WETLAND DELINEATION REPORT

RIDGEWOOD RESERVOIR

Highland Park

Queens & Brooklyn, NY

Prepared by

New York State Department of Environmental Conservation

December 2017

Executive Summary

A wetlands investigation and delineation was conducted at the Ridgewood Reservoir by the New York State Department of Conservation (DEC), with the assistance of the New York City Department of Parks and Recreation (NYCDPR). The site is located at the Brooklyn-Queens border within New York City and is owned by NYCDPR.

The purpose of this investigation and delineation was to propose amendments to DEC's official Freshwater Wetland Maps to include any freshwater wetlands identified on the site as wetlands of unusual local importance. This will bring them under DEC regulation. Site investigations and delineations were performed on 12 and 27 July 2017. Work was performed in accordance with the procedures set forth in the *New York State Freshwater Wetlands Delineation Manual.*

The site contains three separate basins, remnants of its former use as a water supply system for Brooklyn, NY. The majority of the western basin (Basin 1), as well as the majority of the southern half of the western basin (Basin 3) contain forested wetlands that are seasonally flooded. The majority of central basin (Basin 2) contains open water, surrounded by emergent wetlands that are semi-permanently flooded and are dominated by common reed (*Phragmites australis*).

Both forested wetlands, as well as the non-wetland portion of the bottom of Basin 3 contain a mixture of native and non-native species, some of them invasive. The non-wetland slopes of all three basins are dominated by non-native invasive species.

The boundaries and types of wetlands identified on site are presented in Figure 5 (Appendix A). Data were collected from representative points within both the uplands and wetlands in Basins 1 and 3, and are presented in Appendix B. Photographs were taken of both the uplands and wetlands, and are presented in Appendix

Contents

INTRODUCTION:

The Ridgewood Reservoir is a decommissioned 19th century reservoir that sits on the Brooklyn–Queens border within New York City that is owned by the New York City Department of Parks and Recreation (NYCDPR). It is situated within Highland Park, south of Jackie Robinson Parkway, east of Vermont Place, north of Highland Boulevard, and west of Cypress Hill Street (Figures 1 & 2). It consists of three separate basins, two of which have been drained. The central basin retains water.

The New York State Department of Environmental Protection (DEC) regulates freshwater wetlands under the *Freshwater Wetlands Act (Act)*, Article 24 of the Environmental Conservation Law (ECL). To be protected under the *Act*, a wetland must either encompass an area of at least 12.4 acres (5 hectares) or have been considered by the DEC commissioner to have unusual local importance. Around every wetland is an 'adjacent area' of 100 feet that is also regulated to provide protection for the wetland.
The wetlands within Ridgewood Reservoir are of considerable local importance. They provide habitat for a variety of wildlife species, including several State threatened and endangered plant species. A 2007 survey conducted for the NYDPR confirmed the presence of the State endangered late-flowering boneset (*Eupatorium serotinum*), as well as the State threatened fringed boneset (*Eupatorium hyssopifolium* var. *laciniatum*), and globe-fruited ludwigia (*Ludwigia sphaerocarpa*). This survey also confirmed the presence of the State endangered Short-Eared Owl (*Asio flammeus*) and the State threatened Pied-Billed Grebe (*Podilymbus podiceps*). (Kelly and LaPuma, 2007), (Appendix D). The presence of these species qualifies these wetlands as Class I wetlands under sections 664.7(c)(1), 664.6(c)(4), and 664.6(c)(2) and (4) of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York ("NYCRR") Part 664.

The entire site, including its wetlands, is the subject of considerable local attention and concern for its protection. The owner, NYCDPR, has nominated the entire property for designation as a Critical Environmental Area under 6 NYCRR 617.14(g), one of the regulations implementing the State Environmental Quality Review Act (SEQRA). It has also been officially listed on both the State and National Historic Registers. Because of its unusual local importance, a wetland delineation was conducted by DEC staff so that it may be added to the State's list of regulated freshwater wetlands.

WETLAND INVESTIGATION AND DELINEATION

Methodology

Existing data regarding the site were reviewed. The Natural Resources Conservation Service's (NRCS) Soil Survey (Figure 3) indicates the presence of four soil types on the site. The side slopes of the basins are classified as Greenbelt loam, 15-25 percent slopes. The *Pharagmites* marsh in the Basin 2 is classified as Natchaug muck, 0-2 percent slopes, which is a New York State listed hydric soil. The open water portion is classified on the Soil survey as Water, but the underlying soil is a muck, which meets the NRCS criterion for hydric soils. The wetland portions of Basins 1 and 3 are classified as North meadow sandy loam, 0-3 percent slopes, which is not listed as a hydric soil.

The National Wetland Inventory, conducted by the US Fish and Wildlife Service (Figure 4), indicates that the majority of the northern two-thirds of the eastern basin (Basin 1) consists of palustrine scrub-shrub, broad-leaved deciduous, seasonally flooded wetlands (PSS1C) and that most of the southern portion consists and palustrine forested, broad-leaved deciduous, seasonally-flooded wetlands (PFO1C). It also indicates that the majority of the central basin (Basin 2) contains wetlands, with palustrine, unconsolidated bottom, permanently flooded, diked/impounded wetlands (PUBHh) in the central portion, surrounded by a fringe of palustrine emergent, persistent, semi-permanently flooded, diked/impounded wetlands (PEM1Fh). It does not indicate the presence of any wetlands on the western basin (Basin 3).

Site inspections were conducted on 12 and 27 July 2017 for the purpose of identifying freshwater wetlands on the site and delineating the boundaries of any wetlands identified. Field studies and delineations were performed according to the procedures described in the *New York State Wetlands Delineation Manual* (DEC, 1995) (*Manual*).

Studies were led by Ken Scarlatelli, Professional Wetland Scientist® and Certified Wildlife Biologist®, and DEC's Regional Natural Resources Supervisor. Mr. Scarlatelli was assisted by Christopher Haight of NYCDPR staff on both days and by Lauren O'Reilly and Eleni Kavvadias of DEC staff on July 12.

As described in the *Manual*, wetland ecosystems generally possess three essential characteristics: (1) hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology. The hydrophytic vegetation criterion is mandatory, in most cases, under the *Act*. Hydric soils and wetland hydrology are additional criteria to document the presence of a wetland and the location of its boundary. For wetland types that are not consistently "wet", vegetation alone may not be adequately diagnostic for identification of a wetland boundary. For these wetland types, field verification of wetland hydrology and/or hydric soils might be required to demonstrate that the plants found at the location actually do "…depend upon seasonal or permanent flooding (hydrology) or sufficiently water-logged soils (hydric soils) to give them a competitive advantage over other [plants]" [ECL §24-0107(a)(1), (2) and (6)].

The boundaries of areas identified as wetlands within Basins 1 and 3 were delineated by placing numbered flagging around their perimeters. These points were located using a Global Positioning System (GPS) device and their locations plotted on the Draft Freshwater Wetland Map (Appendix A). Data were collected at representative points both within the wetlands and non-wetlands to support each determination (Appendix B). Photographs were taken on either side of the wetland boundaries and at each data collections location (Appendix C).

No data were collected from within Basin 2, as it is dominated by *Phragmites*, which is FACW, and no FACU or UPL species are present. According to the *Manual*, such areas automatically qualify as freshwater wetlands. The boundaries of wetlands within Basin 2 were delineated using aerial photography, and their approximate locations are depicted on the Draft Freshwater Wetland Map (Appendix A). Photographs were taken of the wetlands from the adjacent non-wetlands (Appendix C).

The following descriptions of the technical criteria and field indicators of wetlands are taken from the *Manual*.

TECHNICAL CRITERIA FOR WETLAND DESIGNATION

Hydrophytic Vegetation

For purposes of the *Manual*, hydrophytic vegetation means macrophytic plant life that meets the definition of wetland vegetation in the Freshwater Wetlands Act. In addition, the *Manual* directs delineators to the "National List of Plant Species that Occur in Wetlands," (Reed et al., 1988), published by the U.S. Fish and Wildlife Service (FWS) in cooperation with U.S. Army Corps of Engineers (ACE), Environmental Protection Agency (EPA), and the Natural Resources Conservation Service (NRCS), formerly called the U.S. Soil Conservation Service. For the purpose of the field inspection conducted on 12 and 27 July 2017, the updated *State of New York 2016 Wetland Plant List* (Livchat et al., 2016), published by the ACE, was used.

The list separates vascular plants into four basic groups (commonly called "wetland indicator status") based on a plant species' frequency of occurrence in wetlands:

Plant Indicator Status Categories

(1) *Obligate Wetland Plants* (OBL) occur almost always (estimated probability >99%)

in wetlands under natural conditions;

(2) *Facultative Wetland Plants* (FACW) usually occur in wetlands (estimated probability 67-99%), but occasionally are found in non-wetlands;

(3) *Facultative Plants* (FAC) equally likely to occur in wetlands or non-wetlands (estimated probability 34-66%); and

(4) *Facultative Upland Plants* (FACU) usually occur in non-wetlands but occasionally are found in wetlands (estimated probability 1-33%).

(5) Obligate Upland Plants (UPL) almost always (estimated probability >99%) in non-wetlands under natural conditions. These UPL plants do not usually appear on wetland plant lists; they are listed only when found in wetlands with a higher probability in a particular region of the country. If a species is not on the State of New York Wetland Plant List, it is considered UPL for wetland delineation purposes.

Dominant Vegetation

Dominance, as used in the *Manual*, is based strictly upon the abundance of a species that can be visually estimated or measured in the field. Dominance is determined and considered independently within each stratum, and all dominants are treated equally in characterizing the plant community as a whole to determine whether hydrophytic vegetation is present. For each stratum in the plant community, dominant species are considered to be those with 20 percent or more areal coverage in the plant community.

Percent areal canopy coverage for trees and shrubs and percent areal ground coverage for herbs are commonly used measures of dominance. Dominant species can also be identified using other accepted approaches; however, under most circumstances, visual estimation of percent coverage is quick, convenient and adequate for evaluating plant communities. When present, vegetative strata for which dominants should be determined include:

(1) Trees*:* usually 5.0 inches diameter at breast height [dbh] and 20 feet or taller;

(2) Shrubs and saplings*:* usually 3 to 20 feet tall, including multi-stemmed plants, bushy shrubs and small trees and saplings;

(3) Herbs*:* herbaceous plants including graminoids, forbs, ferns, fern allies, herbaceous vines, and tree and shrub seedlings; and

(4) Woody vines

Bryophytes (mosses, horned liverworts, and true liverworts) may also represent an important component of some wetlands. There are no national, state or regional plant lists that include the wetland indicator status of these non-vascular plants. However, some bryophytes including Sphagnum species are often abundant in some wetlands including shrub bogs, moss-lichen wetlands, and wooded swamps, and are considered by most wetland scientists to be obligate wetland plants.

Vegetation Field Indicators of Wetlands

Having established the dominant species for each stratum, hydrophytic vegetation is considered present if any of the following are present:

(1) FACW or wetter species comprise more than 50 percent of the dominant species of the plant community and no FACU or UPL species are dominant, or;

(2) OBL perennial species collectively represent at least 10 percent areal cover in the plant community and are evenly distributed throughout the community and not restricted to digressional microsites, or;

(3) One or more dominant plant species in the community has one or more of the following morphological adaptations: hypertrophied lenticels, buttressed stems or trunks, multiple trunks, adventitious roots, shallow root systems, or other locally applicable adaptation,1 or;

(4) The presence of unbroken expanses of peat mosses (Sphagnum spp.) and other regionally applicable species of bryophytes over persistently saturated soil.

Indicators are listed in order of decreasing reliability. Although all are valid indicators, some are stronger than others. When a decision is based on an indicator appearing in the lower portion of the list, carefully evaluate the parameter to ensure that the proper decision was reached.

The presence of any of the above-listed hydrophytic vegetation characteristics typically indicates a wetland. Thus, an area that exhibits any of these indicators can be considered a wetland without detailed examination of hydrology and/or soils, provided significant unusual hydrologic modifications are not evident.

If none of the above vegetation indicators of wetland is found, but more than 50 percent of the dominant species of all strata are *FAC* or some combination of *FAC* and wetter species (including OBL, FACW+, FACW-, FAC+); then investigation and verification of hydrology and/or hydric soils is required to locate a wetland boundary.

Wetland Hydrology

Of the three technical criteria of wetland identification, wetland hydrology can be the most difficult to verify with certainty in the field.

Permanent or periodic inundation or soil saturation to the surface, at least seasonally, are the driving forces behind wetland formation. The presence of water to the root zones for two weeks or more during the growing season (*ie*. soil temperatures above biologic zero [41°]) typically creates anaerobic conditions in the soil. These conditions affect the types of plants that can grow and the types of soils that develop. In other words, wetland hydrology is exhibited in the species of plants growing at the site and recorded in the morphological soil features.

Many factors influence the wetness of an area including: precipitation, stratigraphy, topography, soil permeability, and plant cover. Most freshwater wetlands usually have at least a seasonal abundance of water. This water may come from direct precipitation, overbank flooding, surface water runoff due to precipitation or snow melt, or groundwater discharge. The frequency and duration of inundation and soil saturation vary widely from permanent to seasonal or irregular flooding or saturation. The duration of inundation or soil saturation are important characteristics in separating wetlands from non-wetlands, with duration usually being the more important factor.

Hydrologic Field Indicators of Wetland

At some times of the year and in some types of wetlands, wetland hydrology is obvious since standing water or inundated or saturated soils are readily observable. Yet in many instances, especially along the uppermost boundary of wetlands, hydrology is not nearly so apparent. Another complicating factor is that indicators of flooding can extend well beyond a wetland boundary, into low-lying upland areas flooded by some unusual event. Consequently, hydrologic indicators alone are generally not sufficient for delineating wetland boundaries. Despite this limitation, hydrologic indicators are useful in determining the presence of wetlands in some situations such as sites dominated by FAC vegetation. Signs of hydrology can help to confirm that such an area meets the definition of a wetland. In the absence of visible evidence of significant hydrologic modification, wetland hydrology is presumed to occur in an area having hydrophytic vegetation and hydric soils.

Some hydrologic indicators can be assessed quickly in the field. Although they are not necessarily indicative of hydrologic events during the growing season or in wetlands alone, they do provide evidence that inundation or soil saturation has occurred at some time. Professional judgement should be used in deciding whether the hydrologic indicators demonstrate that the wetland hydrology criterion has been satisfied.

When considering these indicators, it is important to be aware of recent flooding events and heavy rainfall periods that could cause low-lying non-wetlands to exhibit some of these signs. It is best to avoid, if possible, field inspections during and immediately after these events. If it cannot be avoided, then these events must be considered when delineating a wetland boundary. Additionally, hydrology varies seasonally, annually, and sometimes daily, and at some times of the year (e.g. late summer in New York) water tables are at their lowest points. During these low water periods, signs of soil saturation and flooding may be difficult to find in many wetlands. The following indicators can be assessed quickly in the field:

Primary Hydrologic Indicators

Any one of the following primary hydrologic characteristics (along with hydrophytic vegetation) indicates the presence of a wetland. Although all are valid indicators, some are stronger than others. Indicators are listed in order of decreasing reliability. When a boundary decision is based on an indicator appearing in the lower portion of the list, the specific indicator must be evaluated carefully, in conjunction with other information found on the site, to ensure that the decision is justified.

