CHAPTER 3.D

NATURAL RESOURCES

A. INTRODUCTION

The New *York City Environmental Quality Review (CEQR) Technical Manual* defines a natural resource as a plant or animal species and any area that is "capable of providing habitat for plant and animal species or capable of functioning to support environmental systems and maintain the City's environmental balance." Included in these resources are the City's terrestrial habitats such as woodlands, fields and grassy areas, tidal and nontidal wetlands, ponds, lakes, and freshwater and brackish (mix of fresh and saltwater) surface waterbodies. Throughout the City, these habitats support a wide variety of wildlife as well as resident and seasonal birds and fish.

The seven Representative Areas described previously in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning," provide examples of these different terrestrial and aquatic habitats and the associated organisms. The purpose of this chapter is to:

- Provide a general description of the City's natural resources;
- Present a detailed description of the natural resources within the Representative Areas;
- Assess potential risks to these resources from the five mosquito adulticides selected for presentation of detailed technical analysis through an ecological risk assessment;
- Assess potential impacts associated with application related processes by truck and air; and
- Develop measures to reduce the potential effects to natural resources.

This chapter is organized into the following sections:

- The methodology employed to assess the ecological risks from the application of the adulticides;
- The current natural resource conditions within the City in general and then more specifically, within the Representative Areas;
- The future conditions of the City's natural resources without the proposed *Adult Mosquito Control Programs*; and
- The results of the Tier I and Tier II ecological risk assessments;
- An assessment of potential impacts to the City's natural resources based upon the results of the risk assessment and empirical studies.

B. METHODOLOGY

INTRODUCTION

This section describes the methodology employed to assess the potential effects to the City's natural resources from the application of the adulticides evaluated in this document. This assessment consisted of several components. First, the City's natural resources were described with a focus on the resources found within the Representative Areas to identify the potential receptors (i.e., organisms or habitats that could be exposed to adulticides) within the City. Then, an ecological risk assessment was conducted to determine the likelihood that the adulticides evaluated in this document would adversely impact wildlife survival and fitness, and environmental quality.

The methodology used for the ecological risk assessment consisted of the following steps that are described more fully in the next section, "Methods of Analysis."

- Literature Review—The existing literature was reviewed to provide information on the physical and chemical characteristics of the adulticides, to assess the toxicity to natural resource species, and to characterize the fate and effects of the adulticides in the environment. This also includes results of empirical studies conducted throughout the country that compiled and evaluated the effects of adulticide spraying on natural resources.
- Screening Level (Tier I) Risk Assessment—The objective of the screening-level risk assessment is to focus the overall ecological risk assessment process by eliminating from consideration those possibilities that do not have the potential for resulting in adverse effects to plants or animals.
- The Detailed (Tier II) Risk Assessment—The Tier I assessment identified those stressors and pathways which would require additional investigation prior to making decisions regarding potential ecological risk. The purpose of the focused or detailed (Tier II) risk assessment is to evaluate these areas needing further assessment under more realistic conditions and assumptions to better reflect the City's current conditions, such as those found within the Representative Areas.

A weight of evidence approach that incorporated the results of empirical studies and conclusions drawn from the risk assessments was then used to assess the potential effects of the active ingredients to the City's natural resources.

METHODS OF ANALYSIS

Ecological Risk Assessment

Literature Review

Information on the chemical and physical characteristics of the active ingredients, toxicity to animals and plants, and fate and effects in the environment used in the Tier I and II risk assessments and assessment of impacts was obtained through a search of various electronic databases that included the following:

- Biological Abstracts—Searched for the time period of 1985 through 2000 using the name of each adulticide and active ingredient combined with the root of the word "toxic" to identify words such as toxic, toxicity, toxicological, etc.

- National Technical Information Service (NTIS)—Searched for the time period of 1983 to 2000 using the name of each adulticide and active ingredient combined with the root of the word "toxic."
- Environmental Toxicology and Chemistry Online—All available issues of Environmental Toxicology and Chemistry were searched by title for the adulticides and active ingredients.
- Datalog—Searched by adulticide and active ingredient.
- U.S. Geological Survey (USGS) Acute Toxicity Database—Searched by adulticide and active ingredient.
- U.S. Environmental Protection Agency (USEPA) Integrated Risk Information System (IRIS) Database—Searched by adulticide and active ingredient.
- USEPA One-Liner Database—Searched by adulticide and active ingredient.
- USEPA Hazardous Substances Database—Searched by adulticide and active ingredient.
- EXTOXNET Database (a cooperative effort of the University of California-Davis, Oregon State University, Michigan State University, Cornell University, and the University of Idaho)—Searched by adulticide and active ingredient.
- John A. Mulrennan, Sr., Public Health Entomology Research and Education Center, Florida Agricultural and Mechanical University, Publications List and Nontarget Database—Searched by adulticide and active ingredient.
- U.S. Department of Agriculture (USDA), U.S. Department of Agriculture's Agricultural Research Station (ARS), and the Remote Sensing and Modeling Laboratory (RSML) Pesticide Properties Database—Searched by adulticide and active ingredient.
- National Institute of Health, National Library of Medicine Toxicology Data Network, Hazardous Substances Database (HSDB)—Searched by adulticide and active ingredient.
- USEPA Office of Pesticide Programs Internet Website—Searched by adulticide name and active ingredient.
- Personal contacts at the USEPA Office of Pesticide Programs and New York Department of Environmental Conservation (NYSDEC).
- World Health Organization Internet Website—Searched by adulticide name and active ingredient.

