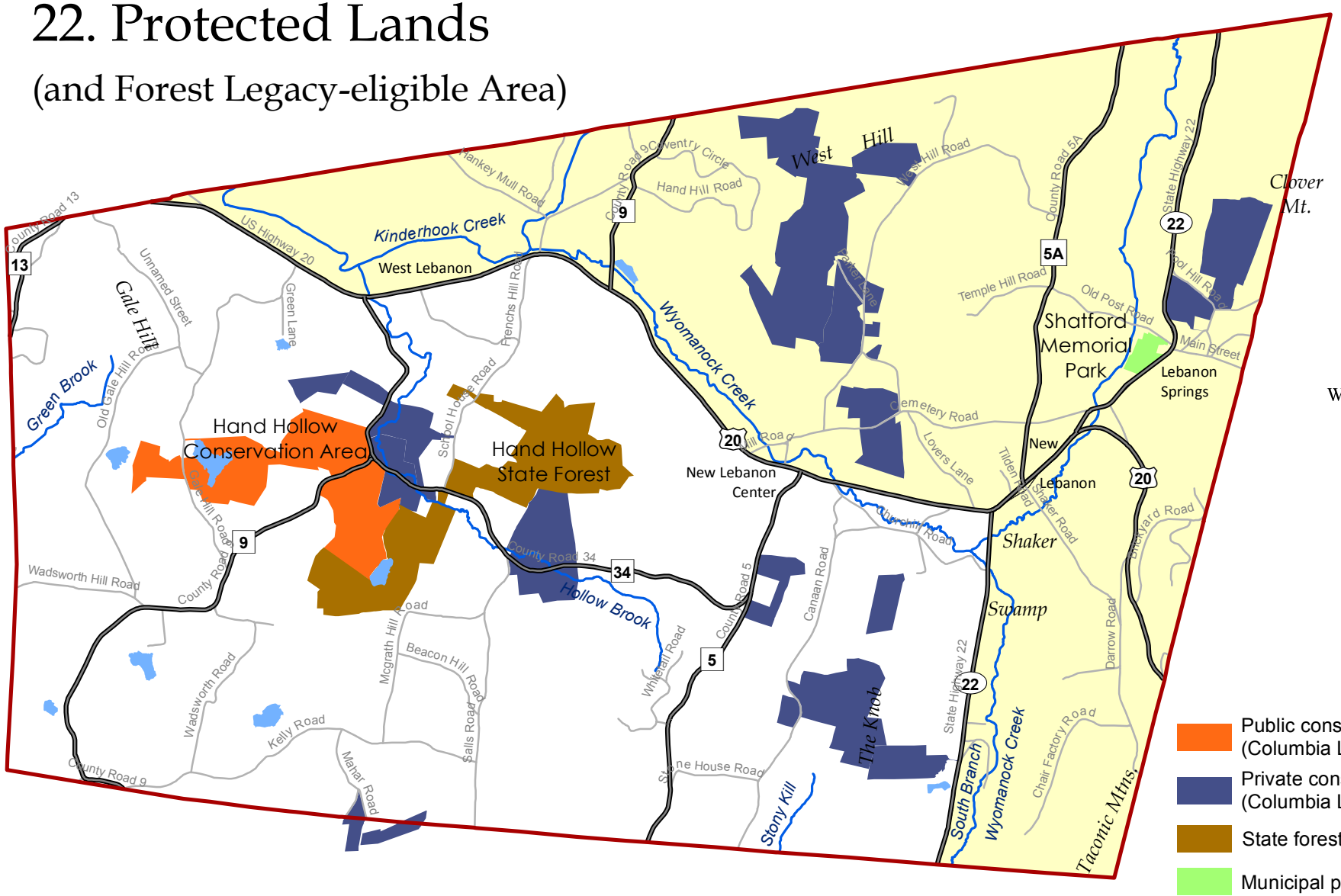


Figure 22. Protected lands and area eligible for the USFS Forest Legacy Program in the Town of New Lebanon, Columbia County, New York. Public access is not permitted to private conservation easements. New Lebanon Natural Resource Conservation Plan, 2017.

DATA SOURCES

Areas eligible for Forest Legacy Program, public conservation area, and private conservation easements from the Columbia Land Conservancy. State forest and municipal park from the NYS GIS Clearinghouse. See Figure 2 for roads, streams, and waterbodies. Map created by Hudsonia Ltd., Annandale, NY.

Environmental Research and Education
Science for Conservation
Hudsonia Ltd.

Conservation Areas

Significant habitats, farmland, water resources, and scenic areas are widely distributed throughout New Lebanon, and the general Conservation Measures listed in sections above are designed to be applied everywhere. But to help draw attention to the places where certain features of concern are concentrated, we have divided the town into four so-called "Conservation Areas" (Figure 1). Each is described below.

High Taconics

The eastern edge of New Lebanon is on the lower western slopes of the Taconic Mountains. The Taconics run through New York and three New England states, and encompass 40,000 acres of substantially **unfragmented forest** (Strong 2010). Large forests have particular value for biodiversity, for local and regional climate moderation, for carbon sequestration, and for conservation of water resources. Because large forests are disappearing in this region due to fragmentation by roads, driveways, residences, and other developed uses, the populations of many of the plant and animal species of large forests are also declining. These include area-sensitive birds such as red-shouldered hawk (SC), Acadian flycatcher (PB), and black-throated blue warbler (SGCN). Mammals that we associate with wilderness—such as black bear, bobcat, and fisher—also require deep interior forest habitats or other areas distant from human disturbance for certain of their life history stages.

Cool ravine on a Taconic Mountain slope, St. Germain property. David Farren © 2017

The Taconics have been recognized by the DEC as a **Significant Biodiversity Area** (Figure 16), due to their large forests, species of conservation concern, and importance as a water source feeding the wetlands, streams, and groundwater of the adjacent valleys. The forests on the western slopes of the Taconics in New Lebanon are interrupted by many roads, residences, farm fields, and other land uses but still retain some **large forest areas**,

including some that are part of immense forests of 5000+ acres extending into neighboring Massachusetts. These forests have been identified by the New York Natural Heritage Program as important "**linkage zones**" due to their apparent capability for providing ecological connectivity between larger forest blocks ("matrix forests"). Parts of New Lebanon's Taconic forests **border on the Pittsfield State Forest** and **Bates Memorial State Park** (both in Massachusetts), magnifying the conservation value of lands on both sides of the state boundary.

The Taconic slopes have forested **ledge and talus** habitats, several **cool ravines**, many **seeps** and **intermittent streams**, and several **perennial streams**. A northern stream has been designated as a Known Important Area for sensitive **coldwater stream habitat**. New Lebanon's famed **warm spring**, the only such feature known to occur in New York, emerges at the summit of Spring Hill Road. There are "**rich forest**" communities on the lower slopes, with many spring ephemeral wildflowers and at least one location of a state-listed **rare butterfly**. Some of the meadows, even at high elevations, have **prime** or **statewide important farmland soils**, and several land parcels were preliminarily designated as **priority agricultural lands** in the Columbia County *Farmland Protection Plan*.