(1) Visual observation of inundation

(2) Visual observation of soil saturation

(3) Water marks

(4) Drift lines

(5) Water-borne sediment deposits

(6) Wetland drainage patterns

Secondary Hydrologic Indicators

Any two or more of the following secondary hydrologic characteristics (along with hydrophytic vegetation) indicate the presence of a wetland.

(1) Oxidized zones around living roots and rhizomes (rhizospheres)

(2) Water-stained leaves

(3) Surface-scoured areas

(4) Dead vegetation

Hydric Soils

Hydric soils are defined as soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. In general, as defined by "Soil Taxonomy" (USDA Soil Survey Staff 1975), hydric soils are flooded, ponded, or saturated usually for more than two weeks during the period when soil temperatures are above biologic zero (41ɴF). These soils usually support hydrophytic vegetation. The National Technical Committee on Hydric Soils (NTCHS) has developed criteria for hydric soils and a list of the Nation's hydric soils (USDA Soil Conservation Service [NTCHS], 1991).

Hydric Soil Criterion

Hydric Organic Soils

Accumulation of organic matter results from prolonged anaerobic soil conditions associated with long periods of submergence and/or soil saturation during the growing season. These saturated conditions impede aerobic decomposition (oxidation) of the bulk organic materials such as leaves, stems, and roots, and encourage their accumulation as peat or muck. Consequently, most organic soils are characterized as very poorly drained soils (Tiner & Veneman 1989).

Hydric organic soils are subdivided into three groups based on the presence of identifiable plant material:

(1) muck,

(2) peat, and

(3) mucky peat or peaty muck.

.

Hydric organic soils can be easily recognized as black-colored muck and/or as black to dark brown-colored peat.

Hydric Mineral Soils

Soils without a significant organic material component are classified as mineral soils. Some mineral soils may have thick organic surface layers due to heavy seasonal rainfall or a high water table, yet they are still composed largely of mineral matter (Ponnamperuma 1972). Mineral soils that are covered with standing (ponded) water or are saturated for extended periods during the growing season are classified as hydric mineral soils. Soil saturation may result from low-lying topographic position, ground-water seepage, or the presence of soils or layers with low permeability (e.g., clay, confining bed-rock or hardpan).

Due to their wetness during the growing season, hydric mineral soils usually develop certain morphological properties that can be readily observed in the field. Prolonged anaerobic soil conditions cause a chemical reduction of some soil components, mainly iron oxides and manganese oxides. This reduction affects solubility, movement, and aggregation of these oxides which is reflected in the soil color and other physical characteristics that usually indicate the presence of hydric soils. The two most widely recognized features that reflect wetness in mineral soils are gleying and mottling.

Gleyed soils are predominantly neutral gray in color and occasionally greenish or bluish gray. The distinctive colors result from the segregation or removal of reduced iron and manganese from the soil. Gleying immediately below the A-horizon is an indication of a markedly reduced soil. Mineral soils gleyed to the surface layer are hydric soils. Gleying can occur in both mottled and unmottled soils. Gleyed soils also often show evidence of rust-colored, oxidized zones (rhizospheres) around living roots.

Mottles are spots or blotches of different colors or shades of colors interspersed with the dominant (matrix) color. Mineral soils that are alternately saturated and oxidized (aerated) during the year are usually mottled in the part of the soil that is seasonally wet. The abundance, size, and color of the mottles usually reflect the duration of the saturation period and indicate whether or not the soil is hydric. Soils that have brightly colored mottles and a low chroma matrix are indicative of a fluctuating water table. Mineral soils that are predominantly grayish with brown or yellow mottles are usually saturated for long periods during the growing season and are classified as hydric. Soils that are predominantly brown or yellow with gray mottles are saturated for shorter periods and may or may not be hydric.

Soil colors are emphasized in the process of wetland delineation because they often reveal much about a soil's wetness regime. Approximate colors can be quickly determined by comparing a soil sample with the *Munsell Soil Color Charts* (Kollmorgen Corporation, 1975). The standardized Munsell soil colors are identified by three components: hue, value and chroma:

(1) *Hue* is related to one of the main spectral colors: red, yellow, green, blue, or purple, or various mixtures of these principal colors;

(2) *Value* refers to the degree of lightness;

(3) *Chroma* notation indicates the color strength or purity.

Low chroma colors (two or less) such as black, various shades of gray, and the darker shades of brown and red are often diagnostic of hydric soils. Hydric mineral soils usually have one of the following color features in the horizon immediately below the A-horizon

(1) matrix chroma of 2 or less in mottled soils, or

(2) matrix chroma of 1 or less in unmottled soils.

Mineral soils that are never saturated are usually bright-colored and not mottled. However, in some hydric soils, mottles may not be visible due to masking by organic matter (Parker, et al. 1984).

Hydric mineral soils can be quite difficult to recognize. In general, a thick dark surface layer, grayish (gleyed) subsurface and subsoil colors, the presence of orange or reddish brown (iron) and/or dark reddish brown or black (manganese) mottles or concretions near the surface, and the wet condition of the soil indicates the presence of a hydric mineral soil. Care should be taken when identifying the thick, dark surface layer. It can occur under wet or dry conditions. Usually, under wet conditions, the layer is greasy and saturated. Under dry conditions, it is often very fibrous.

The grayish subsurface and subsoil colors and thick, dark surface layers are the best indicators of current wetness, since the orange-colored mottles are very insoluble and once formed, may remain indefinitely as relict mottles of former wetness.

Soil Field Indicators of Wetland

Several field indicators are available for determining whether a given soil meets the definition of hydric soils. Other factors to consider in recognizing hydric soils include obligate wetland plants, topography, observed or recorded inundation or soil saturation, and evidence of human alterations, e.g., drainage and filling. Any one of the following typically indicates that hydric soils are present:

(1) Organic soils (all Histosols except Folists) present; or

(2) Histic epipedon (e.g., organic surface layer 8-16 inches thick) present; or

(3) Sulfidic material (H S, odor of "rotten eggs") present within 12 inches of the soil surface; or

(4) Gleyed, low chroma (*ie.* chroma 2 or less with mottles *or* chroma 1 or less with or without mottles) horizon or dominant ped faces present immediately below (within 1 inch) the surface layer *and* within 18 inches of the soil surface; or

(5) Nonsandy soils with a low chroma matrix (chroma of 2 or less) within 18 inches of the soil surface *and* one of the following present within 12 inches of the surface:

- a. iron and/or manganese concretions or nodules.
- b. distinct or prominent oxidized rhizospheres along several living roots;
- c. low chroma mottles; or

(6) Sandy soils with one of the following present:

- a. thin surface layer (1 inch or greater) of peat or muck where a leaf litter surface mat is present;
- b. surface layer of peat or muck of any thickness where a leaf litter surface mat is absent.
- c. a surface layer (A-horizon) having a low chroma matrix (chroma of 1 or less and value of 3 or less) greater than 4 inches thick;
- d. vertical organic streaking or blotchiness within 12 inches of the surface.
- e. easily recognized (distinct or prominent) high chroma mottles occupy at least 2 percent of the low chroma subsoil matrix within 12 inches of the surface;
- f. organic concretions within 12 inches of the surface;

g. easily recognized (distinct or prominent) oxidized rhizospheres along living roots within 12 inches of the surface;

h. a cemented layer (orstein) within 18 inches of the soil surface; or

(7) Other regionally applicable, field-verifiable soil properties associated with prolonged seasonalhigh water tables.

Summary of Technical Criteria for New York State Wetland Delineation

The hydrophytic vegetation criterion must be verified when conducting a wetland boundary delineation. The presence of any of the four "Vegetation Field Indicators of Wetland" is sufficient to make a freshwater wetland determination. In the absence of any of these field indicators, but where more than 50 percent of the dominant species of all strata are FAC or some combination of FAC and wetter species (including OBL, FACW+, FACW-, FAC+), then examination of hydrologic and hydric soil indicators are necessary. "Hydrologic Field Indicators of Wetland" include both primary and secondary indicators. Hydric soils are determined through observation of soil composition, colors, morphology, etc.

RESULTS

BASINS 1 & 3

The majority of the eastern basin (Basin 1), as well as most of the southern half of the western basin (Basin 3), contain palustrine forested broad-leaved deciduous, seasonally flooded wetlands (PFO1C). Wetlands within Basin 1 are 8.10 acres in size, and those within Basin 3 measure 9.41 acres. These areas are dominated by a mixture of hydrophytic and non-hydrophytic vegetation, and display indicators of wetland hydrology, but no hydric soils, However, one or more dominant plants display morphological adaptations to saturated soil conditions, mostly surface roots, multiple trunks, and hypertrophied lenticels.

Under the procedures described in the *Manual*, areas meeting this criterion are considered wetlands, without the need to conduct a detailed examination of hydrology and/or soils. Therefore, the field data sheets for the wetland portions of the site (Appendix B) contain data regarding the vegetation within the sampling area, but no data regarding soils or hydrology, as the wetland determination was made soley upon the vegetation characteristics. The boundaries of wetlands within Basin 1 were marked by wetland boundary flags B1 – B67, and those within Basin 3 are marked by wetland boundary flags A1 – A80.

Non-wetland portions of Basins 1 and 3 are either dominated by non-hydrophytes or by a mixture of hydrophytes and non-hydrophytes, but dominant species in these areas do not display morphological adaptations. Some of these areas contained indicators of wetland hydrology, but did not contain hydric soils. All soils were non-sandy mineral soils with high matrix chroma (i.e. >2) immediately below the surface layer. Data sheets for the non-wetland portions of the site (Appendix B) contain information on vegetation, hydrology, and soils within the sampling area.

Dominant plants within the overstory of the forested wetlands include several native species, including gray birch (*Betula populifolia*), red maple (*Acer rubrum*), eastern cottonwood (*Populus deltoides*), honey locust (*Gleditsia triacanthos*), sweetgum (*Liquidambar styraciflua*), green ash (*Fraxinus pennsylvatica*), and pin oak (*Quercus palustris*). The understory is dominated by the invasive species European buckthorn (*Rhamnus frangula*), with multiflora rose (*Rosa multiflora*), also an invasive species as subdominant. Dominant vines include Virginia creeper (*Parthenocissus quinquefolia*) and poison ivy (*Toxicodendron radicans*), both native species; as well as European bittersweet (*Celastrus orbiculatus*), and Japanese honeysuckle (*Lonicera japonica*), both invasive species. Groundcover was sparse, but was dominated by seedlings of the tree and shrub species, as well as the invasive species garlic mustard (*Allaria petiolata*). Common rush (*Juncus effusus*), and sedges (*Carex* spp.), both native wetland plants, were present in some depressions.

Dominant species within the non-wetland portions of the bottom of Basin 3 are dominated by the above species, with the addition of the native species black cherry (*Prunus serotinum*) and sassafras (*Sassafras albidum*) in both the overstory and understory. Additionally, the groundcover was denser and was dominated by mugwort (*Artemisia vulgaris*), an invasive species, and by pokeweed (*Phytolacca americana*), a native species. The non-wetland slopes of Basins 1 and 3 were dominated by invasive vines, including European bittersweet and Japanese honeysuckle.

BASIN 2

Basin 2, the central basin, consists entirely of wetlands beginning at the tow of slope. The central and largest portion of the wetland is classified as palustrine, unconsolidated bottom, mud, artificially flooded (PUB3K). This is surrounded by a fringe of palustrine emergent *Phragmites australis* artificially flooded wetlands (PEM5K). Since FACW or wetter species comprise more than 50 percent of the dominant species of the plant community (*Phragmites australis*, FACW) and no FACU or UPL species are dominant, and since visual inundation was observed, this entire area qualifies as wetland under the procedures described in the *Manual*. No field data was collected from within Basin 2; photographs were taken from the adjacent non-wetlands (Appendix C)

The emergent wetlands are dominated by a monoculture of the invasive species common reed (*Phragmites australis*). The wetlands within Basin 2 are 11.97 acres in size, 7.45 acres of which are emergent marsh, and 4.52 acres are open water.

The non-wetland portions of Basin 2 consist of the side slopes only, which were dominated by invasive vines, including European bittersweet and Japanese honeysuckle.

LITERATURE CITED

Brown, S., S. Crocoll, D. Goethke, N. Heaslip, T. Kerpez, K Kogut, S. Sanford, D. Spada. 1995. New York State Freshwater Wetlands Delineation Manual. New York State Department of Environmental Conservation, Albany, NY

Cowardin, L.M., V. Carter V., F.C. Golet, E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service Report No. FWS/OBS/-79/31.Washington, D.C.

Kelly, J.F. and D. LaPuma. 2007. Preliminary Assessment of the Flora and Fauna of Ridgewood Reservoir, Queens, New York.

Kollmorgen Corporation. 1975. Munsell Soil Color Charts. Macbeth Division of Kollmorgen Corp., Baltimore, MD

Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin. 2016. The National Wetland Plant List: 2016 wetland ratings. Phytoneuron 2016-30: 1-17. U.S. Army Corps of Engineers
Ponnamperuma, F.N. 1972. The Chemistry of Submerged Soils. Advances in Agronomy 24: 29-96.

Reed, P.B., Jr. 1988. National List of Plan Species That Occur in Wetlands: National Summary. U.S. Fish and Wildlife Service, Washington, DC. Biol. Rpt. 88924), 244 pp.

Tiner, R.W. and P.L.M. Veneman. 1989. Hydric Soils of New England. University of Massachusetts Cooperative Extension Communications Center. 27 pp.