Screening-Level (Tier I) Risk Assessment

The purpose of the screening-level (Tier I) assessment is to focus the overall ecological risk assessment process by eliminating from consideration those possibilities that do not have the potential for resulting in adverse effects to plants or animals. As such, the Tier I assessment often uses worst-case, conservative assumptions for determining exposure concentrations and environmental conditions, many of which far exceed those likely to occur. As a result, the Tier I assessment is likely to greatly overestimate the true impact to natural resources, and is useful in screening out possibilities that are identified as no potential adverse impact from adulticide applications. The steps followed in conducting the Tier I assessment include:

- Toxicity assessment—this includes a description of the chemical and physical characteristics of the adulticides based on the literature review and a description of how the active ingredient

behaves in the natural environment with respect to metabolism, degradation, migration, and volatilization. The toxicity assessment was used to help focus the risk assessment.

- Description of the ecosystem at risk and the potential receptors—using the toxicity assessment, and the description of current conditions of natural resources, the potential receptors to be evaluated in the screening-level risk assessment were identified.
- Development of conceptual models—using the toxicity assessment and the potential receptors identified for evaluation along with the toxicity characterization, conceptual models were developed that identify the active ingredients, exposure pathways, and potential sensitive receptors.
- Exposure characterization—for each of the conceptual models developed for analysis, the worst hypothetical exposure concentration of each active ingredient was calculated for each exposure route identified in the models.
- Ecological effects characterization—toxicological benchmark concentrations are presented for each potential receptor identified for evaluation based on the results of the literature review. These are taken from the results of laboratory toxicity testing of the active ingredients on test organisms for registration or reregistration of the active ingredient. For potential receptors where no toxicological benchmark concentrations are available, surrogate species were identified.
- Risk characterization—to characterize the ecological risks of the adulticides, hazard quotientss were used to be able to compare exposure concentrations or doses with the toxicological benchmark concentrations or doses. The hazard quotient (HQ) is the estimated environmental concentration divided by the toxicological benchmark concentration for a particular test organism. HQ = exposure concentration/benchmark concentration.
- Uncertainty factors—assumptions that affect the results of the risk assessment were identified and discussed along with a description of how they may affect the assessment.

Detailed (Tier II) Risk Assessment

The purpose of the Tier II assessment is to examine in greater detail those scenarios identified by the Tier I assessment as having the *possibility* of producing adverse ecological effects on certain natural resource receptors. The Tier II assessment used the same basic conceptual models as the Tier I but attempted to include more realistic assumptions in estimating exposure concentrations. It also used more representative assumptions to describe environmental conditions. Assumptions used in the Tier II risk assessment included incorporating degradation of the adulticides in the environment through the use of half-life estimates, the change in environmental concentration caused by the partitioning of some adulticides to organic matter in the soil or sediment, decrease in deposition to soil or surface waters with distance from the spray truck, etc. The risks are characterized using the estimated exposure concentrations resulting in more representative HQs.

Empirical Studies

The empirical studies, or field studies, of the fate and effects of the adulticides and active ingredients conducted by other investigators were used to help place the results of the Tier II risk assessment into a more meaningful context. These emipirical studies have the advantage of providing "real world" findings from field studies, but the applicability of conclusions is greatly limited by the time, place, and local conditions under which the studies were performed. The results of these studies are not always consistent with results of the risk assessments, which rely largely on laboratory studies and

mathematical modeling. A weight-of-evidence approach that combines both the risk assessment findings and results of empirical studies was therefore used to assess the potential impacts of spraying to the City's natural resources.

C. CURRENT NATURAL RESOURCE CONDITIONS WITHOUT THE PROPOSED ACTION

This section describes in general, the plant and animal resources within the City, and then provides specific information on the seven Representative Areas whose land use was described previously in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning." The description of existing conditions includes information from public documents and observations made during the site visits to the Representative Areas. The public documents were obtained by contacting the New York City Department of Parks and Recreation (NYCDPR), the New York City Department of Environmental Protection (NYCDEP), the New York Natural Heritage Program (NYNHP), NYSDEC, the U.S. Department of the Interior's Fish and Wildlife Service (USFWS), and the U.S. Gateway National Recreation Area. During the site visits, observations were made of natural resources in the developed areas. The undeveloped portions within the Representative Areas, primarily parkland owned by the New York City or the U.S. Park Service, were examined on foot. Because the site visits were intended to provide a general description of the existing plants and animals, to augment the existing published information, detailed surveys of the plants and animals were not conducted. Observations recorded during the site visits included general descriptions of the overall land use, vegetation, animal species either through direct (sightings or calls) or indirect (tracks or scat) observations, and photographs.

BACKGROUND

Though heavily populated and developed, New York City contains uplands, wetlands, and shorelands that are rich in natural resources, although most are reduced in terms of abundance and distribution from pre-colonial conditions (USFWS, 1997). The Representative Areas are within the USFWS's Urban Core region of the New York Bight Watershed (USFWS, 1997). The Urban Core includes the New York-New Jersey Harbor and the greater metropolitan New York City region within a 25-mile radius of Central Park in Manhattan. New York City is located at the convergence of several major river systems, such as the Hudson, Raritan, Passaic, Hackensack, and Navesink/Shrewsbury. All of these river systems connect to the New York Bight portion of the Atlantic Ocean, which results in a mixture of habitats in the estuary (a semi-enclosed body of water where fresh and saltwater meet and mix) that support marine fish, estuarine fish, anadromous fish (fish that migrate up rivers from the sea to breed in freshwater), and catadromous fish (fish that live in freshwater but migrate to marine waters to breed). Additionally, the location of this area at a bend in the coastline of the Atlantic Coast tends to concentrate overland migrating species, such as birds and butterflies, through or near to this area.