The Taconics are a prominent **scenic feature** along and westward of US Route 20 and NYS Route 22, and represent one of the "**enduring features**" of fundamental conservation importance to the region. The lands and buildings of the former Shaker community on Mount Lebanon are a renowned and treasured **historic landmark**, now maintained by the Mount Lebanon Shaker Society, the Darrow School, the Abode of the Message community, and other private landowners.

Wyomanock and Kinderhook Valleys

The Wyomanock and Kinderhook creeks are the two **largest streams** in New Lebanon., and their valleys have surficial geology and past and present land uses distinct from the rest of the town. The primary glacial **outwash** and **kame** deposits are in these corridors, and thus the town's three commercial **gravel mines** are located here. The **floodplains** are narrow in some places, but nearly one mile wide at the confluence of the Wyomanock South Branch and mainstem in the New Lebanon hamlet. The Farmscape Ecology Program found large areas of **floodplain forest** in these corridors, including significant examples of "**ancient" floodplain forests**. These valleys hold the town's major unconsolidated **aquifers**, where groundwater yields and accessibility are likely to be much greater than elsewhere in the town, and where the groundwater may be most vulnerable to contamination from human land uses and activities.

The valleys contain numerous **wetlands**, including the iconic **Shaker Swamp** wetland complex, which supports **rare and uncommon species** of plants and animals, and has a long history and pre-history of uses by Native Americans, the Shakers, perhaps the Tilden Pharmaceutical Company, and

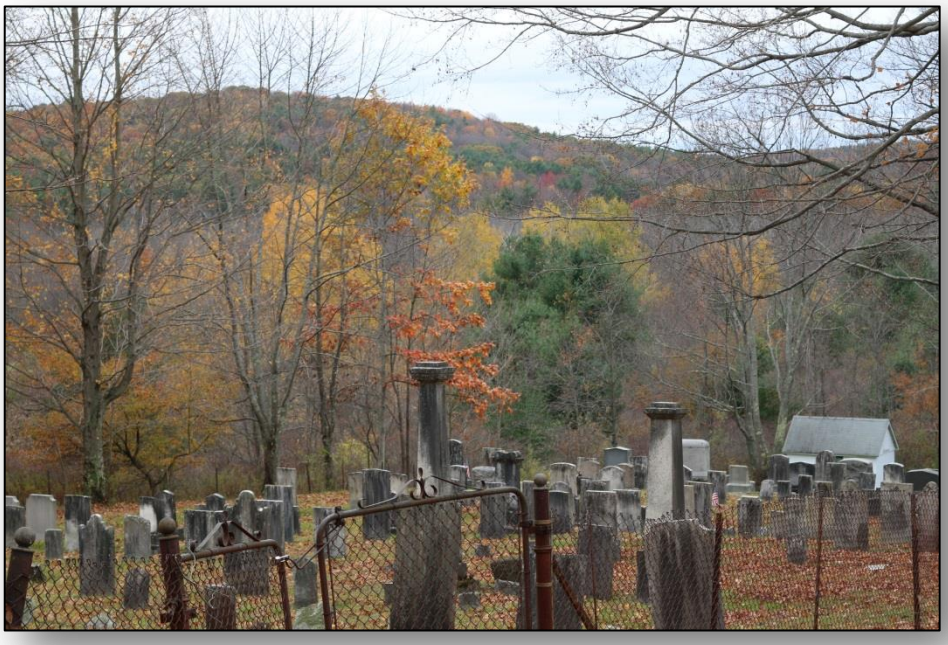
others that helped to shape the development of New Lebanon from its beginnings. **Prime Farmland Soils**, much of the **active farmland**, and many of the **large meadows** are concentrated in these valleys, and several of the parcels designated as **priority agricultural lands** are in these corridors. The mainstems and major tributaries of the Wyomanock and Kinderhook are designated as Known Important Areas for sensitive **coldwater stream habitat**, a declining resource in the Hudson Valley. The Wyomanock valley contributes to especially **scenic vistas** along County Route 5A and US Route 20. The banks of the Kinderhook and the lower reach of the Wyomanock are designated for **public fishing access**.

Rocky Foothills

This is the hilly area in the central part of the town that encompasses many of the **high-elevation** (1200+ft asl) areas, and those with shallow soils and exposed bedrock. The summits of **West Hill** and **The Knob** have some of the highest elevations in New Lebanon. The Knob, a ledgy, steep-sided ridge that extends south into Canaan, has been identified by the New York Natural Heritage Program as a Known Important Area for biodiversity because of the **exemplary beech-maple mesic forest** that covers much of the summit and slopes. The "**Little Knob**," a lower adjacent knoll, has a limestone ledge with a community of calcicolous (calcium-loving) plants, many of which are rare or uncommon in the county. Just west of the Little Knob is a wetland locally called "The Bog" that may be the town's only occurrence of a **circumneutral bog lake**, an uncommon habitat type in the region that is known to support rare plants and animals. The northern forests of the Rocky Foothills area are part of a large **matrix forest** and The Knob is in one of the **linkage zones** connecting large forest blocks; these areas were identified by The Nature Conservancy and the New York Natural Heritage Program for their particular value for supporting area-sensitive and interior-forest species, and providing landscape connectivity between habitat areas. The Rocky Foothills also have some of the largest contiguous forests (1000+ acres) internal to New Lebanon. The Rocky Foothills contain the **headwaters of Hollow Brook**, one of the major tributaries to Kinderhook Creek. Hollow Brook and one other small perennial stream have been designated as Known Important Areas for sensitive coldwater stream organisms. In addition, these hills have many other small, **intermittent streams**, most of which do not appear on publicly-available hydrography maps. The corridor along County Route 5a and West Hill Road has large areas of **Statewide Important** and **Prime Farmland Soils**, and contains several parcels identified as **priority agricultural lands** in the Columbia County *Farmland Protection Plan*. A location along County Route 5A has been recognized for exceptional s**cenic views** of Lebanon Valley and the Taconic hills. The Rocky Foothills has large areas of private land protected by **conservation easements**.

Western Hills

Covering much of the western half of New Lebanon, this area contains the **lower-elevation hills**, much of the **Hollow Brook mainstem and tributaries**, and most of the large **open waterbodies** in the town. The northwest corner of the Western Hills has small areas of bedrock types that occur nowhere else in the town—**shale, slate, argillite, quartzite,** and **greywacke**; these are not rare in the region as a whole, but are examples of "**enduring features**" that deserve some conservation attention due to their local rarity and the likelihood that they support biological communities distinctive from those elsewhere in New Lebanon. Hollow Brook, two tributaries, and two other streams have been identified as "Important Areas" for **wild native brook trout**. Several of these streams have small areas of **floodplain forest**, including some that have been identified as "**ancient**" **floodplain forest**. The Western Hills have large areas of **Prime Farmland Soils** and **Farmland Soils of Statewide Importance**, and a few parcels identified as **priority agricultural lands**. The **Hand Hollow Public Conservation Area** (PCA) and the **Hand Hollow State Forest** are the two largest areas for **public recreation** in the town, and the PCA has been recognized as a place of **special scenic importance** in partial surveys. The PCA and State Forest together with adjacent large private properties with **conservation easements** create a very large block of protected land, magnifying the conservation value of any one piece.