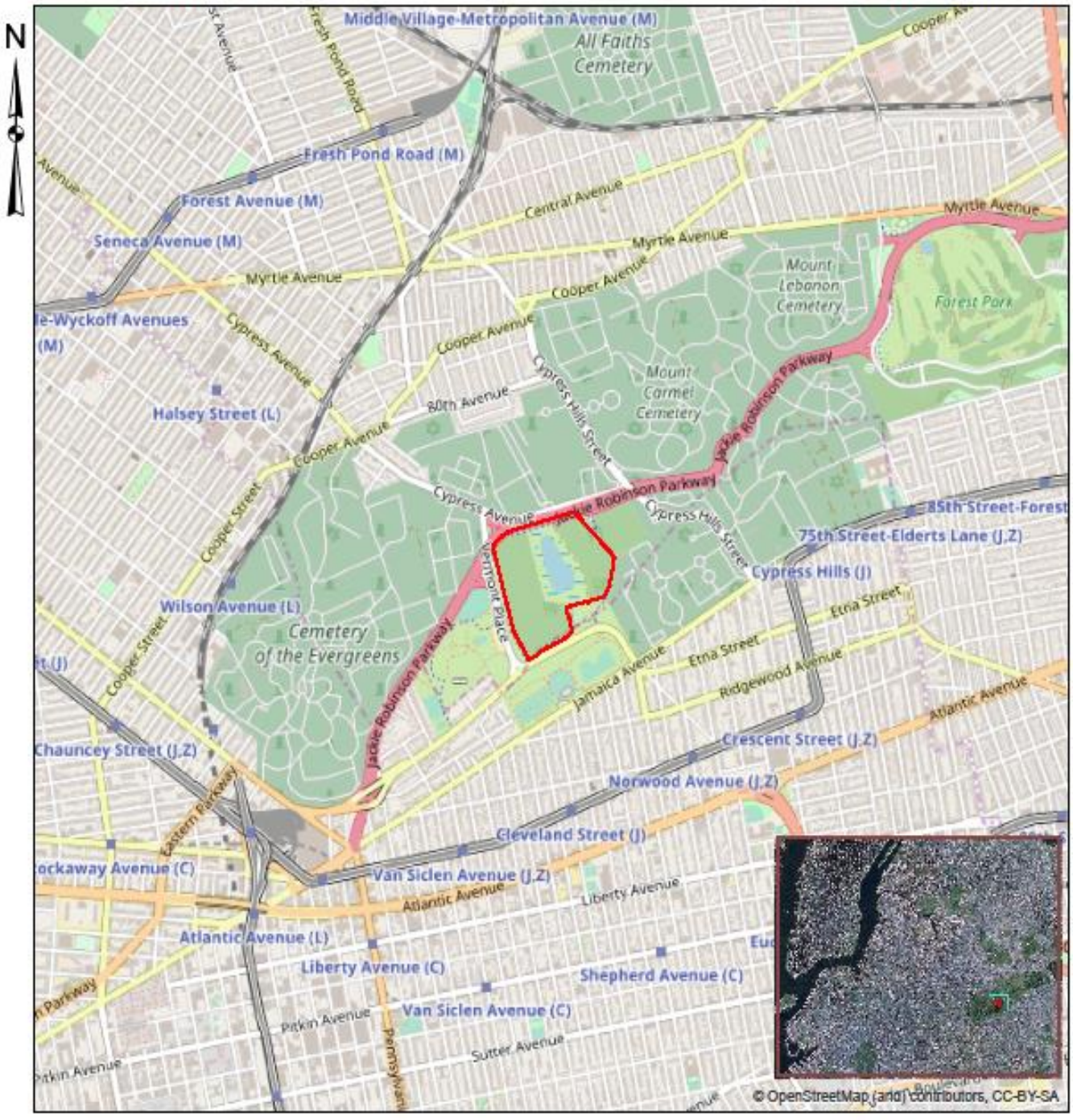
U.S.D.A. Soil Conservation Service. National Technical Committee for Hydric Soils [NTCHS]. 1991):

APPENDIX A
FIGURES

Figure 1: Ridgewood Reservoir Site Location

Date Map was Prepared: September 18, 2017

Designation Agency: City of New York



Legend

Ridgewood_Reservoir_Site_Boundary

0 0.25 0.5 1 1.5 2 Miles

1 inch = 2,562 feet

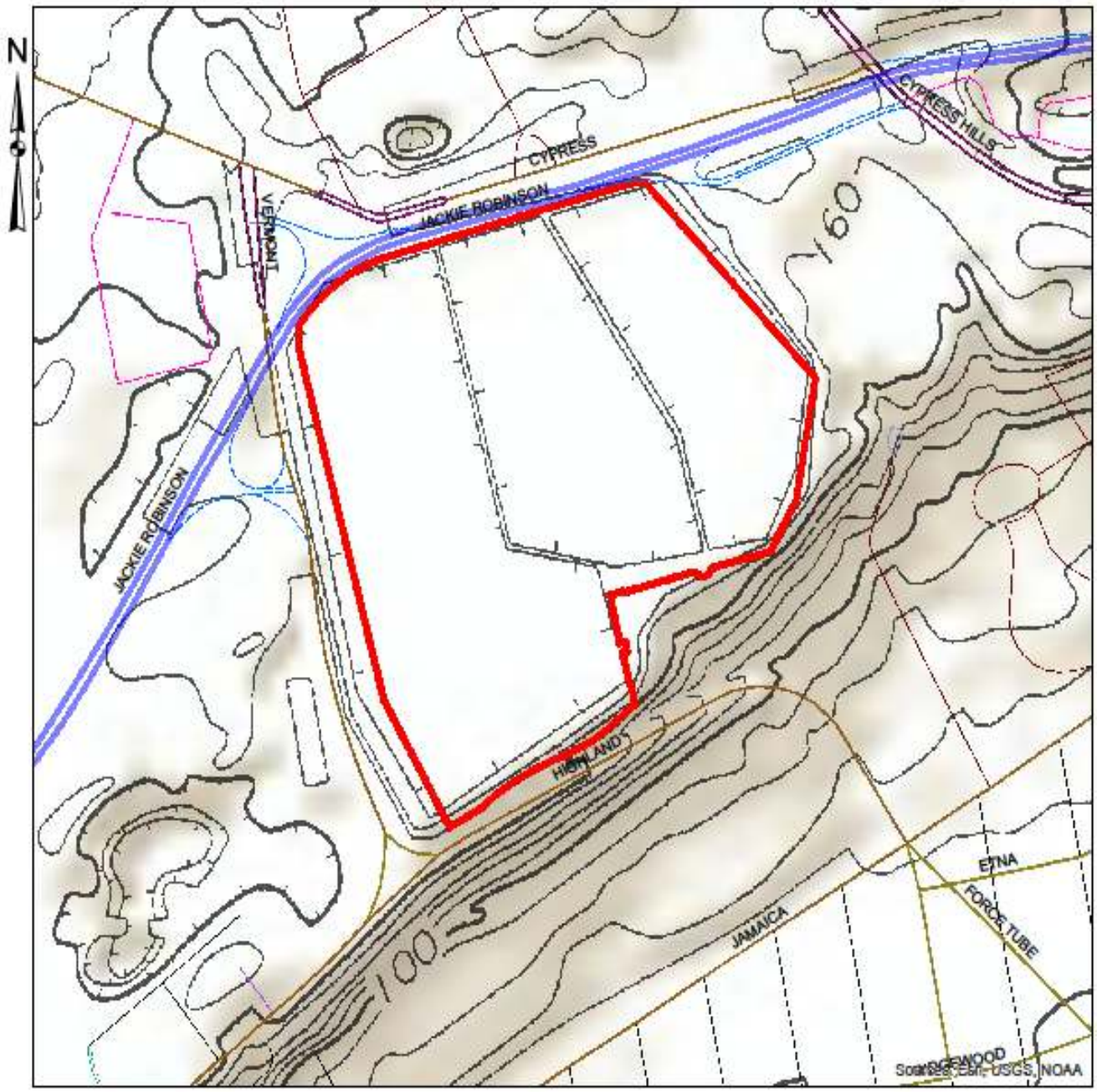
Disclaimer: This map was prepared by the New York State Department of Environmental Conservation using the most current data available. It is deemed accurate but isnot guaranteed. NYS DEC is not responsible for any inaccuracies in the data. Please contact the designating authority for additional information regarding legal boundary descrptions

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Figure 2: Ridgewood Reservoir Topographical Survey

Date Map Prepared: September 18, 2017

Designation Agency: City of New York



Legend

Ridgewood_Reservoir_Site_Boundary

Base Map: USGS Topgraphical Survey

0 0.05 0.1 0.2 0.3 0.4 Miles

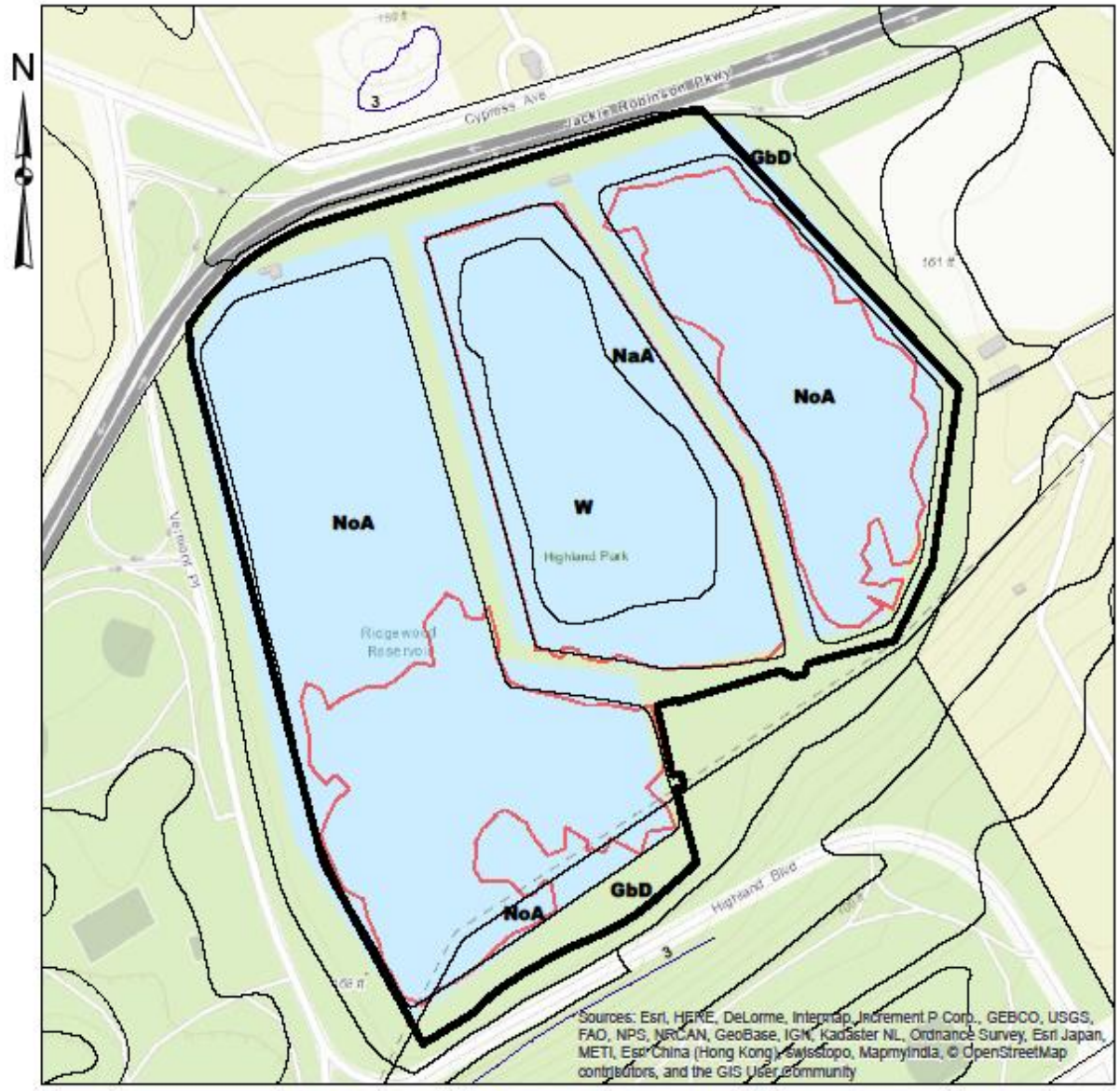
1 inch = 615 feet

Disclaimer: This map was prepared by the New York State Department of Environmental Conservation using the most current data available. It is deemed accurate but isnot guaranteed. NYS DEC is not responsible for any inaccuracies in the data. Please contact the designating authority for additional information regarding legal boundary descrptions

NEW YORK STATE OF OPPORTUNITY

Department of Environmental Conservation

Figure 3: Ridgewood Reservoir Soil Survey



Base Map: City of New York Topographic Street View USGS

0 0.05 0.1 0.2 Miles

1 inch = 316 feet

Ridgewood Reservoir Wetland Boundary

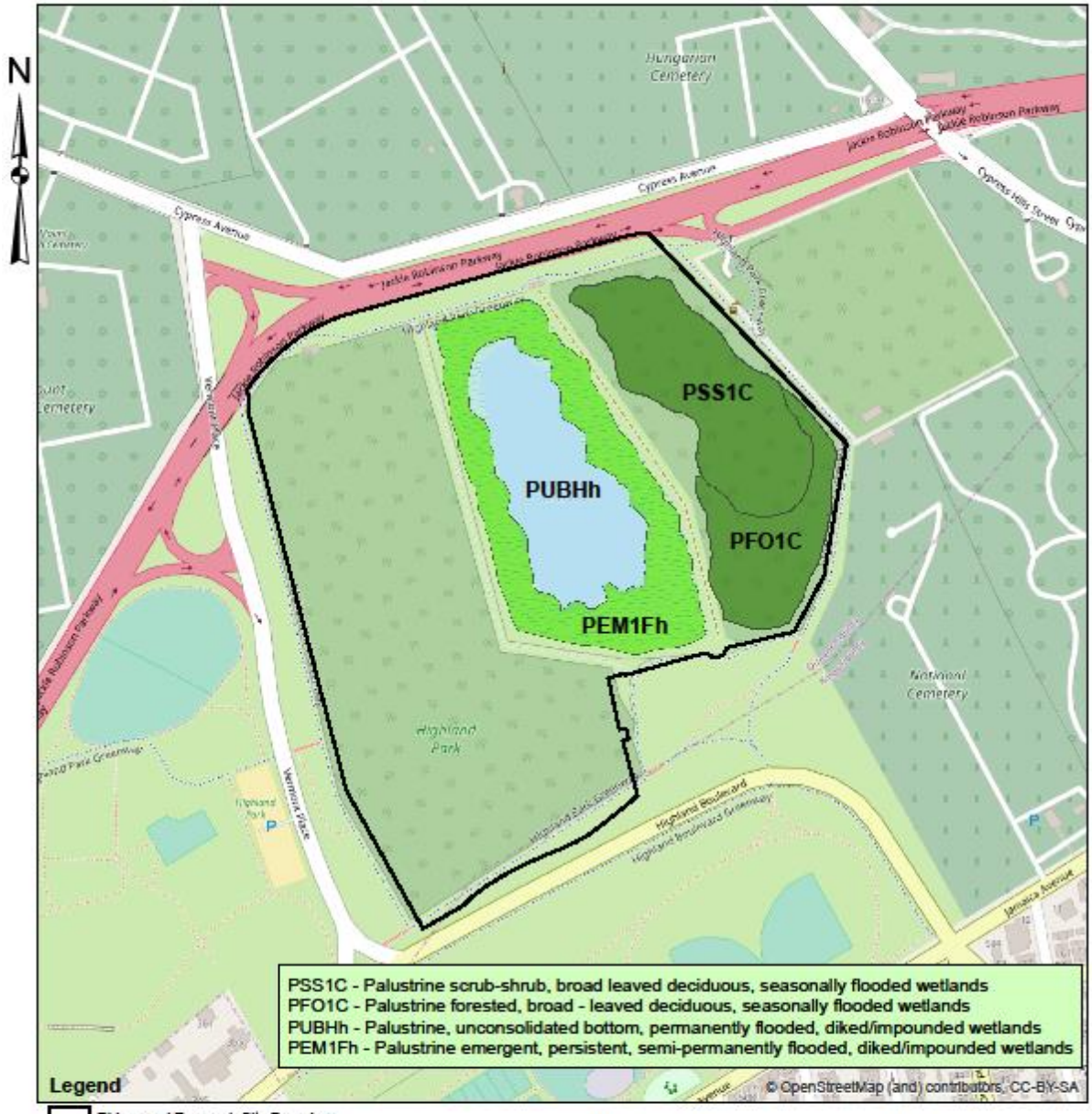
Ridgewood Reservoir Site Boudary

Disclaimer: This map was prepared by the New York State Department of Environmental Conservation using the most current data available. It is deemed accurate but isnot guaranteed. NYS DEC is not responsible for any inaccuracies in the data. Please contact the designating authority for additional information regarding legal boundary descrptions