The following provide a general description of the resources within New York City and the Urban Core area, and then the resources specific to the Representative Areas.

AQUATIC RESOURCES

This section describes the various aquatic habitats found in and around New York City, then provides a general description of the phytoplankton (microscopic plants whose distributions are determined by tides or currents), zooplankton (microscopic animals whose distributions are determined by tides or

currents), benthic (organisms that live on or in the bottom of a sea, river, lake, or pond) invertebrates, aquatic vegetation, marine turtles, fish, and marine mammals that inhabit these areas.

Aquatic Habitats

The waters surrounding New York City include:

- The Atlantic Ocean along the south shores of Brooklyn, Queens, and Staten Island.
- The New York Harbor—Part of the Hudson River Estuary system, it receives freshwater flows from the Hudson, Raritan, Passaic, Hackensack, and Navesink/Shrewsbury Rivers, and saltwater from the Atlantic Ocean. Although it is affected by surrounding and up-estuary land use, including increased sedimentation, pollutants, and habitat loss, the New York Harbor provides a variety of habitats including submerged aquatic vegetation (SAV), rock reefs, barrier islands/sand bars, lagoon and shallow open water areas, rocky intertidal/subtidal areas, beaches and dunes, sand/mud/salt flats, tidal pools, and freshwater and brackish marshes. These habitats support estuarine and marine fish and invertebrates, resident and migratory birds, reptiles, amphibians, and mammals.
- Long Island Sound—this narrow tidal water borders Queens and the Bronx on its western end and is connected on its eastern end to the Atlantic Ocean. Long Island Sound contains a variety of resources, including tidal marsh and open water habitat, and supports a diverse recreational and commercial fishery.
- Bays and coves, partially enclosed tidal waters fed by freshwater streams—Examples include Jamaica Bay bordering Brooklyn and Queens, Little Neck Bay, Bowery Bay, and Powell's Cove in Queens, and Pelham Bay and Eastchester Bay in the Bronx. Jamaica Bay provides a variety of habitats, such as tidal wetlands, grasslands, beach, dunes, nesting and wintering areas for birds, and significant habitat for finfish and shellfish. Pelham Bay in the Bronx contains high marsh, intertidal marsh, and salt flats, and is used as a feeding and resting area for a large number of birds.
- Tidal straits, such as the East and Harlem Rivers, Kill Van Kull, and Arthur Kill—The upper East River is used as a passageway for several anadromous and estuarine fishes and as a seasonal residence for a variety of marine fish species as part of seaward or coastal movements. The hard and soft substrates within the East River support different communities of benthic invertebrates (invertebrates living on the bottom of a river, lake or sea). The area bordering the Arthur Kill in Staten Island has about 1,000 acres of tidal wetlands that provide habitat for a variety of fish and wildlife species.
- Rivers such as the Hudson, Bronx, and Hutchinson Rivers—In the reach along the City, the Hudson River is actually an estuary, receiving freshwater input from upriver and saltwater from the Upper New York Bay. It provides habitat for a variety of plankton, benthic invertebrates, and fish and is an important overwintering habitat for juvenile striped bass and winter flounder, as well as nursery habitat for a number of fish species. Tidal wetlands are located near the mouths of the Bronx and Hutchinson Rivers.
- Streams, such as Spring Creek in Brooklyn, and Fresh Kills, Richmond Creek, Lemon Creek, and Sawmill Creek on Staten Island—Lemon Creek has fresh and saltwater marsh and has been identified as a significant coastal fish and wildlife habitat by NYSDEC. Sawmill Creek includes Chelsea Marsh and Merrell's Marsh and has also been identified as significant coastal fish and wildlife habitat.

- Ponds and lakes—Found in all five boroughs, these include Kissena Lake in Queens; Van Cortland Lake in the Bronx; Brooks and Clove Lakes, and Goethals Bridge Pond on Staten Island; the Lake in Central Park, and Prospect Lake in Prospect Park, Brooklyn. Goethals Bridge Pond, a State significant coastal fish and wildlife habitat, provides an important feeding area for three major heronries as well as breeding areas for several waterfowl species.

Chapter 3.F, "Water Quality," describes the water quality of the New York Harbor area as well as the Representative Areas.

Aquatic Life

The wide range of habitats in the waters surrounding New York City support a high diversity of aquatic species (e.g., fish, plankton, and benthic invertebrates). Much of the waters surrounding the City are subject to wide fluctuations in temperature, salinity, and dissolved oxygen associated with their estuarine nature. Estuarine species are generally very tolerant of the wide ranges and abrupt changes in these physical conditions.

Vertebrates

Fish

Estuarine fish species are year-round residents of this area, using the different habitats available for shelter and food during various life stages. Many anadromous fish migrate through this area on the way to spawning areas in the main stem of the Hudson, or the numerous tributaries, and also on their seaward migration out of the estuary. Marine species use the higher salinity areas of the harbor, and freshwater species the lower salinity areas or upper tributaries (USFWS 1997). Table 3.D-1 summarizes the species observed in these aquatic habitats.