New Britain Cemetery viewed from New Britain Road. Craig Westcott © 2017

Achieving Conservation Goals

The New Lebanon *Comprehensive Plan* (2005) expresses the town's strong interest in protecting, conserving, and responsibly managing its natural resources, and lays out an ambitious set of goals and an action plan to achieve those ends. Some of the action items—such as creating a Conservation Advisory Council, encouraging adoption of a countywide farmland protection plan, and establishing a local farmers' market—have already been implemented. The town now has an active Conservation Advisory Council; the county has published a farmland protection plan; and the New Lebanon farmers' market has been operating successfully since 2009. This *Natural Resource Conservation Plan* supports the action items listed in the *Comprehensive Plan*, adds a few more, and provides natural resource information to underpin those actions.

Private landowners are the town's most important partners in natural resource conservation.

Conservation and sound stewardship of natural resources is most effectively achieved through a variety of means, and perhaps the most important of these is the voluntary actions of individual landowners. Most of the land in New Lebanon is and will continue to be in private ownership, and the overall condition of the forests, meadows, streams, and ponds reflects the cumulative history and present-day land management on each parcel. For this reason, landowners are the town's most important partners in natural resource conservation.

An important tenet of this *Plan* is that protection of valuable resources should occur on every land parcel in the town, including every half-acre or three-acre residential lot, every 10-acre subdivision, every 15-acre or 50-acre woodlot, and every 200-acre farm. This protection does not need to interfere with ordinary uses for living, farming, or conducting a business, but can nonetheless contribute to the care and stewardship of land and water.

Protection of valuable natural resources should occur on every land parcel in the town.

Other ways to promote the protection and stewardship of important resources include, for example, guidance to applicants during the town's review of land development projects, establishment of conservation easements with willing landowners, acquisition of land from willing landowners, or land use restrictions imposed by local policy or legislation

The ambitious goals of this *Plan* can only be achieved by pursuing multiple courses of action that exploit many different regulatory and non-regulatory "tools" available to the town, such as 1) outreach to landowners and the general public on matters related to conservation and stewardship

of important resources, 2) development of effective town policies, procedures, and legislation for natural resource conservation, and 3) collaboration with other agency and organization partners to accomplish goals that are beyond the capacity of the town to achieve by itself.

Assessment of habitats, water resources, and habitat connectivity should precede any new land development project.

One of the reasons for the degradation of water resources and the regional losses of biodiversity is that land development often occurs with little knowledge of the resources that might be affected. An assessment of habitats, water resources, and landscape connectivity should be among the first steps in planning a new project so that, right from the start, the project can be designed to accommodate the most sensitive areas. Providing assessment guidelines to applicants and their consultants will help to insure that sufficient information is supplied to the Planning Board.

A pre-application meeting between the applicant and the Planning Board can help the board and the applicant better understand the site and the proposal, and provide an opportunity for the applicant to learn about local land use regulations, and hear the Planning Board's concerns and recommendations before the applicant spends unnecessary time and money on a project or design unsuitable for the site.

For all development projects, a "conservation design"—that is, where developed uses are spatially clustered to allow contiguous open space to remain unfragmented—should be the default requirement, whether the proposed project is a for single house and driveway on a single lot, or a 20-lot residential subdivision. A waiver could be sought in cases where the conservation design seems unfeasible.

The town should encourage members of the Planning Board and the Zoning Board of Appeals to undergo annual training in landscape analysis, habitat assessment, and the SEQR process so that they are well-equipped to analyze materials submitted by applicants, and bring independent knowledge and natural resource information to the project review. When appropriate, the Planning Board should hire an outside expert to help review a proposed development site or the application materials, and to help answer some of the difficult questions about impacts to natural resources. The costs of the consultation can be passed on to the applicant.

Conservation Tools

Landowner Education

Educating landowners about their important roles as stewards of biological, water, farmland, and scenic resources can help raise awareness and support for conservation activities, and inspire voluntary action on their own land. Education can occur through outreach at community events, through lectures and workshops, through educational mailings, through materials posted on the town's website, through articles in local publications, and by involving landowners in townwide projects related to resource conservation. Educating landowners about appropriate preparations for, adaptations to, and responses to the effects of climate change will improve the town's overall preparedness and resiliency.

The Master Forest Owner program of the Cornell Cooperative Extension (https://www.ccecolumbiagreene.org/natural-resources/woodland-stewardship.html) provides advice to landowners on techniques and resources for sound forest management. The DEC Forest Stewardship program (http://www.dec.ny.gov/lands/45941.html) provides technical assistance to forest landowners to develop Forest Stewardship Management Plans to help achieve their goals for the land. The Environmental Quality Incentives Program (EQIP) (https://www.nrcs.usda.gov/wps/portal/nrcs/main/ny/programs/financial/eqip/) of the Natural Resources Conservation Service provides financial and technical assistance to help farmers install structural features or adopt management practices to improve environmental quality while maintaining agricultural production. The Forest Connect blog of the Cornell Cooperative Extension (http://blogs.cornell.edu/cceforestconnect/) provides information and resources related to forest ecology and sustainable forestry practices to forest owners and managers. Links to other sources of information and conservation ideas are on the webpage of the New Lebanon Conservation Advisory Council (http://www.townofnewlebanon.com/conservation-advisory-council-cac/).

Municipal Land Use Policy, Environmental Reviews, and Legislation

The Town of New Lebanon regulates certain aspects of land use through zoning and other local laws that set forth legal standards for reviewing development proposals and balancing private property rights with community environmental, health, and safety concerns. Carefully designed legislation, project review procedures, and standards for decision-making can ensure that any land use restrictions are applied consistently and fairly, and that resources important to the public welfare are protected.

New Lebanon's *Comprehensive Plan* and *Open Space Inventory* both lay out goals and specific actions for town policy and practice that bear on land and resource conservation. The *Comprehensive Plan*, now 12 years old, calls for the establishment of **Critical Environmental Areas** to protect aquifers and

scenic areas, **zoning overlay districts** to protect steep slopes and farmland, other legislation to establish streamside buffer zones, and restrictions on noise, light, and air pollution, and establishment of a **Community Preservation Fund** program to aid with resource protection. This *Natural Resource Conservation Plan* can serve as a catalyst to move some of those efforts forward.

Critical Environmental Areas

A Critical Environmental Area (CEA) is a geographical area with exceptional character with respect to one or more of the following:

- a benefit or threat to human health;
- a natural setting (e.g., fish and wildlife habitat, forest and vegetation, open space and areas of important aesthetic or scenic quality);
- agricultural, social, cultural, historic, archaeological, recreational, or educational values; or
- inherent ecological, geological or hydrological sensitivity that may be adversely affected by any change in land use. (http://www.dec.ny.gov/permits/45500.html).

The purpose of establishing a CEA is to raise awareness of the unusual resource values (or hazards) that deserve special attention during environmental reviews and land use decisions. The procedure for establishing a CEA is as follows:

1. Identify the CEA, delineate the boundaries, and prepare a written justification for a CEA designation.
2. Publish a public notice that describes the boundaries and special environmental characteristics of the proposed CEA.
3. Conduct a State Environmental Quality Review (SEQR) (as an Unlisted action).
4. Hold a public hearing.
5. Adopt the CEA (Town Board).
6. File the map, the written justification, and proof of a public hearing with the DEC and with town and county agencies.