Soil Types

GbD: Greenbelt loam, 15-25 percent slopes
NaA: Natchaug muck, 0 to 2 percent slopes
NoA: North Meadow sandy loam, 0 to 3 percent slopes
W: Water

Figure 4: Ridgewood Reservoir National Wetlands Inventory



Disclaimer: This Map was prepared by the New York State Department of Environmental Conservation using the most current data available. It is deemed accurate but is not guaranteed. NYS DEC is not responsible for any inaccuracies in the data. Please contact the designating agency/authority for additional information regarding legal boundary descriptions

Figure 5: Ridgewood Reservoir Wetland Delineation

Date Map was Prepared: February 27, 2018

Legend

- Wetland Data Points
- Ridgewood_Reservoir_Site_Boundary
- Ridgewood Reservoir Wetland Boundary

0 0.03750.075 0.15 0.225 0.3 Miles

1 inch = 417 feet

N W E S

NEW YORK STATE OF OPPORTUNITY

Department of Environmental Conservation

Disclaimer: This map was prepared by the New York State Department of Environmental Conservation using the most current data available. It is deemed accurate but is not guaranteed. NYS DEC is not responsible for any inaccuracies in the data. Please contact the designating authority for additional information regarding legal boundary descriptions.

APPENDIX B

DATA SHEETS

FRESHWATER WETLAND DELINEATION

DATA SHEET

Data Collection Point I.D.: WET-1

Site Photographs: Yes

Wetland status: Wetland

Rationale: Hydrophytes dominant

Date: 07/12/17

Time: 9:00 a.m.

Site location: Ridgewood Reservoir Recreation

Owner: New York City Department of Parks and

DEC staff: Ken Scarlatelli, Eleni Kavavadias, Lauren O'Reilly

Other people on site: Christopher Haight (NYCDPR)

Weather Conditions (current and past several days): Sampling day: Partly cloudy, 85^0, winds 0-5 mph

Previous days: Warm, with precipitation June 11 (0.16"). Warm no precipitation July 9 – 10.

Wildlife Signs/Sightings: Grey catbird

Site Description: Site is in one of three basins comprising a decommissioned reservoir, which has been drained. It is forested, and the bottom of the basin is nearly level.

Dominant plants: Hydrophytic

Rationale: Morphological adaptations to saturated soils

Stratum	Common name	Latin binominal	Indicator Status
Trees	Gray birch	*Betula populifolia*	FAC
	Eastern cottonwood	*Populus deltoides*	FAC
Shrubs/saplings	European buckthorn	*Rhamnus frangula*	UPL
Woody vines	Oriental bittersweet	*Celastrus orbiculatus*	UPL
Herbs	Virginia creeper	*Parthenocissus quinquefolia*	FACU

Morphological adaptations: Shallow root system, hypertrophied lenticels, multiple trunks

FRESHWATER WETLAND DELINEATION

DATA SHEET

Data Collection Point I.D.: WET-2

Site Photographs: Yes

Wetland status: Wetland

Rationale: Hydrophytes dominant

Date: 07/12/17

Time: 11:00 a.m.

Site location: Ridgewood Reservoir Recreation

Owner: New York City Department of Parks and

DEC staff: Ken Scarlatelli, Eleni Kavavadias, Lauren O'Reilly

Other people on site: Christopher Haight (NYCDPR)

Weather Conditions (current and past several days): Sampling day: Partly cloudy, 85^0, winds 0-5 mph

Previous days: Warm, with precipitation June 11 (0.16"). Warm no precipitation July 9 – 10.

Wildlife Signs/Sightings: None

Site Description: Site is in one of three basins comprising a decommissioned reservoir, which has been drained. It is forested, and the bottom of the basin is nearly level.

Dominant plants: Hydrophytic

Rationale: Hydrophytes dominant, morphological adaptations to saturated soils

Stratum	Common name	Latin binominal	Indicator Status
Trees	Green ash	*Fraxinus pennsylvatica*	FACW
	Eastern cottonwood	*Populus deltoides*	FAC
	Honey locust	*Gleditsia triacanthos*	FAC
Shrubs/saplings	European buckthorn	*Rhamnus frangula*	UPL
	American crabapple	*Pyrus coronaria*	UPL
Woody vines	None		
Ground Cover	Common rush	*Juncus effusus*	FACW

Morphological adaptations: Shallow root system, multiple trunks

FRESHWATER WETLAND DELINEATION

DATA SHEET

Data Collection Point I.D.: WET-3

Site Photographs: Yes

Wetland status: Wetland

Rationale: Hydrophytes dominant

Date: 07/12/17

Time: 12:00 p.m.

Site location: Ridgewood Reservoir Recreation

Owner: New York City Department of Parks and

DEC staff: Ken Scarlatelli, Eleni Kavavadias, Lauren O'Reilly

Other people on site: Christopher Haight (NYCDPR)

Weather Conditions (current and past several days): Sampling day: Partly cloudy, 88^0, winds 0-5 mph

Previous days: Warm, with precipitation June 11 (0.16"). Warm no precipitation July 9 – 10.

Wildlife Signs/Sightings: American goldfinch

Site Description: Site is in one of three basins comprising a decommissioned reservoir, which has been drained. It is forested, and the bottom of the basin is nearly level.

Dominant plants: Hydrophytic

Rationale: Hydrophytes dominant, morphological adaptations to saturated soils

Stratum	Common name	Latin binominal	Indicator Status
Trees	Green ash	*Fraxinus pennsylvatica*	FACW
	Eastern cottonwood	*Populus deltoides*	FAC
Shrubs/saplings	European buckthorn	*Rhamnus frangula*	UPL
Woody vines	None		
Herbs	Common rush	*Juncus effusus*	FACW
	Sedge	*Carex spp.*	FAC, OBL

Morphological adaptations: Shallow root system, multiple trunks

FRESHWATER WETLAND DELINEATION

DATA SHEET

Data Collection Point I.D.: WET-4

Site Photographs: Yes

Wetland status: Wetland

Rationale: Hydrophytes dominant

Date: 07/12/17

Time: 12:30 p.m.

Site location: Ridgewood Reservoir Recreation

Owner: New York City Department of Parks and

DEC staff: Ken Scarlatelli, Eleni Kavavadias, Lauren O'Reilly

Other people on site: Christopher Haight (NYCDPR)

Weather Conditions (current and past several days): Sampling day: Partly cloudy, 88^0, winds 0-5 mph

Previous days: Warm, with precipitation June 11 (0.16"). Warm no precipitation July 9 – 10.

Wildlife Signs/Sightings: American goldfinch, gray catbird, house wren, eastern towhee

Site Description: Site is in one of three basins comprising a decommissioned reservoir, which has been drained. It is forested, and the bottom of the basin is nearly level.

Dominant plants: Hydrophytic

Rationale: Dominant plants FACW, no FACU or UPL dominant, morphological adaptations to saturated soils

Stratum	Common name	Latin binominal	Indicator Status
Trees	Gray birch	*Betula populifolia*	FACW
Shrubs/saplings	None		
Woody vines	None		
Herbs	None		

Morphological adaptations: Multiple trunks

FRESHWATER WETLAND DELINEATION

DATA SHEET

Data Collection Point I.D.: WET-5

Site Photographs: Yes

Wetland status: Wetland

Rationale: Hydrophytes dominant

Date: 07/12/17

Time: 3:15 p.m.

Site location: Ridgewood Reservoir Recreation

Owner: New York City Department of Parks and

DEC staff: Ken Scarlatelli, Lauren O'Reilly

Other people on site: Christopher Haight (NYCDPR)

Weather Conditions (current and past several days): Sampling day: Partly cloudy, 90^0, winds 0-5 mph

Previous days: Warm, with precipitation June 11 (0.16"). Warm no precipitation July 9 – 10.

Wildlife Signs/Sightings: Grey catbird

Site Description: Site is in one of three basins comprising a decommissioned reservoir, which has been drained. It is forested, and the bottom of the basin is nearly level.

Dominant plants: Hydrophytic

Rationale: Hydrophytes dominant, morphological adaptations to saturated soils

Stratum	Common name	Latin binominal	Indicator Status
Trees	Red maple	*Acer rubrum*	FAC
	Sweetgum	*Liquidambar styraciflua*	FAC
	Pin oak	*Quercus palustris*	FACW
Shrubs/saplings	European buckthorn	*Rhamnus frangula*	UPL
	Sweetgum	*Liquidambar styraciflua*	FAC
Woody vines	None		
Herbs	None		

Morphological adaptations: Shallow root system, multiple trunks

FRESHWATER WETLAND DELINEATION

DATA SHEET

Data Collection Point I.D.: UPL-1

Site Photographs: Yes

Wetland status: Non-wetland

Rationale: Dominant plants not hydrophytic, soils non-hydric, hydrologic indicators absent

Date: 07/27/17

Time: 12:12 p.m.

Site location: Ridgewood Reservoir Recreation

Owner: New York City Department of Parks and Recreation

DEC staff: Ken Scarlatelli

Other people on site: Christopher Haight (NYCDPR)

Weather Conditions (current and past several days): Sampling day: Overcast, 74^0, winds 0-5 mph

Previous days: Warm, no precipitation June 25-26. Warm, with precipitation (0.78") July 24.

Wildlife Signs/Sightings: Grey catbird, American goldfinch

Site Description: Site is in one of three basins comprising a decommissioned reservoir, which has been drained. It is forested, and the bottom of the basin is nearly level.

Dominant plants: Not hydrophytic Rationale: Hydrophytes not dominant

Stratum	Common name	Latin binominal	Indicator Status
Trees	Eastern cottonwood	*Populus deltoides*	FAC
	Honey locust	*Gleditsia triacanthos*	FAC
Shrubs/saplings	European buckthorn	*Rhamnus frangula*	UPL
	Honey locust	*Gleditsia triacanthos*	FAC
	Multiflora rose	*Rosa multiflora*	FACU
Woody vines	None		
Herbs	Mugwort	*Artemisia vulgaris*	UPL
	Pokeweed	*Phytolacca americana*	FACU

Morphological adaptations: None

Soils: Not hydric Rationale: Mineral soil with high chroma matrix in B horizon

Depth (in.)	Matrix color	Mottle(s) color	Texture	Other
0 - 4	10YR 3/3	N/A	Sandy clay loam	N/A
4 - 24	10YR 4/4	N/A	Sandy clay loam	N/A

Depth to water/saturation: No water encountered

Hydrologic indicators: None

FRESHWATER WETLAND DELINEATION

DATA SHEET

Data Collection Point I.D.: UPL-2 Site Photographs: Yes

Wetland status: Non-wetland Rationale: Dominant plants not hydrophytic, soils non-hydric, hydrologic indicators absent

Date: 07/27/17 Time: 3:50 p.m.

Site location: Ridgewood Reservoir Recreation Owner: New York City Department of Parks and

DEC staff: Ken Scarlatelli

Other people on site: Christopher Haight (NYCDPR)

Weather Conditions (current and past several days): Sampling day: Overcast, 75^0, winds 0-5 mph Previous days: Warm, no precipitation June 25-26. Warm, with precipitation (0.78") July 24.

Wildlife Signs/Sightings: Grey catbird, American goldfinch

Site Description: Site is in one of three basins comprising a decommissioned reservoir, which has been drained. It is forested, and the bottom of the basin is nearly level.

Dominant plants: Not hydrophytic Rationale: Hydrophytes not dominant

Stratum	Common name	Latin binominal	Indicator Status
Trees	Eastern cottonwood	*Populus deltoides*	FAC
	Sassafras	*Sassafras albidum*	FACU
Shrubs/saplings	European buckthorn	*Rhamnus frangula*	UPL
	Sassafras	*Sassafras albidum*	FACU
	Norway maple	*Acer platanoides*	UPL
	Black cherry	*Prunus serotina*	FACU
Woody vines	None		
Herbs	Sassafras	*Sassafras albidum*	FACU
	Norway maple	*Acer platanoides*	UPL
	Garlic mustard	*Allaria petiolata*	FACU
	Poison ivy	*Toxicodendron radicans*	FAC

Morphological adaptations: None

Soils: Not hydric Rationale: Mineral soil with high chroma matrix in B horizon

Depth (in.)	Matrix color	Mottle(s) color	Texture	Other
0 - 2	N/A	N/A	Organic matter	N/A
2 - 6	10YR 2/2	N/A	Sandy clay loam	N/A
6 - 18"	10YR 4/4	N/A	Sandy clay loam	N/A

Depth to water/saturation: No water encountered

APPENDIX C

SITE PHOTOGRAPHS

Grey birch in Basin 3 showing multiple stems.

Grey birch in Basin 3 showing surface roots. Note water-borne sediment deposits and sediment stained leaves.

Grey birch in Basin 3 showing hypertrophied lenticels.

Red maple in Basin 1 showing multiple stems and surface roots. Note water-borne sediment deposits and sediment stained leaves.

Basin 2, taken from the adjacent uplands, showing open water at center of basin and outer fringe of common reed in background and invasive species in upland foreground.

Uplands in Basin 3, showing dominance of mugwort, honey locust, and European buckthorn.

Uplands in Basin 1, showing sassafras, Norway maple, and European buckthorn.