Woodhead (1991) characterized the fish communities of the New York Harbor area, using data collected by other researchers from 1979 to 1989. Of the 101 fish species recorded, marine species were the most abundant in the entire system (70 percent), with the greatest diversity of marine species occurring where salinities were highest in the lower portion of the bay. Migratory fish, primarily anadromous species, made up 10 percent of the species recorded in the harbor. These fish use it as an adult migration corridor to the Hudson and other tributaries, and as juvenile nursery and overwinter habitat. The migratory species include shortnose sturgeon (*Acipenser brevirostrum*, Federally listed endangered species). Freshwater species comprise 10 percent of the total. Estuarine species were found throughout the Bay and made up 10 percent of the total number of species. The greatest number of estuarine species was found in the lower salinity areas.

Use of the Harbor area for some of the species mentioned above is seasonal. For example, bay anchovy is most abundant in the summer and least abundant in the winter. Winter flounder is most abundant in the winter and fall, and least abundant in the summer (Woodhead 1991). In addition to seasonal differences, the diverse habitats found within the Harbor system influence the distribution, abundance, and life stage of fish. Using existing ichthyoplankton (early life stages of fish, such as eggs and larvae) data collected from 1972 to 1988, Woodhead and McEnroe (1991 in USFWS 1997) characterized the use of the harbor system for spawning and nursery habitat, also presented in Table 3.D-1.

A commercial fishery for shad occurs in the spring in the Palisades-Manhattan area. The other commercial fisheries, in the near shore areas of the Apex and Bight (a wide bay formed by a bend or curve in a shoreline), and the Hudson Canyon are of the continental shelf that is influenced by the outflow from the Harbor estuary. These fisheries focus on groundfish such as hake, summer flounder, winter flounder, tautog, and scup, and mid-water species such as menhaden, bluefish, weakfish, and Atlantic mackerel (*Scomber scombrus*) (USFWS 1997).

Table 3.D-1
Use of the New York Harbor Estuary System by Certain Fish Species for Spawning and as a Nursery Area

Common Name	Scientific Name	Spawning in Coldwater	Spawning in Warm Water	Use as Nursery Area
MARINE				
American sandlance	*Ammodytes americanus*	X		X
Bay anchovy	*Anchoa mitchilli*		X	X
Bluefish	*Pomatomus saltatrix*			X
Butterfish	*Peprilus triacanthus*			X
Cunner	*Tautogolabrus adspersus*		X	X
Summer flounder	*Paralichthys dentatus*			X
Four-beard rockling	*Enchelyopus cimbrius*	X		X
Four-spot flounder	*Paralichthys oblongus*			X
Grubby sculpin	*Myoxcephalus aenaeus*	X		X
Lookdown	*Selene vomer*			X
Lined seahorse	*Hippocampus erectus*		X	
Naked goby	*Gobiosoma bosci*		X	
Northern puffer	*Sphoeroides maculatus*		X	X
Northern searobin	*Prionotus carolinus*			X
Red hake	*Urophycis chuss*			X
Rock gunnel	*Pholis gunnellus*		X	
Round herring	*Etrumeus teres*			X
Seaboard goby	*Gobiosoma ginsburgi*			X
Scup	*Stenotomus chrysops*			X
Silver hake	*Merluccius bilinearis*			X
Small mouth flounder	*Etropus microstomus*			X
Spotted hake	*Urophycis regina*			X
Striped searobin	*Prionotus evolans*			X
Tautog	*Tautoga onitis*		X	X
Weakfish	*Cynoscion regalis*			X
Windowpane	*Scophthalmus aquosus*		X	
Winter flounder	*Pleuronectes americansu*	X		X
MIGRATORY				
Alewife	*Alosa pseudoharengus*		X	X
American eel	*Anguilla rostrata*			X
American shad	*Alosa sapidissima*		X	X
Atlantic menhaden	*Brevoortia tyrannus*		X	X
Blueback herring	*Alosa aestivalis*		X	X
Striped bass	*Morone saxatilis*			X
Tomcod	*Microgadus tomcod*	X		X
ESTUARINE				
Atlantic silversides	*Menidia menidia*		X	X
Banded killifish	*Fundulus diaphanus*		X	X
Hogchoker	*Trinectes maculatus*		X	X
Inland silverside	*Menidia beryllina*		X	X
Mummichog	*Fundulus heteroclitus*		X	X
Northern pipefish	*Syngnathus fuscus*		X	X
Striped killifish	*Fundulus majalis*			X
3-spine stickleback	*Gasterosteus aculeatus*		X	X
4-spine stickleback	*Apeltes quadracus*		X	X
White perch	*Morone americana*		X	X

Table 3.D-1 (continued)
Use of the New York Harbor Estuary System by Certain Fish Species for Spawning and as a Nursery Area

Common Name	Scientific Name	Spawning in Coldwater	Spawning in Warm Water	Use as Nursery Area
FRESHWATER				
Bluegill	*Lepomis macrochirus*		X	X
Brown bullhead	*Ameiurus nebulosus*		X	X
Carp	*Cyprinus carpio*		X	X
Gizzard shad	*Dorosoma cepedianum*		X	X
Golden shiner	*Notemigonus crysoleucas*		X	X
Tessellated shiner	*Theostoma olmstedi*		X	X
Yellow perch	*Perca flavescens*		X	X

Source: Woodhead and McEnroe (1991) in USFWS (1997).