Once a CEA has been formally designated and registered with the state, the special characteristics of the CEA must be specifically addressed in the SEQR process associated with a development project. The town can also adopt procedural or regulatory requirements to ensure that the important attributes of the CEA are considered in the siting and design of land development projects in that area. Thus, for example, a CEA could be delineated around the warm spring and the land area contributing to its water source; or around the Wyomanock and Kinderhook creek corridors that contain the major unconsolidated aquifer areas, some of the town's best farmland, and the floodplains and Active River Areas of those streams.

Create Local Funding

A variety of mechanisms are available to raise local funds for land acquisition, purchase of conservation easements, and assist with other conservation projects; for example:

- A dedicated fund can be established from a small increase in the local property tax.

- A local general revenue bond can be issued to obtain funds to acquire lands or easements for conservation.
- With authorization from the State of New York, the town could establish a Community Preservation Fund (CPF) to help with the establishment of parks or preserves, purchase of recreation lands, aquifer recharge areas, important habitat areas, scenic areas, or historic sites, purchase of conservation easements, and other purposes related to conservation of natural or cultural resources. The CPF program works by imposing a Real Estate Transfer Tax on properties whose sale price exceeds a certain minimum (e.g., the median sale price in town). New Lebanon could learn from the experience of other municipalities in the Hudson Valley (e.g., the towns of Red Hook and Warwick) that have established such funds.
- Grants can be obtained by the town from agencies such as the Hudson River Estuary Program, the Hudson River Valley Greenway, the Office of Parks, Recreations, and Historic Preservation, and the NYS Department of State, and organizations such as the Berkshire Taconic Community Foundation, the Hudson River Bank and Trust Fund, and others for projects related to conservation.
- The Clean Water State Revolving Fund (CWSRF) provides municipalities and not-for-profit organizations a mechanism to fund land acquisition projects that protect and enhance water quality and preserve open space.

These and other ways to raise local funds for conservation purposes are outlined in the *Local Open Space Planning Guide* (2004) (https://www.dos.ny.gov/lg/publications/Local_Open_Space_Planning_Guide.pdf).

Local Legislation

Although state and federal laws provide limited protection to certain wetlands and streams, many smaller wetlands and streams and most upland habitats lack any legal protection and are susceptible to loss or harm. Local legislation is one of the best ways to ensure that resources of importance to the community are not harmed by our uses of the land. Local laws can be crafted to protect small streams and wetlands, aquifer areas, farmland soils, special habitat areas, and other features deemed to be important to the public welfare. For example, an Aquifer Overlay Zone could be established to protect the unconsolidated aquifer from land uses with potential to contaminate the groundwater or reduce groundwater recharge.

Environmental Reviews

For proposed land development projects, the town could help ensure better outcomes by establishing environmental review procedures that foster a collaborative process between town agencies and applicants to design new projects in ways that minimize harm to sensitive resources. Requiring a natural resource assessment or a habitat assessment in the early stages of planning land development projects helps the landowner, developer, and town agencies understand the biological, water, and mineral resources and the particular sensitivities of a site, and enables them to design the

new project in ways that accommodate those features. Construction of even a single house and driveway on a single lot can have large impacts on habitat fragmentation; on loss and fragmentation of farmland; on quality, volume, and patterns of surface water runoff and groundwater recharge; and on the scenic viewshed. A natural resource assessment would inform the applicant and town agencies about which parts of a site may be best suited to the proposed new uses, and which areas are best avoided. The model *Habitat Assessment Guidelines* developed by Hudsonia Ltd. could be adapted to New Lebanon's needs and provide a starting place for these assessments.

Conservation Advisory Council

The role of the New Lebanon Conservation Advisory Council (CAC), whose members are appointed by the Town Board, is to assist and advise town agencies on matters related to environmental conservation. The CAC is available to help the Planning Board review land development projects, and to conduct research on local policy. It provides educational materials to agencies and the public and carries out special projects such as the New Lebanon *Open Space Inventory* (Conservation Advisory Council 2014) and this *Natural Resources Conservation Plan*. The CAC webpage provides information for landowners and residents, and links to other resources (http://www.townofnewlebanon.com/conservation-advisory-council-cac/.

Other Non-Regulatory Measures

- Provide incentives to land use applicants for setting aside certain important areas of development sites for conservation purposes;
- Establish Best Management Practices to protect sensitive areas from specific activities such as logging, mining, and farming;
- Establish a funding program to help landowners relocate buildings and other structures and materials to places outside of floodplains;
- Adopt a requirement that "**green infrastructure**" be incorporated wherever possible and practical when town roads, bridges, driveways, and other kinds of infrastructure are being upgraded.

Both the Wyomanock Creek and the Kinderhook Creek have been named "designated inland waterways" under the NYS Waterfront Revitalization of Coastal Areas and Inland Waterways Act. This designation makes the Town of New Lebanon, the Corkscrew Rail Trail Association, the Shaker Swamp Conservancy, and other organizations eligible to apply for grants dedicated to waterway revitalization along those streams. Such grants (funded by the NYS Environmental Protection Fund) could help support a variety of efforts related to protection of the stream corridors.

Land Acquisition

Although the Town of New Lebanon may rarely have funds available for acquiring lands for conservation purposes, the town can nonetheless collaborate with other public and private entities to help with acquisition efforts for lands with special environmental, historic, agricultural, recreational, or scenic importance, or lands that are threatened by inappropriate development. A decision to purchase a property for conservation purposes requires assessing the conservation values of the property in relation to conservation goals and priorities, and determining the long-term capacity for stewardship of the property. Financial and other forms of collaboration with other agencies, organizations, businesses, and landowners can expand the opportunities for and success of land acquisition projects. The CAC will share this *NRCP* with the Columbia Land Conservancy and other land conservation agencies to help them evaluate and prioritize potential conservation lands, and design conservation easements with willing landowners.

Land donation is simply a form of land acquisition whereby the town or another entity such as a land trust receives a gift of land and becomes the immediate owner. As with land purchases, the decision to accept a land donation should be based on an assessment of the property's conservation values and the capacity of the receiving agency to assume the long-term stewardship costs.

Conservation Easements

A conservation easement is a legal agreement between a landowner and an entity such as a municipality or a land trust. The easement is developed by the landowner and the receiving agency (such as a land trust) for purposes of protecting certain aspects of the property in perpetuity. Typically the easement permanently restricts the type, location, and amount of development and types of land uses that can occur on the property so that conservation values recognized by both entities—such as wildlife habitat, scenic views, agricultural value, and water resources—are protected forever. An easement may be donated by the landowner to the receiving agency, or may be purchased from the landowner by the receiving agency.

Easement lands remain in private ownership and on local tax rolls. The landowner retains full title to the land and is free to sell, lease, or mortgage the property, or pass it on to heirs. But the easement "runs with the land;" that is, the responsibilities and restrictions in the easement are conveyed to all future owners of the property. In this way a conservation easement allows the current landowner to maintain ownership and use of the property, and secure a conservation legacy for future generations. Conservation easements with, e.g., the Columbia Land Conservancy are completely voluntary, are developed on the landowner's initiative, and are designed to meet the wishes and long-term needs of the landowner while adhering to the conservation principles of the land trust. Easements require regular (annual) monitoring to ensure that the terms of the land use agreement continue to be met. Several properties in New Lebanon have conservation easements held by the Columbia Land Conservancy (Figure 22).