APPENDIX D

PRELIMINARY FLORA AND FAUNA SURVEY

Preliminary Assessment of the Flora and Fauna of Ridgewood Reservoir, Queens, New York

October 28, 2007

(DRAFT) Report Prepared for:

Mark K. Morrison Associates LTD
242 W. 30th Street Suite 403
New York, NY 10001

and

City of New York, Department of Parks and Recreation
The Arsenal
Central Park
830 5th Avenue
New York, NY 10021

Prepared By:

Jay F. Kelly, Ph.D.[1] and David LaPuma[2]
Round Mountain Ecological LLC
42 Woodschurch Rd.
Flemington, NJ 08822

Other contributors included:

Richard Lynch, Botanist
Sweetbay Magnolia Conservancy
17 Monroe Ave.
Staten Island, NY 10301

Alison Cucco
[1]Raritan Valley Community College
Department of Science and Engineering
P.O. Box 3300
Rt. 28 and Lamington Rd.
Somerville, NJ 08876

Blake Mathys
[2]Graduate Program in Ecology and Evolution,
Department of Ecology, Evolution and Natural Resources
Rutgers University
New Brunswick, NJ 08901

Abstract

We conducted a survey of the flora and fauna of the Ridgewood Reservoir site in Queens, NY, in the summer and fall of 2007. No less than ten plant and animal species listed as Threatened, Endangered or Special Concern in New York State were found at the site. A total of 173 plant species were observed, three of which are listed as Threatened or Endangered in New York State. Several plant communities observed were also of significant conservation concern. The bog-like open areas and forest fringes in the East Basin, where thick carpets of mosses (*Polytrichum* spp.) dominated the understory, for example, appeared to be entirely unique within New York City and should clearly be preserved. Also of conservation concern were the significant areas of wetland and ecotonal habitats present at the site, including not only the emergent marshes and open water of the Central Basin, but the entire East Basin and southern half of the West Basin as well.

A total of 127 bird species were observed during fall migration at the site, including seven species which are listed as Threatened or Special Concern in New York State. A breeding bird survey conducted by local naturalists in 2007 also confirmed or suspected 38 bird species to be nesting at the site (H. Steiner unpublished data). The high diversity and abundance of bird and other wildlife species present at the site appeared to be due the abundance of food resources present, the diversity, size and contiguity of habitats at the site, and its location on the ridge of the Harbor Hill glacial moraine, which puts it directly in the flight path of a large number of species migrating through the area. The significance of the site for bird species is well-known, both presently and historically, it being listed among the top 500 places to see birds in all of New York State as far back as the 1970's (Drennan 1981).

Further studies are needed to determine the significance of the site for wintering and migratory birds, breeding rails, spring flora and aquatic plant species. However, based on the data from the summer and fall of this year, it is clear that one of the major priorities for maintaining and enhancing the biological integrity of the site is confronting the rampant growth of exotic, invasive plant species present there. More than 20 such species were documented at Ridgewood Reservoir in 2007. One or more of these species were dominant in 85% of the plant communities described by NRG (2006). These species should be actively replaced with native species that have comparable or greater ecosystem, wildlife and aesthetic values, using seed collected onsite or from nearby natural areas. This would not only serve to inhibit the future growth of invasive species, but would enhance the native species diversity at the site, which appears to be somewhat diminished by its severe isolation from other existing natural areas.

Accomplishing all these goals will require significant, long-term devotion of financial and other resources. However, the costs could be greatly reduced by building on the strong community of residents, naturalists and others who already regularly visit the site. Activities such as exotic plant removal, native species planting and propagation, and biological monitoring offer excellence opportunities for environmental education, research and community involvement. The development of such programs and activities would be further facilitated by establishing a small nature center at the site. By combining the resources of the park system and local community to bring about the conservation and restoration of the site, Ridgewood Reservoir could effectively become a model of environmental stewardship for other parks in New York City, and the world, well into the future.

Acknowledgements

Thanks to Mark K. Morrison Associates LTD and the NYC Parks Department for giving us the opportunity to study this remarkable site. Thanks also to Mike Feller and Marielle Anzelone at NYC Parks, Natural Resources Group, for giving us their input and recommendations. Thanks to Richard Lynch of the Sweetbay Magnolia Conservancy and Alison Cucco at Raritan Valley Community College for their assistance with the botanical surveys, and to Blake Mathys for his assistance with the bird migration studies. Special thanks to Heidi Steiner, Rob Jett, Steve Nanz, Alfred and Karen Ott, Jennifer Monson, and others for sharing their data for the 2007 breeding bird survey, migration data, animal lists and other observations from the site over the years. XYZ provided helpful reviews of this draft.

Table of Contents

Tables

Figures

Introduction

The Ridgewood Reservoir is an historic reservoir system in Queens, New York, that was built in the late 1800's and early 1900's. The approximately 50-acre site was recently acquired by the City of New York Department of Parks and Recreation for use as a City park, the design and development of which is currently being conducted by the firm, Mark K. Morrison Associates LTD. Integral to the planning and development of the park is an understanding of the current, historic and potential significance of the site for native plant and animal species and communities, especially those that are globally and/or locally imperiled. In addition to the concern for conserving those species listed as Endangered, Threatened or Special Concern, the wetland status of the species and habitats present is also important to determine, as this may inhibit or constrain the potential use of the site for active recreation or other purposes.

This study provides a preliminary assessment of the flora and fauna of Ridgewood Reservoir, based on field surveys conducted in the summer and fall of 2007, as well as other information provided by available literature, internet and local sources. A final report will be provided in 2008 following additional surveys to be conducted during the winter and spring months, which are needed to determine the significance of the site for spring and aquatic flora, wintering and migratory bird species, and breeding rails.

Study Area

The Ridgewood Reservoir is approximately 50 acres in area, and is bordered by Vermont Place to the west, Jackie Robinson (Interborough) Parkway to the north, a landfill to the east, and Highland Blvd. and Cypress Hills National Cemetery to the south. The west side of the site borders Highland Park, an existing City park, and another larger City park, Forest Park, lies approximately ***one mile*** to the east.

The site sits atop the Harbor Hill Moraine, the younger section of Long Island's glacial margin, which is marked by large piles and blankets of rock waste that were left by the retreating ice sheet thousands of years ago (Drennan 1981). Rising abruptly more than 100 feet above the surrounding outwash plain, the site allows spectacular views of the surrounding city, Jamaica Bay, and the Atlantic Ocean, which lies approximately ten miles to the south.

The reservoir system at Ridgewood consists of three contiguous basins, enclosed and separated by large, steep stone levees. These are referred to in this study as the West, Central and East Basins. The West Basin is the largest basin, amounting almost to the combined area of the other two basins, which are roughly proportionate in size. While the Central Basin still contains a large body of open water, the East and West Basins were drained several decades ago and significant forest, shrub and emergent plant communities have developed in the basin interiors and the slopes and crests of the surrounding levee systems. Much larger, older planted trees line the outer rim of the levee system, and an open grassy area with scattered trees and shrubs fills the space between the West and Central/East Basins to the south. In all these plant communities provide contiguous tree, shrub, vine

and herbaceous cover throughout the site.

A paved bicycle path and walkway encircle the outer rim of the reservoir system and two brick buildings (historic pump houses) remain at the northern edge of the West and Central Basins, with a small caretaker's house existing at the northeast corner of the East Basin. A small communications tower rises out of the southern section of the levee separating the West and Central Basins. Access to the levee rim from outside the side is facilitated by large staircases on the West and South of the site. Access to the Basin interiors can only be gained by scaling the steep levee walls.

Methods

Flora

Vegetation surveys were conducted in the summer and fall of 2007, with approximately 2 visits per month, from July to October. A plant species list was created by searching all major vegetated areas of the site, including the East and West Basins interiors, the levee system (crests and slopes) surrounding each basin, and the open grassy area to the south of the Central Basin. Photographs and specimens were collected for many of the species observed. Any species that were difficult to identify in the field were collected, pressed, and later identified by R. Lynch. In addition to name and location, the federal and state-wide conservation significance (Endangered, Threatened, Special Concern), native/non-native status, and wetland indicator status of each species was then determined using the appropriate resources (Young 2007, Reed 1988). A request for information about T&E species records for the site was also made to the New York Natural Heritage Program in October 2007.

In addition to compiling a list of plant species present at the site, efforts were also made to verify the recently conducted NYC-NRG Entitation of the site (NRG 2006), which provided a preliminary assessment of the dominant plant communities at the site. This included a list of 28 distinct plant communities, based on dominant canopy and understory species, as well as acreages and maps of their respective locations within the site. Visits were made by A. Cucco to each area identified as a separate community by the Entitation, and the general area and plant species dominants were assessed. Notes were made of any conspicuous woody or other plant species that were missing in each community description. The conservation and regional significance of each plant community present at the site was also determined according to Endinger et al. (2002), and discussion with local naturalists and NRG staff.

Fauna

In order to assess the importance of the site for migratory birds, five visits were made during fall migration in 2007. Surveys were conducted in the morning and early afternoon, between 7:30 AM and 1:30 PM, from September 23-October 9, 2007. Surveys were conducted primarily by D. LaPuma and B. Mathys. Incidental observations were also made by J. Kelly during vegetation surveys

conducted in the same period. The species, number and location of each bird that was positively identified during each visit was recorded. Locations included the West, Central and East Reservoirs, and the open, grassy area to the South. Birds for which the location data was missing, or which occurred in other areas above and around the reservoir system, were recorded as being in an "Undetermined" location. The conservation status (Endangered, Threatened, Special Concern) of each species in the U.S. and in N.Y. State was determined using NYDEC (2007) and USFWS (2007), and the migratory status and population trends of each species (Neotropical or not) was determined according to Sauer et al. (2007). A request for T&E species records for the site was also made to the New York Natural Heritage Program in October 2007.

Given the short amount of time and resources available to conduct these surveys, we designed our study in a way that would allow us to determine to the greatest extent possible, what species were using the site. In order to maximize the overall number of species observed, systematic point sampling or transect methods were not used. Instead, surveys were conducted in a haphazard fashion, following patterns of greatest bird activity within each site. While this meant that the amount of time spent in each area was not strictly standardized, we attempted to spread surveys out evenly across each respective site (and including each type of habitat within each site), as much as possible. For consistency of the data, only the observations of D. LaPuma and B. Mathys were included in the quantitative analyses.

Early morning surveys (4:30-5:30 AM) were also conducted by J. Kelly and A. Cucco on two dates (early August and late September) in order to listen for rail species that may be inhabiting the central basin or other areas, and to hear the overall pre-dawn chorus, which would help gauge the significance of the site as both roosting and breeding habitat for birds.

Information about other bird observations made at the site was also gathered from other sources, including Drennan's (1981) Where to Find Birds in New York State (Syracuse: Syracuse University Press), the eBirds internet site (http://ebird.org), interviews with local birders and Natural Resource Group staff, and other sources. Local residents and naturalists, including Alfred and Karen Ott and others, also contributed information about other fauna observed at the site in the past few decades, Heidi Steiner and Rob Jett contributed a list of breeding birds at the site from 2007, and Steve Nanz contributed a partial list of invertebrate and other species that have been identified at the site.

Results

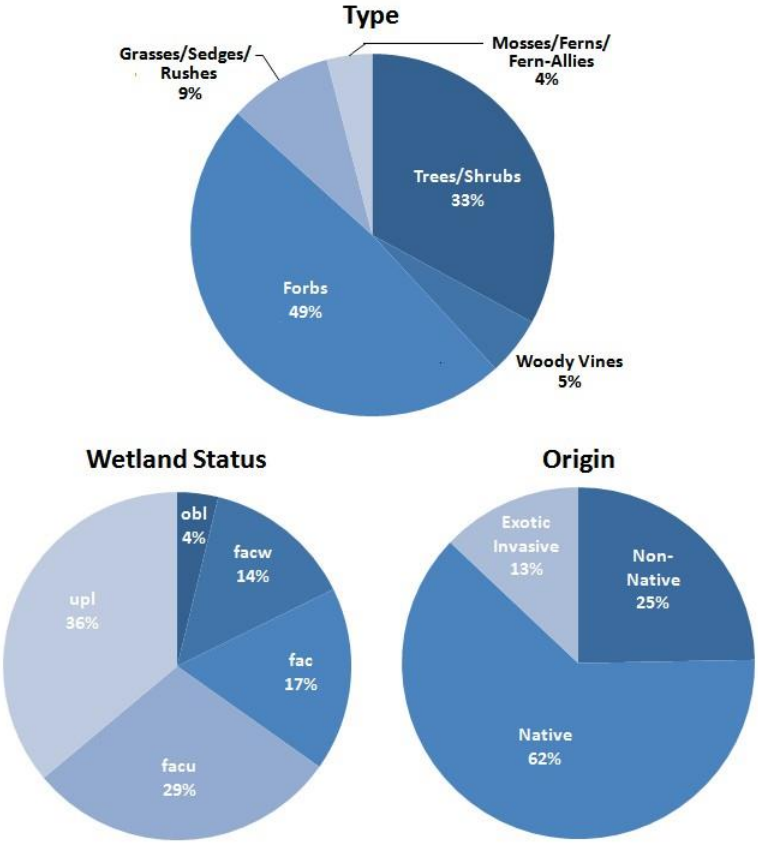
Flora

Our studies found a total of 173 species at the site, 159 of which we were able to positively (or probably) identify to species. By our estimates, these represent more than 95% of the species present at the site overall in the summer and fall. Those species that could not be identified to species included a Willow (*Salix*), Morning-Glory (*Ipomoea*), Smartweed (*Polygonum*), Spikerush (*Eleocharis*), Sedge (*Cyperus*), Moss (Unknown), Grass (Unknown), and Violet (*Viola*) species, which were either past flowering or were unidentifiable due to the poor condition or non-flowering status of

available specimens in the field. Several of the moss and grass species are currently being reviewed by a local botanist, R. Lynch, for species identification.

Of those species found, approximately half were forbs, and a third were trees/shrubs, with the remainder representing woody vines, grasses/sedges/rushes, and mosses/ferns/fern-allies (Figure 1). In terms of their wetland status, a third of the overall species found represented either obligate wetland plants, facultative wetland plants, or facultative plants. These groups all represent species adapted to wetlands, with 50% or more of their distributions occurring in wetland areas (Reed 1988) (Figure 1). Approximately 40% of the species found were non-indigenous to the area, more than a third of which were problematic exotic invasive species (Figure 1). These species included *Rhamnus frangula, R. cathartica, Ailanthus altissima, Celastrus orbiculatus, Polygonum cuspidatum, Phragmites australis,Lonicera morrowii, L. japonica, Ligustrum vulgare*, *Paulownia tomentosa*, *Artemisia vulgaris,Populus* x *nigra, Acer platanoides, A. pseudoplatanus, Berberis thunbergii, Morus alba, Ampelopsis brevipedulculata, Alliaria petiolata,* and others (Table 3). *Robinia pseudoacacia* is native to southeastern North America but has recently spread throughout the northeast, and is considered by many to be invasive here as well.

Figure 1. Summary of plant species found at Ridgewood Reservoir according to type, wetland status, and origin



No federally listed endangered plant species were found at the Ridgewood Reservoir site. Three of the species found, however, are currently listed as Threatened or Endangered in New York State, including *Eupatorium serotinum* (Endangered), *E. hyssopifolium* var. *laciniatum* (Threatened), and *Ludwigia sphaerocarpa* (Threatened) (Table 1). Information from the NYNHP about other T&E species known from the site was not received by the time of writing this report.