Phytoplankton

Phytoplankton are generally microscopic plants whose movements within the waters surrounding New York City are controlled by tides and currents. Because phytoplankton, and other primary producers of energy in the ocean food chain require sunlight as their primary energy source, their productivity, biomass, and depth distribution will be limited by light penetration. The phytoplankton community in New York coastal waters is dominated by diatoms (unicellular members of the largest group of algae in the golden algae phylum) in late winter to early spring when the diatoms are succeeded by smaller forms (Malone, 1977; Lively et al., 1983, cited in Lonsdale and Cosper, 1994). Brosnan and O'Shea (1995) identified 29 taxa in a 1993 survey of the New York Harbor. Common phytoplankton species include the diatoms *Skeletonema costatum* and *Thalassiosira spp*., dinoflagellates (a group of microscopic algae characterized by two flagella, whiplike projections) such as *Prorocentrup spp.*, and green algae such as *Nannochloris atomus* (Brosnan and O'Shea 1995).

Zooplankton

Zooplankton are another integral component of the aquatic food web—they are primary grazers on phytoplankton and detrital (organic debris formed by decomposition of plants and animals) material, and are themselves consumed by fish such as bay anchovy and early life stages of commercially and recreationally important fish species such as striped bass and white perch. Zooplankton also include life stages of other organisms such as fish eggs and larvae and decapod (group of crustacean invertebrates with 5 pairs of legs? e.g., shrimp, lobster and crab) larvae that spend only part of their life cycle as plankton. In the lower Hudson River Estuary, copepods (microscopic crustaceans) are the dominant mesozooplankton (retained on nets with mesh openings greater than 200 µm) group throughout the year (Stepien et al. 1981). The most dominant species include the copepods *Acartia tonsa*, *Acartia hudsonica*, *Eurytemora affinis*, and *Temora longicornis*, with each species being prevalent in certain seasons (Stepien et al., 1981: Lonsdale and Cosper 1994; Perlmutter 1971; Lauer 1971; and Hazen and Sawyer 1983). Copepods, rotifers, and barnacle larva (Cirripedia) are common microzooplankton (smallest zooplankton) (U.S. Army Corps of Enginers [USACOE], 1984). Common larger macrozooplankton (retained on nets with mesh openings of 505 µm) are mysid shrimp (*Neomysis americana*), cumaceans, and amphipods (USACOE, 1984). A more detailed discussion of crustaceans is presented in the section on arthropods below.

Benthic Invertebrates

Benthic invertebrates inhabit the sediments and surfaces of submerged objects such as rock, pilings, or debris. They are important to the energy flow of aquatic systems because they use detrital and suspended organic matter as food, and are food for fish and waterfowl. Benthic invertebrates include those that are retained on a 0.5 mm screen (macroinvertebrates) and smaller forms, such as nematodes (a class of roundworm) and harpacticoid copepods (order of copepods found in fresh and saltwater that are primarily benthic) called meiofauna. Some of these animals live on top of the substratum (epifauna) and some within the substratum (infauna). Substrate type (rocks, pilings, sediment grain size, etc.) are the primary factors influencing benthic invertebrate communities, secondary factors include currents, wave action, predation, succession, and disturbance.

Over 180 benthic taxa (identified to lowest possible level, typically genus or species) have been recorded in the Hudson River, East River, and upper New York Harbor (PBS&J 1998). Common infaunal macroinvertebrates collected within the New York Harbor system include aquatic earthworms (oligochaetes), segmented worms (polychaetes, such as *Streblospio benedicti*), snails (gastropods), bivalves (*Mulina lateralis* and soft shell clam *Mya arenaria*), barnacles (*Balanus improvisus*), cumaceans, amphipods, isopods (*Edotea triloba*), crabs and shrimp (EEA, 1988; EA Engineering, *Science & Technology* 1990; New Jersey Department of Environmental Protection [NJDEP], 1984; *Princeton Aqua Science*, 1985a, 1985b; LMS, 1980a, 1984). Epifauna include hydrozoans, sea anemones (anthozoans *Diadumene leucolena*), flatworms, oligochaete worms (*Sabellaria vulgaris*), polychaetes, bivalve, barnacles (*Balanus improvisus*), gammaridean and caprellid amphipods, isopods, sea squirts (*Mogula manhattensis*) (EEA, 1988), sand shrimp (*Crangron septemspinosa*), hermit crabs (*Pagurus longicarpus*), rock crabs (*Cancer irroratus*), grass shrimp (*Palaemonetes spp*.), sand shrimp, blue crabs (*Callinectes sapidus*), mud dog whelks (*Illyanassa obsoletus*), mud crabs (xanthids), rick crab (*Cancer irroratus*), horshoe crabs (*Limulus polyphemus*), blue mussels (*Mylisis edulis*), softshell clams (*Mya arenaria*), and a sea slug (nudibranch) (EA Engineering, *Science & Technology*, 1990, Able et al., 1995; NYCDPR, 1994). A more detailed discussion of crustaceans is presented in the section on arthropods below.

Submerged Aquatic Vegetation (SAV) and Benthic Macroalgae

SAV are vascular plants that live or grow completely underwater, or just up to the water surface. They are found in shallow areas where light sufficient for photosynthesis can penetrate through the water column. Light penetration, along with salinity, temperature, substrate type, water currents, and wave action influence the distribution of SAV (Hurley, 1990). SAV provide prey with refuge from predators, increase availability of food, provide attachment area for plant epiphytes (a plant that anchors itself to the top of another plant), act as a nutrient buffer and sediment trap, and lower current flow and the associated erosion potential.