Legislative Protections

Protection of Wetlands

Federal Wetland Regulatory Program

Section 404 of the federal Clean Water Act is the basis for the federal wetland regulatory program, which is administered by the US Army Corps of Engineers (ACOE), sometimes in consultation with the US Environmental Protection Agency and other federal agencies. The federal government regulates activities in wetlands of any size as long as the wetland is functionally connected to "navigable waters." The law prohibits certain kinds of activities (especially filling) in jurisdictional wetlands without a permit. It imposes no regulated buffer zone around a wetland, but federal agencies may specify such a zone in permit conditions if they so choose.

Decisions about jurisdiction (that is, which wetlands come under the federal jurisdictional purview) are made by the ACOE on a case-by-case basis. The criteria for federal jurisdiction are somewhat vague after US Supreme Court decisions in 2000 and 2006. In most situations, however, a wetland adjacent to a perennial stream, or adjacent to a stream that ordinarily runs continuously for the duration of a season (e.g., all winter or all spring) and is tributary to a perennial stream, is considered jurisdictional under the federal program. An isolated wetland or a wetland adjacent to an intermittent stream that runs only a few days or a few weeks of the year is often non-jurisdictional. According to Kusler (2001) 30-60 percent of the nation's wetlands are excluded from federal jurisdiction; the percentages vary greatly by location and can be much higher in landscapes where small wetlands are concentrated.

New York State Wetland Regulatory Program

The New York State Freshwater Wetlands Act (Article 24 of the New York Conservation Law) regulates the kinds of activities that can occur in and near large wetlands (12.4 acres and larger), and in a few smaller wetlands "of unusual local importance." The most typical instances of the latter are wetlands connected to a public drinking water supply, or wetlands known to support a state-listed Threatened or Endangered animal. The law also regulates activities in a 100-foot-wide "adjacent zone" around the perimeter of any jurisdictional wetland. Most wetlands in New York do not fall under state jurisdiction, however, because they do not meet the size criteria or the criteria for "unusual local importance."

Thus, due to their small size or hydrologic isolation, most of our intermittent woodland pools, isolated swamps, wet meadows, and other small, isolated wetlands receive no protection from the federal or state governments. Small, isolated wetlands can have great value for biodiversity and for water management, however. Indeed it is often those very characteristics—small size and hydrologic isolation—that impart their special value to certain plants or animals. In the case of intermittent woodland pools, for example, their isolation from streams and other wetlands helps to maintain the

fish-free environment that is a critical characteristic for the pool-breeding amphibians of conservation concern (Jefferson salamander, spotted salamander, marbled salamander, wood frog). For the time being, local legislation is the only means of legal protection of the many wetlands that do not fall under state or federal jurisdiction.

The New Lebanon zoning ordinance refers to New York State and federal wetland jurisdiction, but extends no additional local protection to small or isolated wetlands that are excluded from federal or state jurisdiction. .

Protection of Rare Species

The federal and New York State governments maintain lists of rare species, and have laws intended to prevent harm to individuals and populations of those species. Most places in the state have never been surveyed for rare species, however, so no one knows all the locations where rare species occur. Consequently, most land development takes place without anyone knowing whether or not rare species occur in the vicinity and will be harmed by the project.

Most species, however, are associated with particular kinds of habitats, so information on habitats can help to determine where particular species are likely to occur. For example, Loesel's twayblade is a rare plant of wetland habitats, so we can safely assume that they will not occur in an upland forest. Similarly, an eastern meadowlark is likely to nest in a large meadow, but not in a marsh; and a blue-spotted salamander is likely to spend most of the year in an upland forest but not in a meadow. Thus, a habitat assessment is one of the best tools for determining the likely occurrence of a rare species.

Below are brief descriptions of some of the federal, state, and local laws, policies, and procedures that can help to protect rare species and their habitats.

Federal Endangered Species Act

The Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884) prohibits unauthorized taking, possession, sale, and transport of federally-listed endangered or threatened species of plants and animals. The US Fish and Wildlife Service establishes and revises the list of plant and animal species deemed to be rare nationwide, and assigns a rank of "Endangered" or "Threatened" to each. Only a few species in New York are on the federal list.

New York State Environmental Conservation Law

Animals ranked as Endangered, Threatened, and Special Concern are listed and regulated under 6 NYCRR Part 182 of the New York Environmental Conservation Law (ECL) 11-0535. The regulations prohibit the taking of (or engaging in any activity likely to result in the taking of) any species listed as Endangered or Threatened in New York. The regulations also prohibit importing,

transporting, possessing, or selling "any endangered or threatened species of fish or wildlife, or any hide or part thereof..."

Plants ranked as Endangered, Threatened, Rare, or Exploitably Vulnerable are listed and regulated under Environmental Conservation Law section 9-1503 Part (f): "It is a violation for any person, anywhere in the state to pick, pluck, sever, remove, damage by the application of herbicides or defoliants, or carry away, without the consent of the owner, any protected plant." ("Exploitably Vulnerable" plants are not rare but are likely to be picked for commercial or personal purposes.) Thus, plants are considered the property of the landowner, and are protected only to the degree that the landowner wishes. Under NYS law, any landowner can lawfully remove, damage, or destroy (or grant permission to others to destroy) state-listed plants on their own property, but others are not permitted to harm those plants without the landowner's permission.

Protection of Other Resources – New Lebanon Local Code

Many provisions in New Lebanon's local code are intended to protect natural resources of conservation concern. Among the stated purposes of the zoning law (2010) that are related to natural resources are:

- To protect and enhance scenic vistas and the town's natural beauty and rural and small-town character;
- To preserve and protect the environment;
- To preserve farms and farmland;
- To promote health and the general welfare;
- To provide adequate light and air;
- To prevent the overcrowding of land;
- To encourage the most appropriate use of land throughout the town.

The list of purposes is intended to guide general land use planning and reviews of proposed development projects, and provide the underpinning for regulatory decisions around land use.

The New Lebanon code has an "incentive zoning" provision to encourage the preservation of open space and agricultural lands. It authorizes the Planning Board to allow greater lot density in exchange for one or more benefits related to active farmland or good farmland soils. In the Residential-Agricultural/Conservation District (RA-5), a conservation subdivision plan is specifically required when the parcel contains, in whole or in part, state and/or federal wetlands occupying 25% or more of the site, slopes of greater than 20% occupying 25% or more of the site; a floodplain or flood hazard area as mapped by the Federal Emergency Management Agency's Flood Insurance Maps; a critical environmental area; an identified scenic view or scenic vistas; or if the parcel is under a DEC Forestry Management Plan.

The ordinance also states that all development within the Residential-Agricultural/Conservation District should incorporate smart or "low-impact development" measures to reduce the impacts of new growth, such as limiting total impervious surface, retaining and incorporating natural site features that promote infiltration of stormwater, and use of bioretention, pervious surfaces, open space, surface water dispersion, soil restoration, and other dispersed facilities to control stormwater as close to the origin as possible.

Furthermore, the ordinance provides that "the appropriate board may specify the location of the building envelope, to preserve trees or other resources, take advantage of soil conditions, or make the development more rural in character. New buildings adjacent to significant historic structures should be designed to harmonize with the general architectural features of the historic structures. Major modifications to the existing landscape such as extensive grading, clear-cutting of trees, or other similar activities shall be avoided."