Table 1. Endangered and Threatened plant species observed at Ridgewood Reservoir in 2007

Common Name	Scientific Name	Conservation Status
Late-Flowering Boneset	*Eupatorium serotinum*	Endangered[C]
Fringed Boneset	*Eupatorium hyssopifolium* var. *laciniatum*	Threatened[C]
Globe-Fruited Ludwigia	*Ludwigia sphaerocarpa*	Threatened[P]

C = confirmed species ID; P = probable species ID, requiring comparison to known specimens

Plant Communities

With few exceptions, the plant communities at Ridgewood Reservoir were fairly typical of other wetland and upland areas of southern New York State. Some of the communities present were characteristic coastal swamp forests dominated by birch, maple, pin oak, poplars and/or sweet gum, rich open woodlands with dense, diverse herbaceous cover in the understory, emergent marshes and herbaceous species-dominated wetlands, upland forests dominated by poplars, sassafras, cherry, oaks and sumac, as well as ruderal communities characteristic of more disturbed areas, including locust-mugwort savannahs and open, weedy areas lining the pathways and buildings. Most of the plant communities present represented early-mid successional forests or shrublands, which have developed in the few decades since the east and west reservoirs were drained and the surrounding levees and uplands left unattended. The trees surrounding the reservoirs were planted much earlier and now represent mature upland forest habitats. The most unique and significant habitat present from a conservation standpoint was the large bog habitat in the East Basin, the understory of which was dominated by a dense carpet of *Polytrichum* mosses. This extended from the open, northern half of the Basin, which contained numerous herbaceous wetland plants and woody shrubs, into the central and southern portions, which were also dominated by grey birch and other woody species. Many of the plant communities found have been invaded by numerous exotic species, which represent significant threats to the persistence of these communities in the future.

Our analysis of the NYC Parks Entitation for Ridgewood Reservoir generally confirmed the vegetative units and distribution maps provided for the site. However, the maps represented rather coarse units of cover and in many cases were not entirely accurate, and numerous species tended to be omitted from each descriptive unit as well. Some of the more problematic descriptions, for example, included the community described as lining the slopes of the Central Basin (#27). While this was described as being dominated by grass, plantain and mugwort, it actually contained a high diversity of woody shrubs and vines, as well as numerous other herbaceous plants, totaling more than 20 in all.

Another problematic unit, which was described as lining the slopes of several reservoirs (#10), listed only oriental bittersweet as a dominant. In the field, however, numerous other woody plant species were present in the canopy and understory, some of which appeared to be co-dominant, and at least a dozen other species that were not listed in the accompanying description were also present. In all, however, this document was found to provide a fairly good general description of the dominant species present in different areas of the Ridgewood Reservoir, and should serve as a useful starting point for future research and management.

Spatial Distribution

Despite the overall summary of plant species found at Ridgewood Reservoir, the wetland status and origin of these species differed significantly according to different kinds of habitats and sites present within the reservoir system. The vast majority of the wetland plant species found, for example, were located within the basins, while the majority of upland plants were found primarily on the levee systems. Less than ¼ of the plants found on the levees in fact belonged to wetland-adapted plant groups (obl, facw,fac), while nearly ½ of those found within the basins were wetland, facultative wetland, or facultative plants (Figure 2). Similarly, while nearly half of the species found on the levees were non-native or exotic invasive species, these groups comprised less than a third of the species found in the Basins (Figure 3). The endangered plant species found at Ridgewood were also located entirely within the reservoir Basins, in the southern half of the West Basin and throughout the East Basin, with no state-listed species documented on the levee slopes or crests.[1]

Figure 2. Plant species wetland status at Ridgewood Reservoir according to site

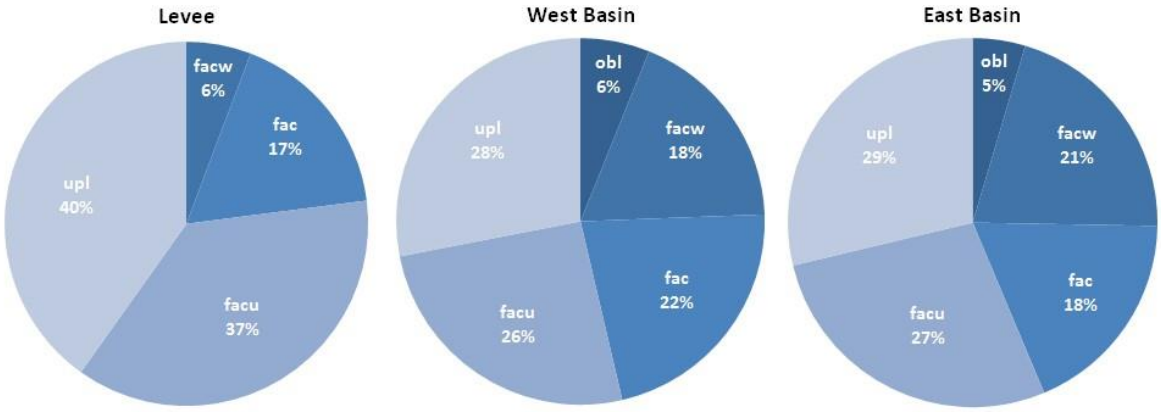
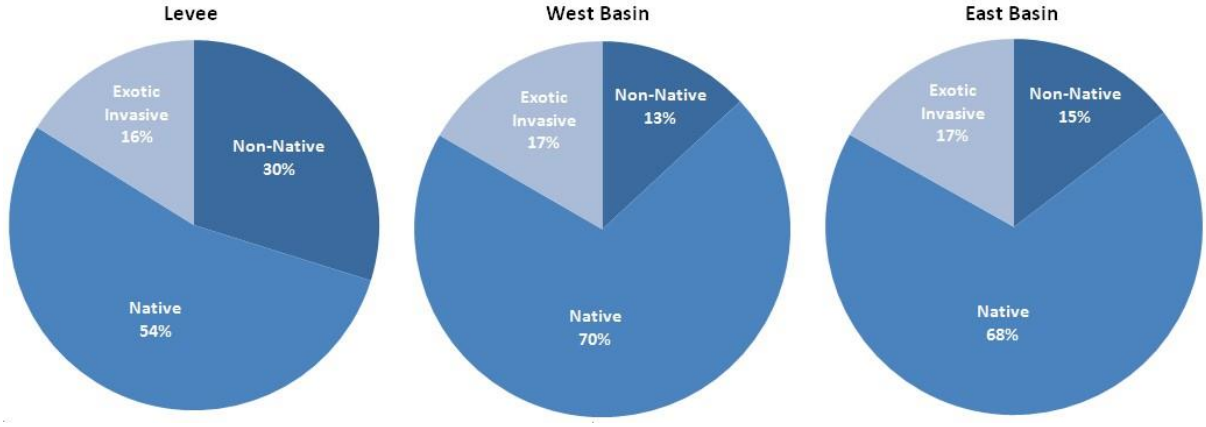


Figure 3. Plant species origin according to site at Ridgewood Reservoir



West Basin

The West Basin is the largest basin at the Ridgewood Reservoir Site, and had both the greatest number of plant species (n = 90) and plant communities present of any of the three basins. Despite this overall diversity, the majority of these species and communities were located in the southern half of the basin. The northern half of the basin consisted almost entirely of an open, savannah-like habitat dominated by only by black locust (*Robinia pseudoacacia*) in the forest canopy and mugwort (*Artemisia vulgaris*) in the understory.

To the south of this area, however, were numerous species and habitats of both wetland and conservation significance. Directly to the south of the locust-mugwort savannah, for example, was an interesting open grassy area with occasional clusters of grey birch (*Betula populifolia)* trees, sedges (*Cyperus* spp.), rushes (*Juncus* spp.*, Eleocharis* spp.), and mosses. Based on the composition and structure of vegetation in this area, it appears likely that significant periods of inundation have occurred here, probably in the early spring and winter months. Further evidence of this was provided by the extremely shallow rooting systems of the few birch trees growing in this area, which is a common physiological adaptation to hydric soil conditions. Photographs taken by local naturalists in January of 2007 in fact show the open areas to consist entirely of standing water.

Surrounding this open, grassy area were dense birch and poplar stands with little undergrowth, as well as large areas of rich woodlands dominated by grey birch, black locust (*Robinia pseudoacacia*), willow (*Salix* spp.) and poplar species (*Populus* spp.) in the canopy, with numerous composites (e.g., *Aster, Solidago, Eupatorium,* etc.), grasses, and other herbaceous species in the understory. These included the Endangered *Eupatorium serotinum* and Threatened *E. hyssopifolium* var. *laciniatum* as well as numerous facultative wetland species.

[1] Note: This refers only to state-listed species found at Ridgewood Reservoir. Other species that may be of conservation significance within New York City (e.g., *Spiraea latifolia*) did in fact occur on the levee systems (e.g., the northwest and southwest corner of the levee surrounding the West Basin, in the case of *S. latifolia*).

To the south of these areas were a variety of habitats, many of which were more obvious wetlands, including birch and maple swamps and open pools of standing water in the southwest, herbaceous species-dominated wetlands (e.g., *Scirpus cyperinus*, *Phragmites australis*) in the south-central area, and more upland forests located in the southeast. The Threatened *Ludwigia sphaerocarpa* occurred in southwestern area, and south-central area had populations of both *Eupatorium serotinum* and *E. hyssopifolium* var. *laciniatum.*

Central Basin

The Central Basin was dominated entirely by dense, uniform stands of *Phragmites australis* which surrounded the standing water on all sides. No attempt was made to search this area on foot in 2007 as it appeared to be more or less uniform in composition. However, because the open water may provide habitat for various aquatic plant species, many of which are listed as Threatened or Endangered in New York, this area should be surveyed more thoroughly in 2008.

East Basin

The East Basin contained the largest and most significant native plant communities at Ridgewood Reservoir overall. The southern area largely dominated by a typical coastal swamp forest, dominated by sweet gum (*Liquidambar styraciflua),* red maple (*Acer rubrum*), grey birch, and black cherry (*Prunus serotina*). The understory of this area was also fairly species-rich, with various grasses, sedges, rushes, and other herbaceous wetland and upland plants (e.g., *Iris versicolor*, *Lycopus americanus, Phytolacca americana*), and numerous composite species, including the Endangered *Eupatorium serotinum* and the Threatened *E. hyssopifolium* var. *laciniatum.*

North of this area was another large forested area dominated by grey birch, but with a dense ground cover of hair cap mosses (*Polytrichum commune*), and various grass, sedge, rush and composite species scattered throughout. The thick moss carpet extended beyond the birch forest and into the large open area that comprised the northern half of the Basin, where it grew even more dense and tall. This area also included occasional wetland shrubs and vines (e.g., *Salix discolor, Baccharis halimifolia, Rubus hispidus*), herbaceous wetland plants (e.g., *Scirpus cyperinus, Scutellaria lateriflora, Hypericum virginicum, Phragmites australis)*, and saplings of various tree species such as poplars, birches, and willows. The species composition and structure of this area somewhat resembled a northern bog, and according to local naturalists and NRG staff appears to be entirely unique within the greater New York City area. No comparable plant communities were listed in any available references on the subject (Edinger et al. 2002). The eastern and western fringes of the East Basin contained dense stands of various tree and shrub species, notably including elderberry (*Sambucus canadensis*) and cutleaf blackberry (*Rubus laciniatus*), as well as numerous invasive species, especially glossy buckthorn (*Rhamnus frangula*).

Levees

The levee system surrounding the reservoir was dominated by upland plant species, many of which appear to have been planted as shade trees (e.g., *Quercus rubra, Q. velutina, Q. robur, Prunus serotina, Celtis occidentalis, Platanus x acerifolia, Pinus strobus, P. sylvatica*). These and other native and introduced woody species, including sassafras (*Sassafras albidum*), sumacs (*Rhus* spp.), maples (*Acer* spp.), hawthorns (*Crataegus* spp.), roses (*Rosa* spp.), crabapples (*Malus* spp.), buckthorn (*Rhamnus* spp.), poplars (*Populus* spp.) and dogwoods (*Cornus florida*) have colonized the surrounding areas. The thick growth of woody trees, shrubs and vines on both the crests and slopes of the levees have resulted in a continuous forest canopy connecting the older, larger tree canopies of the trees lining the reservoir with the younger, smaller forest trees and other species existing in the basins of the old reservoirs. The understory of the levees consists largely of ruderal habitats dominated by introduced species, such as plantains (*Plantago* spp.), orchard grass (*Dactylis glomerata*), clovers (*Trifolium* spp.) sweet clovers (*Melilotus* spp.), path rush (*Juncus tenuis*), nightshades (*Solanum* spp.), smartweeds (*Polygonum* spp.), chicory (*Cichorium intybus*), butter and eggs (*Linaria vulgaris*), and dock (*Rumex* spp.). Other native species, such as enchanter's nightshade (*Circaea quadrisulcata*), Virginia jumpseed (*Tovara virginiana*) and common evening primrose (*Oenothera biennis*) have persisted both in these and other, less disturbed, areas as well.

Fauna - *Birds*

Our studies found a total of 68 species in 5 visits during fall migration in 2007 (Table 4). Four of these species (6%) were listed as Threatened or Special Concern in New York State. A full third of the species observed were neotropical migrants, nearly half of which have been experiencing significant declines (43%) due to the destruction of habitat in their wintering or breeding grounds in the tropics and/or North America, respectively. Incidental observations by J. Kelly also included a Long-Eared Owl, American Woodcock, Merlin and a probable Short-Eared Owl (Endangered). Information from the NYNHP about other T&E species known from the site was not received by the time of writing this report.

Figure 4. Conservation significance and migratory status of bird species observed at Ridgewood Reservoir in Fall 2007

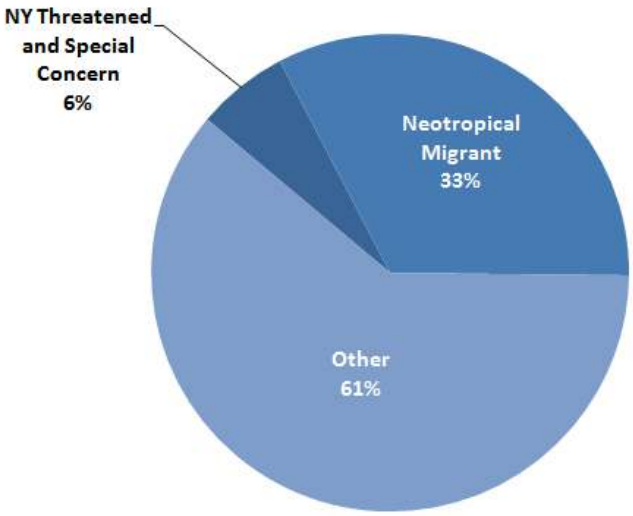
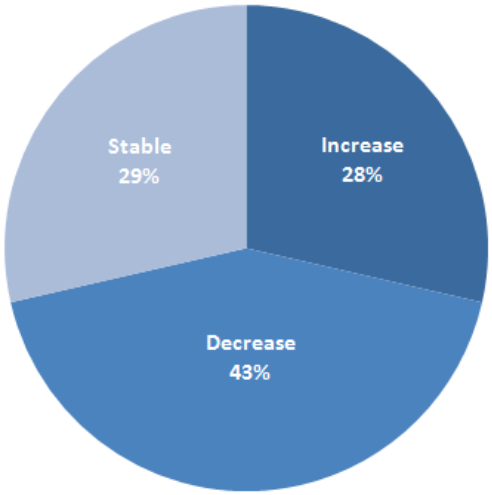


Figure 5. Population trends of Neotropical migrant bird species observed at Ridgewood Reservoir in Fall 2007



Other surveys conducted at Ridgewood Reservoir confirm that the site provides habitat for numerous other bird species. Sitings posted in the eBirds database, for example, showed an additional 56 species (125 species total) were observed at Ridgewood Reservoir between April and October in 2007, including two others species that were Special Concern in New York State (Red-Shouldered Hawk, Common Nighthawk). These combined observations from our formal surveys and incidental observations, as well as the observations of others, total 127 species positively identified at Ridgewood Reservoir in 2007, seven of which were listed as Endangered, Threatened or Special Concern in New York State.