In the New York Harbor system, the limited light penetration restricts their distribution to shallow areas. Common species reported for this area include brown algae (*Fucus sp.)*, and green algae, such as sea lettuce (*Ulva lactua*), and *Enteromorpha sp*. (Perlmutter, 1971).

Marine Turtles

Four species of marine turtles are found in the waters surrounding New York City: loggerhead (*Caretta caretta*), green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), and Atlantic (Kemps) ridley (*Lepidochelys kempii*). Juvenile Kemps ridley and large loggerhead regularly enter the New York Harbor and bays in the summer and fall. The other two species may enter the higher salinity areas of the Harbor. Other turtles include the northern diamondback terrapin (*Malaclemys t.*

terrapin), an estuarine species that feeds and nests in salt marshes and adjacent upland (USFWS 1997).

Marine Mammals

The harbor seal (*Phoca vitulina*), although not abundant in the area, is the most common marine mammal observed in the New York Harbor. Harbor seals winter in the Harbor, and haul out onto islands in Jamaica Bay and Staten Island. Grey seals (*Halichoerus grypus*) are less common but are also observed in these areas. Occasionally individual whales, dolphins, and porpoises occur in the Harbor.

TERRESTRIAL RESOURCES

The terrestrial resources of New York City are primarily confined to the City's 26,000-acre network of green spaces managed by NYCDPR. Within this network of green space surrounded by human development are more than 8,000 acres of forest, wet meadow, coastal dune, grassy field, and other natural habitats (NYCDPR, 1994). The following sections provide a general description of the most common vegetation communities found within New York City, followed by a general description of the animals found in these habitats. A more specific description, as well as the scientific names for the plants within these communities, is found in the section describing the Representative Areas.

Terrestrial Habitats

Wetlands

The City contains both freshwater and tidal wetlands that provide important habitat for waterfowl and a variety of wildlife and aquatic species. The City contains approximately 2,000 acres of freshwater wetlands, much of it located on Staten Island. Examples of Staten Island freshwater wetlands include Mariner's Marsh, Graniteville Swamp, and Goethals Bridge Pond. The freshwater and tidal wetlands of Alley Pond Park, Queens, have been classified as significant coastal fish and wildlife habitat by NYSDEC. The open water areas of freshwater wetlands contain duckweed, watermeal, water lily, spadderdock, bladderworts, milfoils, and pondweeds. Emergent marsh areas contain arrow arum, cattails, water willow, decodon, blue flag, pickerelweed, water plantain, bulrush, smartweed, American three-square, swamp rose, and rose mallow. Shrub/scrub and forested wetlands contain buttonbush, spicebush, sweet pepper bush, alder, elderberry, highbush blueberry, catbrier, swamp azalea, red maple, sweet gum, pin oak, white ash, and black gum, along with herbaceous species, such as sensitive fern, cinnamon fern, skunk cabbage, and jewelweed (NYCDPR, 1994; Natural Resources Group [NRG], 1991a, 1991b). These wetlands are used by a variety of fish and wildlife species, including the State-threatened Northern harrier (hawk), which overwinters there.

Approximately 5,000 acres of salt marsh remain in New York City (NYCDPR, 1994). Salt marshes have three distinct zones: mud flat, low marsh, and high marsh. The mud flats are exposed at low tide, providing habitat for fiddler crabs, mud snails, and marine worms. Just beyond the mudflats, the low marsh is covered with stands of saltmarsh cordgrass (*Spartina alterniflora*) that get flooded twice a day at high tide. Next to the low marsh, the high marsh area is dominated by salt-meadow cord grass (*Spartina patens*), which is less tolerant of saltwater and gets flooded only a few times a month. Other plants found within the high marsh are black grass (*Juncus gerardii*), ditch grass (*Distichlis spicata*), spike grass, perennial salt-marsh aster, sea lavender, seaside goldenrod, and glasswort (*Salicornia sp.*). At the upland fringe of the high marsh are species such as marsh elder, groundsel tree, swamp rose mallow, sea rocket, and seaside goldenrod. *Phragmites* can be found on the upland fringe, as well as other areas of the marsh (NYCDPR, 1994 and 1995). Most of the City's tidal wetlands are

located in Jamaica Bay, and in the inlets and coves of northern Queens and southeastern Bronx, particularly Udall's Cove, Flushing Bay, Powell's Cove, Pugsley's Creek, the mouth of Westchester Creek, Alley Pond Park, and the mouths of the Bronx and Hutchinson Rivers. All of the tidal wetlands in Jamaica Bay are designated as a State Critical Environmental Area. Udall's Cove, a State significant coastal fish and wildlife habitat, is one of the last undeveloped tidal salt marshes in the northern Queens County and East River area.

Beaches, Dunes and Bluffs

New York City has over 500 miles of shoreline (NRG, 1987). Within this shoreline are beaches, dunes, and bluffs associated with the Atlantic coast, East River, Long Island Sound in the Bronx and Queens, and along southern Staten Island.

Beach grass, seaside goldenrod, and sea rockets grow on the dunes, along with thickets of bayberry, beach plum, cocklebur, and salt spray rose. Thickets of shrubs and small trees are also found near bluffs and the islands of Jamaica Bay. Grasslands are found primarily near the beaches and coastal areas, such as Breezy Point and the islands in Jamaica Bay, and in areas subject to frequent fires, such as Blue Heron Park on Staten Island, and serpentine soils in Latourette Park, Staten Island, and the thin soils of Pelham Bay Park in the Bronx (NYCDPR, 1994; NRG, 1991b).