The zoning provisions for the Flood Zone Overlay are intended to protect the public health and safety by regulating development in areas subject to flooding, and are designed to control the alteration of natural floodplains, stream channels and natural protective barriers that help to accommodate floodwaters, and control filling, grading, dredging and other development which may increase erosion or flood damages.

The ordinance authorizes the Planning Board to allow or require a "conservation subdivision" design, incorporating clustering and open space preservation, in subdivision applications where the Planning Board believes that the purposes of the ordinance cannot be met under conventional subdivision methods.

All these provisions in the local code affirm the town's interest in protecting biological and water resources, farmland, and scenic resources. Adherence to the code and enforcement of these provisions will help to sustain the natural features that define the town and support its economy and culture. This *Natural Resources Conservation Plan* provides supporting information and recommendations to help achieve the purposes and goals of the town's comprehensive plan and zoning ordinance.

Conservation Partners

The effectiveness and breadth of the town's conservation efforts can be greatly extended by collaboration with other public and private entities with shared conservation goals. The success of this Plan depends on marshalling the efforts of active volunteers, willing landowners, and partner organizations and agencies in the town, county, region, and state. Potential partners include:

- State and county agencies
- Statewide and regional conservation organizations
- Regional land trusts
- Regional recreation organizations
- Large and small landowners
- Local businesses

State and County Agencies

New York State Department of Environmental Conservation (DEC)

The regional DEC office conducts ongoing reviews of potential land protection projects based on priorities identified in the New York State Open Space Conservation Plan (2016). Projects that fit the scope of a listed priority conservation project and pass a thorough review process are eligible for funding from the state's Environmental Protection Fund and other state, federal and local funding sources. The state-identified open space priorities in New Lebanon include areas along the Taconic ridge and NYS Route 22.

> **Taconic Ridge/Harlem Valley**
> An area comprising the Taconic Mountain Ridge and its viewsheds, where it straddles the New York, Connecticut, Massachusetts, and Vermont borders in Putnam, Dutchess, Columbia and Rensselaer counties, and the Harlem Valley. …Protection of this area continues to be a high priority due to the region's high biodiversity, presence of threatened and endangered species, scenic views, substantial recreational value, thousands of acres of intact/unfragmented forestland, steeply sloping hillsides, unique geologic segments, historic architecture, working farm landscapes, and multiple connection opportunities to land currently protected by the State, federal government, counties, towns and private land conservation organizations. The Taconic Ridge is a Forest Legacy Area and qualified to apply for land acquisition grants through the federal Forest Legacy Program. In 2013, DEC received a federal Forest Legacy Program grant for the purchase of a 1,300-acre conservation easement on Mount Lebanon, which contains some of the most spectacularly scenic, ecologically important and culturally significant resources found in the area. The easement will provide opportunities for public recreation, environmental education and archeological research.
>
> ….[A]cquisition of properties in the Taconic Ridge/Harlem Valley and Route 22 corridor will protect important open space, scenic viewsheds, working farm landscapes, and watersheds and water quality, and preserve critical wildlife habitat for several threatened and endangered species.
>
> Specific projects include the Shaker Swamp, an almost 500-acre wetland complex supporting high biodiversity and serving as an important aquifer recharge area; surrounding active farmland, formerly owned by the Shakers and regarded as historically significant….

> [B]ecause key portions of the area demonstrating high biodiversity, scenic views, recreational value, working forests and farmland, and potential connections to other protected lands remain unprotected, the Taconic Ridge/Harlem Valley and associated viewsheds continue to be high priorities for protection. In addition,… protection of the Route 22 corridor, which includes scenic vistas, highly productive farmland, and wetland habitat supporting endangered and threatened species, continue to be important considerations within the overall area. [p. 115]
>
> **Hand Hollow Conservation Area**
> This Columbia County property, which is the Town of New Lebanon's only public conservation area, now encompasses 434 acres, including a 21-acre lake, smaller ponds, perennial and seasonal streams, a great blue heron rookery, and more than 5 miles of public trails. There exists the potential to enhance this conservation area if a number of key parcels are acquired. These parcels would secure a portion of the lakefront and Hand Hollow watershed, as well as contribute to the overall habitat diversity by adding extensive areas of woodland and meadows, in addition to streams, upland ponds, and wetlands. [p. 119]

The DEC's **Climate Smart Communities** program is a "state-local partnership to meet the economic, social and environmental challenges that climate change poses for New York's local governments." The program supports local governments and communities as they work to balance the goals of confronting and adapting to climate change, reducing local tax burdens, and advancing other community priorities. Participating communities will be alerted to the availability of state and federal grants, will have privileged access to certain state grants, and will be part of a network of governments working to achieve "climate smart" practices and policies.

The **Hudson River Estuary Program** of the DEC has a strong interest in developing the capabilities of municipalities for conserving important resources. They offer education opportunities for municipal officials and grants to municipalities and nonprofit organizations for projects that advance local biodiversity conservation efforts. The Estuary Program prepared a "*Habitat Summary*" for the town (Strong 2010), and an Estuary Program grant has funded the preparation of this *Natural Resource Conservation Plan*. Other offices of the DEC can provide information and technical assistance with stream and lake monitoring, groundwater protection, and floodplain mapping.

New York State Department of State (DOS)

The DOS offers training opportunities, educational publications, and technical assistance for municipal agencies on a variety of topics including the State Environmental Quality Review (SEQR) process and developing local legislation. SEQR and local legislation can be powerful tools in the protection and stewardship of local resources.

Hudson River Valley Greenway

The Greenway offers technical assistance and small grants to local municipalities and nonprofit organizations for projects related to community planning, economic development, and protection of open space and of natural, cultural, and scenic resources. A grant from the Greenway helped to fund the preparation of the New Lebanon *Comprehensive Plan* (2005).

Cornell Cooperative Extension—Columbia and Greene Counties

The Cooperative Extension is part of a statewide program that aims to put "knowledge to work in pursuit of economic vitality, ecological sustainability and social well-being," serving local families, farms, and communities. Their agricultural education programs provide research-based information on production and marketing of agricultural and horticultural products, through workshops, publications, and consultations. Their natural resource programs provide information, workshops, and assistance on such topics as woodland stewardship, water resource protection, invasive species, and agroforestry.

Natural Resource Conservation Service

The NRCS (of the US Department of Agriculture) collaborates with farmers, communities, and other individuals and groups to protect natural resources on private lands. They identify natural resource concerns related to water quality and quantity, soil erosion, air quality, wetlands, and wildlife habitat, develop conservation plans for restoring and protecting resources, and help to direct federal funding to local conservation projects.

Columbia County Soil and Water Conservation District

The District office provides technical assistance and education on matters related to water, soils, and other natural resources to municipalities, farmers, landowners, and residents, and promotes resource conservation and environmental stewardship. They host educational programs and provide consultations and other services, and assist with obtaining funding for projects that enhance environmental quality or economic viability of farm-related enterprises.

Columbia County Environmental Management Council

The Columbia County Environmental Management Council (EMC) advises local and state government on matters related to use, protection, and conservation of natural resources. Members are representatives of the 18 towns and the City of Hudson appointed to two-year terms by the county Board of Supervisors.