Table 2. Threatened and Special Concern bird species observed at Ridgewood Reservoir in 2007

Common Name	Scientific Name	Conservation Status
Short-Eared Owl	*Asio flammeus*	Endangered[P]
Pied-Billed Grebe	*Podilymbus podiceps*	Threatened[C]
Osprey	*Pandion haliaetus*	Special Concern[C]
Sharp-Shinned Hawk	*Accipiter striatus*	Special Concern[C]
Cooper's Hawk	*Accipiter cooperii*	Special Concern[C]
Red-Shouldered Hawk	*Buteo lineatus*	Special Concern[C]
Common Nighthawk	*Chordeiles minor*	Special Concern[C]

C = confirmed species ID, P = probable species ID

A breeding bird survey conducted by a local group in 2007 also found a total of 38 species that were confirmed (n = 20), probable (n = 15) or possible (n = 3) breeding at the site (Table 5). We were able to confirm most of these during our vegetation surveys conducted in July and August (H. Steiner unpublished data). Yellow-Crowned Night-Herons have also attempted to breed at the site in previous years, according to local naturalists, but were unsuccessful, and Pied-Billed Grebes were observed to exhibit courtship behavior at the site, and may represent potential nesters at the site in the future.

Previous observations of bird species at Ridgewood Reservoir suggest the site has long-standing historical significance for migratory and breeding birds as well. In fact, the site (along with nearby Forest Park) was included in a list of the top 500 places to see birds in all of New York State (Drennan 1981). In these two sites, Drennan (1981: 408) notes that "Since 1960 upwards of 200 species have been sighted…with more than 160 of those seen between 1975 and 1980. In spring 1976, 34 warbler species were recorded and a mid-May single-day Forest Park/Ridgewood Reservoir roundup tallied 102 species by T.H. Davis *et al.*" The optimal time of year to observe birds at these sites, according to Drennan, is during spring migration. This season had the highest ranking (four stars), whereas the other three season gained only one or two stars.

Spatial Distribution

The West Reservoir had the highest bird species richness and abundance during Fall migration in 2007, followed by the East Reservoir and Central Reservoir. The open, grassy area to the south of the reservoir, and other areas above and around the reservoir system had comparable numbers of species, but lower numbers of birds. In the case of the former, this was likely due to the mowing of the high grasses and shrubs of the former during the survey period, which reduced the amount of habitat available for sparrows and other grassland birds.

Figure 6. Bird species diversity by location at Ridgewood Reservoir during Fall migration in 2007

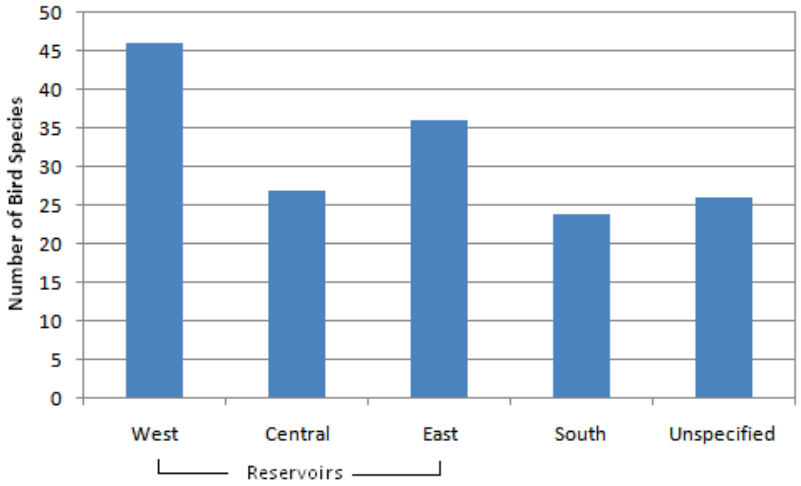
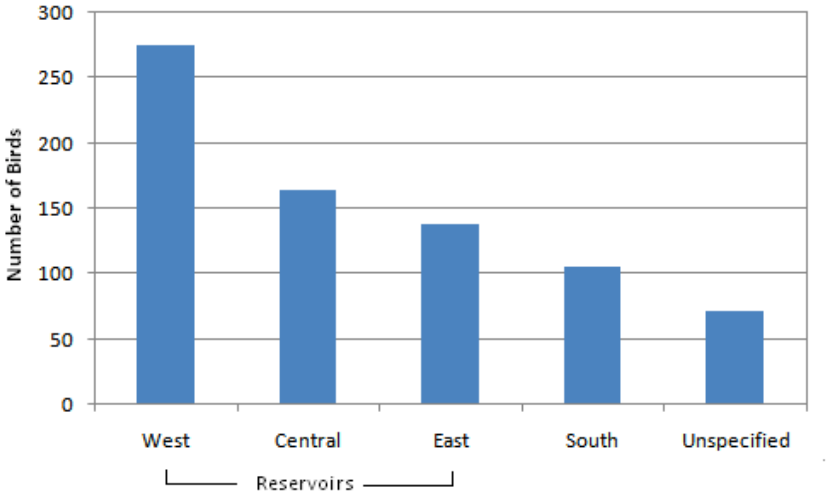


Figure 7. Bird species abundance by location at Ridgewood Reservoir during Fall migration in 2007



West Basin

The West Basin had the high species richness and abundance, supporting species from the widest variety of guilds, due to the increased compositional and structural diversity of habitats at the site relative to other areas. Five species of sparrows were seen actively feeding on the ground of the open

grassy meadow bordered by birch trees, for example. Indigo Buntings were seen along the edge of the meadow, and nearly 13 species of warbler were observed foraging in the canopy trees, while several warblers tended to utilize scattered low shrubs or stands of reed grass (Common Yellowthroat specifically, but also Ovenbird). Flocks of Kinglets, both Ruby-crowned and Golden-crowned foraged extensively in the birch and poplar stands, as did mixed flocks of Northern Parulas, Black-throated Green Warblers, Black-capped Chickadees, and Ruby-crowned Kinglets. The Southeast quadrant of the west basin, which was more uniformly in habitat, supported mainly warblers and the mixed feeding flocks previously described. The black locust/mugwort forest to the north supported Black- and-white, Northern Parula, Black-throated Green, and Nashville Warblers, as well as numerous woodpeckers including Downy, Red-bellied and Northern Flicker. Both Coopers Hawks (Special Concern) and Sharp-shinned Hawks (Special Concern) were observed hunting in the entire west basin. Where understory shrubs existed in the north section, various sparrows could be found, including good numbers of White-throated, Swamp and a single Lincoln's. The eastern edge of the west basin was more diverse with fruiting shrubs and attracted many Gray Catbirds, American Robins, and two species of Catharus trush (Swainson's and Gray-cheeked).

Central Basin

The central basin is the only one of the three which currently holds a significant amount of water (although each shows substantial signs of regular inundation). Anywhere from one to thirteen Wood Ducks, including males, females and young of the year, were observed on each occasion. Present on two surveys were up to four Green-winged Teal, and up to three Pied-billed Grebes (Threatened). Pied-billed Grebes were seen conducting courtship displays by local naturalists in 2007 and previous years, and represent probable breeding species at the site. Several species were commonly found using the stands of dense *Phragmites australis* around the edges of the basin, such as Gray Catbird, Northern Cardinal, Indigo Bunting, and Song Sparrow. Also seen on one survey was a Purple Finch; and Yellow-Rumped Warbler, Palm Warbler, and American Redstart all were seen moving through the reed grass stand. Yellow-Crowned Night-Herons had also attempted to nest in areas around the central reservoir in previous years, according to local naturalists.

East Basin

Many of the species found in the West basin also occurred in the East Basin, although in significantly lower densities. This can be attributed to the lack of vertical structure in the south part of the basin, which has been extensively cleared and disturbed by paintball users, as well as the somewhat lower diversity of habitats in the site overall. The Long-eared Owl was seen in this area of the East Basin, however, and the (probable) Short-Eared Owl (Endangered) was flushed from the denser south-central part of this basin, and a Merlin and Sharp-Shinned Hawks (Special Concern) were observed hunting in the open mossy area in the north-central part of the basin.

Other Species

In addition to the bird species mentioned above, numerous other mammal, reptile, amphibian and invertebrate species have also been observed at the site over time. Although most of these species

were common in southern New York, the site also contained an abundance of the Italian Wall Lizard (*Podarcis sicula*), which was introduced to Long Island in 1966 (Burke and Mercurio 2002). We observed opossum, raccoon, squirrels, voles, wall lizards, cicada killers, and numerous species of butterflies, dragonflies, bees, beetles and wasps. Local naturalists have also observed Snapping Turtles, Garter Snakes and frogs at the site, and various species of invertebrates and other animals were reported by Steve Nanz (Table 7).

Discussion

Our surveys of the flora and fauna of Ridgewood Reservoir in 2007 found the site to be highly significant for the biodiversity of New York City and the region. The site is home to more than 100 native plant species, three of which are listed as Threatened or Endangered in New York State, and more than 125 bird species, seven of which are listed as Threatened or Special Concern. A large proportion of the bird species found were also Neotropical migrants, which are of additional conservation concern due to the precipitous declines observed in many of these species' populations in the past half-century. These declines have resulted primarily from habitat destruction due to deforestation in their wintering grounds in the tropics and destruction or degradation of breeding habitats in North America due to development. Numerous other fish, mammals, reptiles and invertebrate species were also found or known to inhabit the site, including opossum, raccoons, and voles, lizards, turtles, and frogs, and numerous species of butterflies, dragonflies, wasps, beetles and other insects.

Visiting Ridgewood Reservoir in the spring, summer or fall, one cannot help but notice the importance of the site for birds. No less than 38 species of birds appeared to be breeding at the site in 2007, and numerous other species from the surrounding city environment used the site as roosting habitat in the summer as well. In the early morning hours, the sound and sight of these birds is utterly astounding, with tens of thousands of grackles, starlings, robins, catbirds and other species participating in the pre-dawn chorus, and rising up from the site in swarms to spend the daylight hours foraging throughout the city. In the fall, the site becomes substantially quieter, following the southern departure of these large flocks of resident birds, but is no less important for the numerous species migrating through the area from more northern sites. Throughout the autumn months, more than a hundred species can be found quietly foraging throughout the reservoirs basins and surrounding levees, storing up additional energy before heading farther south on migration.

The high value of the site for bird species is the result of a combination of factors, including abundant food resources, the diversity, size and contiguity of habitats, and its location in the overall landscape. The high densities of fruiting shrubs, trees and vines present throughout at the site, for example, provide food resources for a number of thrushes (American Robin, Gray-Cheeked, Swainson's, Hermit), mimids (Brown-Thrasher, Gray Catbird, Northern Mockingbird), and Cedar Waxwings; the open water provides habitat for wading birds, waterfowl, Osprey and swallows; the various swamp forest, locusts and emergent habitats provide abundant habitat for insectivorous birds (e.g., warblers, vireos, nuthatches, woodpeckers); the open grassy areas in the West Basin and southern levee provide habitat for the seed-eating finch and sparrow species; and the abundant birds, themselves, provide food resources for numerous predators, including hawks, falcons and owls.

The sheer amount of foraging resource present at the site is a good sign of this location's importance for migrating birds, as was the constant sight of birds foraging at all times of day. Many species were still present after several nights without migration (confirmed using nightly radar images for New York City) suggesting that the birds made a conscious decision to remain in the Ridgewood Reservoir instead of moving to more optimal foraging habitat (as has been documented in the migratory stopover research literature). All this suggests that this "habitat island" overlooking Queens, New York, does serve as a significant stopover location for migrating birds.

As important as is the abundance and diversity of the food resources at the site, the matter of its position in the landscape; i.e., its elevation and location at the western end of the Harbor Hill glacial moraine (Drennan 1981), itself only increases its significance for migratory birds. Numerous bird species, especially hawks, eagles, vultures, and falcons, are well-known follow such geological formations during migration, riding the heat and wind currents that rise up against these ridges from surrounding areas. Having large areas of protected habitat along those migratory routes (as is currently present at Ridgewood), is extremely important to sustain these populations, providing necessary stop-over habitats for shelter, food, and rest during these long journeys in the fall and spring of each year.

With more than 50 acres of contiguous forests, wetlands, and other habitats, Ridgewood Reservoir is the one of the largest areas of contiguous wildlife habitat remaining in all of Queens County. In addition to its size, the lack of significant fragmentation at the site is also extremely important for wildlife. With abundant trees, shrubs and vines having colonized the slopes of the levees, the wetland and mesic forest habitats of the basin interiors have been effectively connected to the older trees growing on the drier, upland levee crests and surrounding areas. This has made for a continuous layer of forest cover not only throughout the greater portion of the site, but across a wide gradient of environmental conditions and habitats types occurring therein. The size and quality of the habitats at Ridgewood have been further enhanced by the existence of large amounts of forested habitats and mature street trees in the immediately vicinity, including Highland Park, the cemeteries, older residential communities, and landfill. Combined with these adjacent habitats, the effective area of wildlife habitat at the site is much greater, extending far beyond the limits of the Ridgewood site itself and into surrounding areas.

With the combination of all these factors, Ridgewood Reservoir is extremely significant for the ecology and conservation of the bird species diversity not only in New York City, but in the surrounding region, making it among other things one of the top 500 places to see birds in all of New York State (Drennan 1981).

Plant Communities

The plant communities present at Ridgewood were generally characteristic of southern New York, including coastal swamp forests, rich moist woodlands with dense, diverse herbaceous cover in the understory, emergent marshes, ponds and bogs, upland forests, grasslands, and ruderal, disturbed areas. With the exception of the mature trees growing on the surrounding levees, most of the plant communities present were representative of early-mid successional forests or shrublands, which have developed in the few decades since the east and west reservoirs were drained and left unattended. The most unique and significant habitat present was the large bog habitat in the East Basin, the understory

of which was dominated by a dense carpet of Hair-cap (*Polytrichum*) mosses. This extended from the open, northern half of the Basin, which contained numerous herbaceous wetland plants and woody shrubs, into the swamps of the central and southern portions, which were dominated by grey birch and other woody species. Other interesting wetland and ecotonal areas also occurred in the southern half of the West Basin.