Forests and Woodlands

Except for a small stand in the Hemlock Grove in the New York Botanical Garden, the woodlands of New York City are all second growth. Woodlands are found in the Bronx, Queens, Manhattan, and Staten Island. Large well developed woodlands occur in the central hills of Staten Island, near the New York Botanical Garden in the Bronx, and in Inwood Hill Park in Manhattan. In poorly drained soils, typical trees include sweet gum, red maple, silver maple, pin oak, blackgum, white ash, green ash, American sycamore, cottonwood, swamp white oak, American linden, and black willow. Understory shrubs in these areas include spicebush, sweet pepperbush, and silky dogwood and herbaceous species include false nettle, skunk cabbage, and marsh marigold. Drier woodlands, such as the oak-hickory forests that occupy well-drained areas that often occur on ridge tops, upper slopes, or south and west-facing slopes, are dominated by red, black, white and chestnut oaks, tulip trees, shagbark hickory, bitternut hickory, mockernut hickory, black birch and American beech. Understory species in the oak-hickory forests include mapleleaf viburnum, pinxter azalea, witch hazel, lowbush blueberry, and flowering dogwood. Herbaceous (plant with little or no woody tissue, flowers, herbs, etc.) woodland plants include blue-stemmed goldenrod, wild sarsparilla, black snakeroot, bloodroot, tall meadow rue, rattlesnake root, toothwort, and trout lily. Upland forest associations that occur on fertile, moist well-drained soils include oak-tulip stands (dominated by tulip tree, red maple, and red and black oaks), and beech-maple stands (dominated by sugar maple and American beech). Understory species found in these forests and woodlands include spicebush, shadblow, arrowwod, and blackhaw viburnum. Herbaceous species found with these associations include Canada mayflower, New York fern, lady fern, wild geranium, bloodroot, mayapple, and Solomon's seal. Successional forests (i.e., replacement of one vegetative community by another) found in cleared areas, abandoned fields or waste areas include pioneer species, such as black locust, black cherry, gray birch, American elm, sassafras, Norway maple, ailanthus (tree-of-heaven), white mulberry (*Morus alba*), and sycamore maple (NYCDPR, 1994; NRG, 1995b).

Meadows

Meadows of grasses and wildflowers are found throughout the New York City parks. The plants found within any particular meadow area depend on many factors, including soil characteristics such

as wetness. Common meadow plants observed in New York City include: Queen Anne's lace, ragweed, crabgrass, common evening primrose, mugwort, bull thistle, asters, butterfly weed, bellwort, moth mullein, wild strawberry; grasses such as little bluestem, switch grass, broom sedge, sesame grass, and beach grass; false heather, camphor weed, cattails, *Phragmites*, waterhorehound, rushes, and sedges (NYCDPR, 1994).

Terrestrial Life

Vertebrates

Birds

Table 3.D-2 lists birds observed in New York City. The following discussion provides a general description of the birds known to use the habitats found in and around New York City. Where possible, the description of the Representative Areas provided in subsequent sections presents a list of birds specific to each Representative Area.

The wetlands, open waters, and terrestrial habitats are used by numerous birds for breeding, feeding, overwintering, and resting habitat. Waterfowl use the New York City area during fall migration that peaks in November, and as wintering areas. Common migratory species include Atlantic brant, greater scaup, American black duck, canvasback, mallard, bufflehead, oldsquaw, mergansers, common goldeneye, and American wigeon (USFWS, 1997). Waterfowl overwintering in the waters off New York City include horned grebe, brant, red-breasted merganser, American widgeon, greater scaup, and bufflehead (NRG 1990a). Common waterfowl breeding in the New York City area include mallard, American black duck, and Canada goose. Waterfowl concentration areas are found in Jamaica Bay, Raritan/Sandy Hook Bays, the north shore bays of western Long Island, the Shrewsbury and Navesink Rivers, Staten Island shoreline of Raritan and New York Bays, the lower Hudson River, and the Kill Van Kull (USFWS, 1997).

Nearly 30 species of shorebirds regularly use and migrate through the New York Harbor area during the spring (March to June) and fall (July to November), feeding in the marshes, flats, and shallow water areas before continuing their migration. Abundant shorebirds include herring gull, black-backed gull, laughing gull, semipalmated sandpiper, semipalmated plover, sanderling, ruddy turnstone, black-bellied plover, red knot, dunlin, short-billed dowitcher, greater and lesser yellowlegs, and least sandpiper. Spotted sandpiper, willet, killdeer, piping plover, and American oystercatcher, and clapper rail breed in the New York Harbor area (NRG, 1990a and 1995a; USFWS, 1997). Jamaica Bay Wildlife Refuge and the tidal flats along Staten Island are commonly used foraging and staging areas. Breezy Point, located on Rockaway Point at the entrance to Rockaway Inlet supports large nesting populations of the endangered piping plover, least and common terns, and black skimmer. Other terns that nest in the New York Harbor include Forster's tern, gull-billed tern, and the Federally-listed roseate tern (USFWS, 1997).