Columbia County Agriculture and Farmland Protection Board

The Agriculture and Farmland Protection Board, a committee of farmers and representatives of several county agencies, advises the Columbia County Board of Supervisors on matters related to state-certified agricultural districts, and acts as a liaison between county agencies, landowners, and state agencies on matters affecting agricultural district lands. The Board was the lead agency in preparing the *Columbia County Farmland Protection Plan* (2013).

Municipal Agencies

Neighboring towns can be valuable partners in land conservation, especially where shared natural resources straddle municipal boundaries. Adjoining towns can collaborate on developing conservation funding, supportive land use ordinances and other regulatory measures, strong open space plans, and ownership and management of conservation lands.

Statewide, Regional, and Local Conservation Organizations

Columbia Land Conservancy

The Columbia Land Conservancy's mission is to conserve the farmland, forests, wildlife habitat, and the rural character of the county, and to strengthen connections between people and the land. They own and manage the Hand Hollow Public Conservation Area in New Lebanon, and they hold conservation easements on several private parcels in the town. (Both the easement lands and the properties owned outright by the CLC remain on the local tax rolls.) The CLC also sponsors education programs for the public on natural history and conservation, workshops on development of public trails, and workshops for town agencies on incorporating natural resource conservation into land use planning, environmental reviews, and decision-making. The CLC hosts regular "roundtable" meetings that bring together the county's Conservation Advisory Councils to discuss shared issues. The CLC is an energetic and willing partner in local conservation.

The Conservation Fund

The Conservation Fund is an environmental non-profit that works with local governments, businesses, landowners, and conservation NGOs on projects that integrate economic and environmental objectives. They are active in all 50 US states, providing funding, loans, training, and other assistance to help with land acquisition, strategic planning, and other initiatives for longterm conservation and the sustainable use of natural resources. They recently purchased a 23,000 acre forest in New York, Vermont, and Massachusetts to be managed as a working forest and eventually turned over to other entities for long-term conservation.

The Nature Conservancy

The Nature Conservancy (TNC) is an international land conservation organization that has worked extensively throughout the state to further land protection through partnerships with other organizations and agencies (e.g., DEC, Open Space Institute) and private landowners to protect and prevent further fragmentation of important ecosystems. TNC's conservation targets include protecting matrix forest blocks, wetlands and vernal pools, drinking water sources, rare and endangered plants and animals, and they have a particular interest in helping communities adapt to

climate change (www.nature.org/media/newyork/rw_070509_exec.pdf). TNC has designated the Berkshire-Taconic region as one of the world's "Last Great Places" in the world.

Open Space Institute

The Open Space Institute (OSI) works in the eastern U.S. to protect scenic, natural, and historic landscapes through direct acquisition and conservation easements, and partners with local and state government to expand parklands. OSI's conservation strategy focuses on permanent protection at the landscape-level scale. OSI has protected over 46,000 acres in the Hudson Valley, creating connecting corridors that benefit both recreationists and wildlife, and protecting forests and prime farmland.

Preservation League of New York State

The Preservation League of New York State seeks to protect New York's heritage of historic buildings, districts, and landscapes. It leads advocacy, economic development, and education programs, and provides grants, loans, and technical assistance to individuals, organizations, and communities. Most of the historic landscapes in New Lebanon include farmland and/or forests, so may fall under agricultural and scenic as well as historic classifications from the perspectives of potential funders of conservation projects.

Shaker Swamp Conservancy

The Shaker Swamp Conservancy is an all-volunteer not-for-profit organization that works to discover the history of New Lebanon's Shaker Swamp and provide opportunities for public education and recreation. The Conservancy has recently purchased a parcel adjacent to the Shaker Swamp (not shown on Figure 21), and has plans to develop trails and other features for public access and education.

Trout Unlimited

Trout Unlimited (TU) is a national organization whose mission is to conserve, protect and restore the cold-water streams and fisheries of North America through habitat restoration, land conservation, public education, and legislative advocacy. They have a long history of collaborating with local, county, state and federal government agencies as well as other conservation organizations to achieve shared goals. The local chapter of TU is the Columbia-Greene Chapter #569 (Hudson). TU has an extensive network of volunteers that work on local conservation projects and issues. The New York State Council Trout Unlimited Conservation Fund provides small grants to local TU chapters for coldwater fisheries conservation projects. Due to the presence of many small and large trout streams, the local TU chapter (Columbia-Greene, Hudson) might be well-positioned to obtain funding for projects to restore, enhance, or protect the habitat quality of New Lebanon's streams.

Trust for Public Land

The Trust for Public Land (TPL) is a nationwide conservation organization working from inner cities to wilderness areas. In the ten-county area of the Hudson Valley below the Troy dam, TPL has assisted the state, counties, and municipalities in protecting more than 51,000 acres.

Recreation Organizations

Columbia County Mountain Bike Association

The Columbia County Mountain Bike Association and the International Mountain Bike Association are non-profit trails advocacy groups that conduct research and help to build and maintain sustainable multi-use trails. Both organizations could be partners with New Lebanon in building and maintaining biking trails should properties become available for these uses.

Corkscrew Rail Trail Association

The Corkscrew Rail Trail Association established and now manages the Corkscrew Rail Trail which now runs approximately 2.5 miles through private property in parts of Stephentown and New Lebanon. The organization partners with willing landowners and the community to support and enhance the trail.

Environmental Research and Education Organizations

Farmscape Ecology Program

The Farmscape Ecology Program (FEP) is a research and outreach branch of the Hawthorne Valley Association at the Hawthorne Valley Farm in Ghent and Hillsdale. The FEP studies the ecology of agricultural and natural landscapes of the county and the region, and the interactions of people with the land, both historically and in the present. They explore the natural and social ecology of the region, inform people of their findings, and seek to deepen everyone's connections to the land. The FEP has conducted biological field studies of many properties in New Lebanon—looking especially at farmland, floodplain forests, and the CLC public access lands—and, in an ongoing study of the plants and animals of important ecological communities throughout Columbia County, FEP and Hudsonia (see below) have explored several other sites in the town. The FEP has contributed much information on the plants, animals, and habitats of New Lebanon to this *Natural Resources Conservation Plan*. The FEP also leads field workshops to educate the public about habitats, plants and animals, and the ecology of farmland and wildlands here and elsewhere in the county.

Hudsonia Ltd.

Hudsonia is an environmental research institute that studies the plants, animals, and habitats of the region, their ecology and conservation. Hudsonia biologists conduct pure and applied research throughout the Hudson Valley and elsewhere in the Northeast, produce educational and scientific

publications, and conduct training and other educational programs for scientists, environmental practitioners, and land use decision-makers to help people better understand how to recognize, assess, and protect important biological resources. Hudsonia also collaborated with the New Lebanon Conservation Advisory Council to prepare this *Natural Resources Conservation Plan*.

Local Businesses

Some local business owners have a deep personal appreciation for and commitment to the town and the region, and also recognize that their business success is closely tied to the town's natural and cultural environment. Contributing to conservation efforts can offer business owners the personal satisfaction that comes with taking care of the places they love, can serve as an investment in the landscape that supports their livelihood, can demonstrate their commitment to conservation and the community as a prominent aspect of their business profile, and can help build positive relationships with the community. For all these reasons businesses are often enthusiastic partners in conservation initiatives and should not be overlooked in the quest for funding, publicity, and in-kind assistance.