Although the plant communities at Ridgewood Reservoir were fairly typical of other wetland and upland areas of southern New York State, the particular assemblages of species present were somewhat unique in that various species or types of plants that normally occur in these habitats were not present at the site. This was most likely due to the isolated nature of the site, which exists more or less as an island of wilderness surrounded by intensely developed urban areas. With the nearest habitats of similar types occurring so far away, the dispersal of plants from such locations to Ridgewood is far less likely, and many such species are consequently lacking at the site. While the forest at the southern end of the East Basin, for example, is otherwise representative of coastal swamp forests, it lacks certain common components of these ecosystems, including black gum (*Nyssa sylvatica*) and holly (*Ilex opaca*) trees and the entire suite of native shrub species that typically dominate these areas, including various *Viburnum, Amelanchier, Aronia* and other species. Such absences are common in each of the habitats present at the Ridgewood Reservoir, resulting in a low species diversity in each of these habitats relative to other, similar areas.

Unfortunately, the absence of so many native species in the understory and sub-canopy of the forests at Ridgewood, numerous exotic, invasive species have been allowed to fill these niches. No less than 24 such species are present at the site, and many of them are now so abundant as to completely exclude other, native species. On the levees, Chinese Bittersweet (*Celastrus orbiculatus*) has overgrown extensive areas, smothering the canopies of numerous native tree species, and species such as Tree-of-Heaven (*Ailanthus altissima*), Multiflora Rose (*Rosa multiflora*), Privet (*Ligustrum vulgare*), Japanese Knotweed (*Polygonum cuspidatum*) and Common Buckthorn (*Rhamnus cathartica*) have colonized many of the more open areas of the site. Within the wetter basin interiors, other species have tended to become a problem. Common Reed (*Phragmites australis*) has completely overtaken the edges of open water in the Central Basin, and may eventually consume the entire basin, and occurs in several patches in the East and West Basins as well. Glossy Buckthorn (*Rhamnus frangula*) now occurs in most areas of the East and West Basins as well, making it the most abundant seedling and sub-canopy species in several areas, and Common Mugwort (*Artemisia vulgaris*) has dominated the understory of nearly the entire northern half of the West Basin. With numerous other exotic, invasives also present at the site, including *Populus x nigra, Lonicera morrowii, L. japonica, Paulownia tomentosa*, *Acer platanoides, A. pseudoplatanus, Berberis thunbergii, Morus alba, Ampelopsis brevipedulculata, Alliaria petiolata,* and others, these species represent by far the greatest management concern at Ridgewood Reservoir.

Endangered Species

The Endangered plant and animal species present at Ridgewood Reservoir represent a significant concern for future management and development of the site as well. All of the three endangered plant species found in 2007 are ranked as S2 in New York, indicating that they are imperiled due to

their rarity (i.e., having only 6-20 known populations or few individuals) and/or vulnerability to extirpation due to human and/or other factors (Young 2007). The distributions of each of these species are in fact limited to the southern portions of New York State, where the greatest amounts of development have historically occurred, and where few areas of suitable habitat remain for these species. *Eupatorium hyssopifolium* var. *laciniatum* is well-documented in southern New York State, for example, with confirmed occurrences in Queens, Richmond, Suffolk and Nassau Counties. *Eupatorium serotinum* is known from Bronx, Nassau, Richmond, Rockland and Suffolk Counties, and *Ludwigia sphaerocarpa* has been found in Richmond, Suffolk, Ulster and Westchester Counties (Young 2007).

Populations of *Eupatorium serotinum* and *E. hyssopifolium* var. *laciniatum* present at Ridgewood were not large, but were relatively frequent throughout the East and West Basins, while the *Ludwigia sphaerocarpa* occurred in only one location each and numbered only a few individuals. Given their sensitivity at the site and their regional signficance, these species' populations represent major concerns for future management of the site, and efforts should be taken not only to avoid disturbance to these areas, but to manage existing habitat conditions in order to protect and maintain these populations in the future. In addition to these state-listed species, moreover, other species present at Ridgewood Reservoir (e.g., *Spiraea latifolia*, Meadowsweet) may also be of local conservation concern within New York City and consultation should therefore be made with NRG staff to determine which of these should be considered for protection at the site as well (R. Lynch pers. comm.).

A total of seven endangered bird species were observed during summer and fall of 2007 at Ridgewood Reservoir as well, including one Endangered (Short-Eared Owl), one Threatened (Pied-Billed Grebe), and five species of Special Concern (Osprey, Red-Shouldered Hawk, Cooper's Hawk, Sharp-Shinned Hawk, Common Nighthawk) in New York State (DEC 2007). The Pied-Billed Grebes and Osprey were using the open water and emergent habitat in the Central Basin, while the other species were observed in the East or West Basins. Pied-Billed Grebes also exhibited courtship behaviors at the site and may represent possible breeding species there in the future. Most significant to protecting these species populations at Ridgewood is maintaining and augmenting the amount of contiguous habitat present at the site, which will provide not only for those species found to occur at Ridgewood in 2007, but the many other endangered and other species that have occurred there in the past and/or may be found to use the site in the future.

Wetlands

Also significant conservation value at Ridgewood Reservoir is the abundant wetland habitats present in the site. In addition to the large open water and emergent wetlands dominating the Central Basin, standing water was also present in the north of the East Basin and south of the West Basin throughout the summer. Other types of wetland habitats (e.g., vernal pools, hardwood swamps, and open bogs) and ecotonal areas were present throughout the East Basin and southern half of the West Basin. Nearly half of the plant species found in the East and West Basin, in fact, were obligate wetland, facultative wetland, or facultative plants, the populations of which occur 50% or more in wetland areas. Even greater proportions would likely have been found the data for each Basin if the *Cyperus* spp., *Salix* spp., and *Eleocharis* spp. were able to be identified to species. Several of the moss

species found (e.g., *Sphagnum*) are also wetland indicator species, even though no formal rankings exist for them.[2]

Recommendations

The results of this study are entirely preliminary, based entirely on studies conducted in the summer and fall, and further research is needed to determine the significance of the site for the flora and fauna at other times of year. Given the apparent significance of the Ridgewood Reservoir for migratory and other birds, for example, studies are needed of the importance of these habitats for wintering birds, and especially during spring migration. Although large numbers of species were already found to be using the site during the summer and fall, Drennan (1981) ranked these far lower for seeing birds than the spring season at Ridgewood Reservoir, which gained the highest ranking of four stars. Also meriting future study is the significance of the Central Basin for aquatic flora and breeding rails, several of which are also listed as Threatened, Endangered or Special Concern in New York. Lastly, studies are needed of the spring flora, as several of the species found this year could not be identified due to their having flowering earlier in the spring, and many other species also be present at the site but only at those earlier times of year.

Invasive Plant Species

The studied conducted in 2007, however, did provide sufficient basis to determine the status of the Ridgewood Reservoir site in several important respects and to provide recommendations accordingly. It is clear, for example, that the most significant and immediate concern for maintaining the biological integrity of the site is the control of the more than 20 exotic, invasive plant species present there, which are rapidly overtaking the site and decreasing its ability to support native plant and animal species. Essential to this task is a combination of both prescriptive and preventative measures, including not only the *removal* of these species' populations, but their *replacement* with native plant species, and the *prevention* of disturbances and other activities (e.g., non-native species plantings) that could favor their expansion and increase. In addition to controlling the populations of exotic, invasive species at the site, these measures could also serve to enhance the diversity and integrity of native species populations at the site, while providing opportunities for research, education and community involvement in the restoration and continual maintenance of this significant parkland.

Several factors complicate the management of exotic, invasive species present at Ridgewood Reservoir, including their sheer abundance and diversity, their occurrence at varying densities and various levels of community structure (e.g., seed, seedling, sapling, tree), their present importance for food, shelter and nesting habitat for wildlife, and their aesthetic values to recreational park users.

[2] Under New Jersey wetland regulations, in fact, *Sphagnum* moss is accepted as an indicator of hydric conditions (water present), as it only occurs in wetland areas and is able to draw water to the soil surface from water tables existing even several meters underground.

Removal

Some patches of invasives (e.g., *Polygonum cuspidatum,* Japanese pokeweed) at the site, for example, occur so densely as to completely exclude any native species from occurring there. In such situations, blanket control measures (e.g., mowing, digging, clear-cutting, spraying) may prove effective without incurring significant harm to other native species present. In most cases, however, native species are interspersed within even the highest density stands of invasives, and such coarse- scale measures could be counterproductive for restoration or rehabilitation, by simultaneously suppressing the native plant species that are already present there and/or creating patches of disturbance that may facilitate the colonization or spread of other invasives to those areas.

In many (if not most) situations, therefore, more selective control measures (e.g., hand-weeding, culling, girdling, selective spraying) could better facilitate the establishment of native plant communities. While these measures may be far more labor intensive at first, by making use of those plants that have already colonized and established in the area, they may require less seeding, planting and maintenance activities over time. Given these concerns for native plant species, including those that are rare or endangered, all invasive species removal activities should be preceded by surveys of the native plant species present, to determine whether coarse or fine-scale methods of removal are more appropriate for each respective area.

Replace ment

In order to further facilitate the development of native plant species, park managers should consider replacing any exotic invasives removed from the site with native alternatives that share the same ecological niche and wildlife or aesthetic values. Removing the many invasive shrub and vine species (e.g., *Malus, Ligustrum, Rhamnus, Lonicera, Rosa, Rubus, Celastrus, Parthenocissus*) , for example, should coincide with seeding or planting native flowering shrubs of the same or similar genera that have similar resource value for the birds and insects inhabiting the site (e.g., *Prunus*, *Viburnum, Aronia, Crataegus, Rosa* , *Rubus, Vitis, Parthenocissus*). Similarly, non-native tree species (e.g., *Ailanthus, Populus, Paulownia, Rhamnus, Morus*) could be replaced with native species already present at the site, or others that are also endemic to the types of habitats occurring there (e.g,, *Nyssa, Populus, Ilex, Quercus, Morus*). In order to maintain the genetic integrity of native species populations, moreover, seed should be collected from the nearest local populations of those native species to be introduced to the site wherever possible.

In some cases, the exotic and invasive species are so abundant that there is an opportunity to replace these entire communities with native alternatives. By temporarily raising the water level, for example, the invasive *Phragmites australis* that has overtaken the Central Basin could be effectively eradicated and replaced with native emergent marshes and floating aquatic vegetation, which provides habitat value for a greater diversity of native wildlife species. Similarly, the ruderal areas lining the paths and buildings on the levees could be replaced with native grassland habitat, perhaps using the endangered Hempstead Plains remnants as a model, and the more open levee slopes on the northeast and west sides of the Central Basin could be replaced with species indicative

of rocky outcrop and mountain glade communities of the nearby Palisades Region.

Enhancement

In addition to introducing the biotic diversity of native species using seed sources from similar habitats nearby Ridgewood, efforts should be made to propagate and conserve the more rare or endangered species already existing at the site (e.g., *Eupatorium spp., Ludwigia sphaerocarpa, Spiraea tomentosa*). Other endangered plant species from nearby areas could also be chosen to replace exotic plant species (e.g., *Euonymous americana, Celastrus americanus, Amelanchier nantucketensis, Quercus phellos, Populus heterophylla*), which would aid in the conservation of these species as well.

The methods of removing invasives could also serve to enhance the value of these habitats for wildlife. Increased foraging habitat for woodpeckers and nesting habitat for cavity-nesters, for example, could be improved by increasing the amount of standing dead matter (e.g., cutting vines at the base, girdling trees), and cover for birds, small mammals and reptiles could be created by leaving piles of woody debris in some areas. Prescribed burning of some areas could also help remove or suppress invasives while favoring certain native plant species and habitats.

Prevention

Most important to maintaining and enhancing the biotic integrity of the Ridgewood Reservoir is preventing any major disturbances to the otherwise intact forest and other ecosystems. Such disturbances would not only severely reduce the value of these habitats for endangered and other wildlife species, but would greatly increase the susceptibility of these areas to further encroachment by exotic, invasive plant species. The introduction and increase of exotic invasives could also be prevented by refraining from planting any non-native species at the site or depositing large areas of foreign soils or sediments. Also important is reducing the levels of anthropogenic disturbance and other adverse activities currently affecting the site, including off-road vehicles, paintballs, dumping, and trapping birds.

Community Involvement

One of the most important aspects of maintaining and enhancing the integrity of the Ridgewood Reservoir and other sites is making use of the educational and interpretive value of the site, and of the conservation and restoration activities taking place there. Creating opportunities for community involvement in these activities serves not only to increase public awareness and support for these programs, but provides a base of volunteers that can help see these projects to completion at a fraction of what it would otherwise cost. Volunteers could help with invasive species removal, native species planting and propagation, biological monitoring, and garbage removal. The potential for creating such programs at Ridgewood Reservoir is greatly increased by the strong community of people that already visits and cares for the site, including recreational birders, naturalists, bicyclists, joggers and many others. Converting one of the historic pumphouses or caretaker's house into a nature center would greatly benefit these potential uses of the site, providing a physical center for

the many conservation and restoration activities that are needed, as well as all of the potential educational, interpretive and community-building opportunities that these activities, along with the site itself, provide.

Literature Cited

Burke, R.L. and R.J. Mercurio. 2002. Food habits of a New York population of Italian Wall Lizards, *Podarcis sicula* (Reptilia, Lacertidae). *American Midland Naturalist* 147: 368-375

Drennan, S. R. 1981. Where to Find Birds in New York State. Syracuse: Syracuse University

Press. Edinger, G.J., D.J. Evans, S. Gebauer, T.G. Howard, D.M. Hunt, and A.M. Olivero (editors).

2002.
Ecological Communities of New York State. Second Edition. A revised and expanded edition of Carol Reschke's Ecological Communities of New York State. (Draft for review). New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.

NRG (Natural Resources Group). 2006. Entitation for Ridgewood Reservoir. Natural Resources Group, City of New York Department of Parks and Recreation.

Reed, P.B. 1988. National List of Plant Species That Occur in Wetlands: 1988 National Summary. U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Soil Conservation Service.

Young, Stephen M. 2007. New York Rare Plant Status Lists. New York Natural Heritage Program, Albany, NY. June 2007. 105 pages.

Sauer, J. R., J. E. Hines, and J. Fallon. 2007. The North American Breeding Bird Survey, Results and Analysis 1966 - 2006. Version 7.23.2007. USGS Patuxent Wildlife Research Center, Laurel, MD

NYDEC (New York State Department of Environmental Conservation). 2007. List of Endangered Animal Species. http://www.dec.ny.gov/animals/7494.html

USFWS (U.S. Fish and Wildlife Service). 2007. List of Endangered Species in the United States. U.S. Fish and Wildlife Service, Department of the Interior.