Landowners and Others

Private owners of large land parcels or of smaller parcels containing important resources play a critical role in the future of land conservation and are essential partners in conservation action and funding. Landowners can take specific measures to protect habitats and water resources on their own land, can collaborate with their neighbors to protect and manage resources in nearby areas, and can assist the town with larger conservation efforts. Landowners in New Lebanon are diverse and represent a broad spectrum of views on conservation. Town-sponsored conservation efforts can benefit from reaching out to landowners on a regular basis to build partnerships and understand owners' relationships to their land, and their interests, goals, and concerns. Education programs can help landowners understand the role they play in shaping their community's future landscape and the available options for land management and land conservation.

Local professionals, such as biologists, ecologists, amateur naturalists, teachers, environmental engineers, landscape architects, and LEED-certified architects, often have a wealth of knowledge and expertise related to natural resources. Some have a strong personal interest in resource conservation and can offer their volunteer services to the town for technical assistance, grant-writing, or public education. The town should remember to call on such local expertise when appropriate.

Native bee at domestic bee-balm.
Moy Wong © 2017

Conservation Action Plan

This *Natural Resources Conservation Plan* has identified features of special importance (e.g., floodplains, aquifers, good farmland soils, habitat areas, scenic areas) that should be protected wherever possible, as well as some basic conservation principles that can help to guide other decisions about land uses and town policies. Because most of the land in New Lebanon is now and will continue to be in private ownership, the most important component of this *Plan* is the voluntary actions of landowners.

The CAC has identified the following general conservation targets for the purposes of this *Natural Resources Conservation Plan*:

- Streams, floodplains, Active River Areas
- Unconsolidated aquifers
- Active farmland and good farmland soils
- High-elevation areas
- Large forests
- Large meadows
- Unusual and exemplary habitats and ecological communities
- Known locations of plants or animals listed as NYS Species of Greatest Conservation Concern
- Wetlands, lakes, and ponds
- Intact corridors linking large habitat areas
- Scenic areas
- Public recreational resources (existing and potential)

In general we recommend that the town aim to protect large areas representing all elevational gradients and significant land forms, with broad connectivity of intact habitat areas. This approach will help to maintain and protect important physical and biological elements in the present, and provide the greatest opportunities for adaptations and safe migration of wildlife and plants to suitable habitats in a changing environment.

The highest priority areas for conservation may be where multiple conservation targets overlap and are well-connected with formally protected lands, and other high-priority areas may be places with

one or more of those targets. But important natural resources occur throughout New Lebanon, so in addition to those "priority" areas, conservation actions can and should take place on every land parcel by the actions of landowners, developers, and municipal agencies, so that streams, groundwater, farmland, intact habitats, habitat corridors, and scenic vistas are well cared for throughout the town.

Below are some concrete actions that will help to accomplish the goals of this *Plan,* and can be carried out by landowners, other citizens, conservation organizations, and town government to help ensure that the most important natural resources and recreational features are maintained intact for present and future generations. The CAC encourages citizens, agencies, and commissions to review the action items in the *Town of New Lebanon Comprehensive Plan* for additional measures that will contribute to sound stewardship of the town's resources.

Landowner, Farmer, and Citizen Actions

1. Apply the *NRCP*'s general conservation measures (Appendix D) to lands throughout the town, where applicable.
2. Remove structures and hazardous substances from floodplains, and shift to flood-resilient land uses to minimize economic losses from flood damage, flood hazards to downstream areas, soil loss, and stream contamination. Some appropriate land uses are forests, hayfields, and pastures (without structures).
3. Maintain floodplain forests intact wherever possible, and especially the "ancient" floodplain forests that may never have been cleared.
4. Where possible, adopt wildlife-friendly agricultural practices that protect water supplies, build living soils, support native pollinators, and accommodate ground-nesting birds while maintaining efficiency and profitability for farm operations.
5. Minimize applications of polluting substances to the land, such as de-icing salts to driveways and walkways, and pesticides and fertilizers to lawns, gardens, and cropfields.
6. Complete a townwide survey of scenic locations throughout the town, so that they can be considered in land use planning and environmental reviews of land development projects.

Town Policy and Procedures

7. Apply the *NRCP*'s general conservation measures on lands throughout the town, where applicable.
8. Adopt habitat assessment guidelines for applicants, to help ensure that adequate natural resource information is provided to the Planning Board and Zoning Board of Appeals with land use proposals.

9. Consider impacts to water resources, sensitive habitats, good farmland soils, and important scenic and recreational resources at the sketch plan stage of reviewing land development projects.
10. Hold erosion control and stormwater management plans to a high standard, to ensure that soils are not lost and stormwater is conserved.
11. Discourage disturbance of floodplain forests, and especially the "ancient" floodplain forests (Figure 15) identified by the Farmscape Ecology Program.
12. Develop educational programs and materials for town agencies, landowners, business owners, famers, and residents on topics related to natural resource conservation. (See the CAC webpage for links to materials and information from other agencies and organizations in the region.)
13. Join the Complete Streets program to make roads convenient, safe, and efficient for all users, including pedestrians, bicyclists, and motorists.
14. Reduce applications of de-icing salts on town roads, and town-owned parking areas and driveways, and manage stormwater runoff from such areas to promote infiltration of water to the soils.
15. Apply lower assessment values to lands with active farms and with conservation easements.
16. Develop a program to collaborate with farmers in their efforts to reduce pollution of surface water and groundwater, and to assist with obtaining grants and other support to defray the costs of those efforts.
17. Manage town-owned lands in ways that exemplify sound conservation principles (e.g., buffer zones along streams, or bioretention installations to manage stormwater)

Town Legislation

18. Adopt design standards for all land development projects to ensure that harm to sensitive areas is minimized. Standards should address, at a minimum, landscape connectivity; design, sizing, and installation of culverts; exterior lighting; soil erosion; and stormwater management.
19. Adopt local legislation to extend protection to the small streams, and small, isolated wetlands (and buffer zones) that are of critical importance to ecosystems and water supplies but are not protected by state or federal laws.
20. Strengthen steep slope regulations in the local code to better address soil erosion, stormwater management, and protection of streams.
21. Establish an Aquifer Overlay District with regulations to help protect the areas most important for aquifer recharge and most vulnerable to groundwater contamination.

22. Establish a Mining Overlay District in areas of glacial outwash deposits, with requirements that the continued accessibility of sand and gravel resources be considered during reviews of land development projects.
23. Establish Critical Environmental Areas to draw attention to areas of special concern for water resources, farmland, biodiversity, recreation, and scenic values. (Zoning overlay districts may be appropriate for some of these features.)
24. Prohibit construction of new buildings, roads, driveways, and other structures in the 100-year floodplains of New Lebanon streams, and encourage the removal of structures, equipment, and materials that could interfere with natural flood dynamics, or create local or downstream hazards if flooded. (Expand this to the 500-year floodplain when FEMA data is available.)
25. Create local funding for land acquisition, purchase of conservation easements, and other measures that the town deems important for natural resource conservation.

Great blue heron nests in standing snags of beaver ponds, and forages in a variety of other wetlands, ponds, and streams. Moy Wong © 2017

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