Table 3.D-2
Birds Observed in New York City

Common Name	Scientific Name
Loons	
Red-throated loon	*Gavia stellata*
Common loon	*Gavia immer*
Grebes	
Pied-billed grebe	*Podilymbus podiceps*
Horned grebe	*Podiceps auritus*
Red-necked grebe	*Podiceps grisegena*
Gannet	
Northern gannet	*Morus bassanus*
Cormorants	
Double-crested cormorant	*Phalacrocorax auritus*
Great cormorant	*Phalacrocorax carbo*
Herons	
American bittern	*Botaurus lentiginosus*
Least bittern	*Ixobrychus exilis*
Great blue heron	*Ardea herodias*
Great egret	*Casmerodius albus*
Snowy egret	*Egretta thula*
Little blue heron	*Egretta caerulea*
Tricolored heron	*Egretta tricolor*
Cattle egret	*Bubulcus ibis*
Green heron	*Butorides striatus*
Black-crowned night-heron	*Nycticorax nycticorax*
Ibis & Spoonbill	
Glossy ibis	*Plegadis falcinellus*
Waterfowl	
Snow goose	*Chen caerulescens*
Brant	*Branta bernicla*
Canada goose	*Branta canadensis*
Mute swan	*Cygnus olor*
Tundra swan	*Olor columbianus*
Wood duck	*Aix sponsa*
Gadwall	*Anas strepera*
Eurasian wigeon	*Anas penelope*
American wigeon	*Anas americana*
American black duck	*Anas rubripes*
Mallard	*Anas platyrhynchos*
Blue-winged teal	*Anas discors*
Northern shoveler	*Anas clypeata*
Northern pintail	*Anas acuta*
Green-winged teal	*Anas crecca*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*
Ring-necked duck	*Aythya collaris*
Greater scaup	*Aythya marila*
Lesser scaup	*Aythya affinis*
Common eider	*Somateria mollissima*

Table 3.D-2 (continued)
Birds Observed in New York City

Common Name	Scientific Name
Surf scoter	*Melanitta perspicillata*
White-winged scoter	*Melanitta fusca*
Black scoter	*Melanitta nigra*
Oldsquaw	*Clangula hyemalis*
Bufflehead	*Bucephala al beola*
Common goldeneye	*Bucephala clangula*
Hooded merganser	*Lophodytes cucullatus*
Common merganser	*Mergus merganser*
Red-breasted merganser	*Mergus serrator*
Ruddy duck	*Oxyura jamaicensis*
Vulture	
American Black vulture	*Coragyps atratus*
Galliforms	
Ring-necked pheasant	*Phasianus colchicus*
Wild turkey	*Meleagris gallopavo*
Northern bobwhite	*Colinus virginianus*
Rails	
Clapper rail	*Rallus longirostris*
Virginia rail	*Rallus limicola*
Sora	*Porzana carolina*
Common moorhen	*Gallinwa chloropus*
American coot	*Fulica americana*
Hawks and Eagles	
Osprey	*Pandion haliaetus*
Bald eagle	*Haliaetus leucocephalus*
Northern harrier	*Circus cyaneus*
Sharp-shinned hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperii*
Northern goshawk	*Accipiter gentilis*
Red-shouldered hawk	*Buteo lineatus*
Broad-winged hawk	*Buteo platyperus*
Red-tailed hawk	*Buteo jamaiceusis*
Rough-legged hawk	*Buteo lagopus*
Golden eagle	*Aquila chrysuetos*
Falcons	
American kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine falcon	*Falco peregrinus*
Plovers	
Black-bellied plover	*Pluvialis squatarola*
American golden plover	*Pluvialis dominica*
Semipalmated plover	*Charadrius semipalmatus*
Piping plover	*Charadrius melodus*
Killdeer	*Charadrius vociferus*

Table 3.D-2 (continued)
Birds Observed in New York City

Common Name	Scientific Name
Oystercatcher, Stilt and Avocet	
American oystercatcher	*Haematopus palliatus*
American avocet	*Recurvirostra americana*
Sandpipers	
Greater yellowlegs	*Tringa melanoleuca*
Lesser yellowlegs	*Tringa flavipes*
Solitary sandpiper	*Tringa solitaria*
Willet	*Catoptrophorus semipalmatus*
Spotted sandpiper	*Actitis macularia*
Upland sandpiper	*Batramia longicauda*
Whimbrel	*Numenius phaeopus*
Hudsonian godwit	*Limosa haemastica*
Marbled godwit	*Limosa Fedoa*
Ruddy turnstone	*Arenaria interpres*
Red knot	*Calidris canutus*
Sanderling	*Calidris alba*
Semipalmated sandpiper	*Calidris pusilla*
Western sandpiper	*Calidris mauri*
Least sandpiper	*Calidris minutilla*
White-rumped sandpiper	*Calidris fuscicollis*
Baird's sandpiper	*Calidris bairdii*
Pectoral sandpiper	*Calidris melanotos*
Purple sandpiper	*Calidris maritima*
Dunlin	*Calidris alpina*
Curlew sandpiper	*Calidris ferruginea*
Stilt sandpiper	*Micropalama himatopus*
Buff-breasted sandpiper	*Tryngites subruficollis*
Short-billed dowitcher	*Limnodromus griseus*
Long-billed dowitcher	*Limnodromus scolopaceus*
Common snipe	*Capella gallinago*
American woodcock	*Philohela minor*
Wilson's phalarope	*Phalaropus tricolor*
Gulls	
Laughing gull	*Larus atricilla*
Little gull	*Larus minutus*
Black-headed gull	*Larus ridibundus*
Bonaparte's gull	*Larus philadelphia*
Ring-billed gull	*Larus delawarensis*
Herring gull	*Larus argentatus*
Iceland gull	*Larus glaucoides*
Lesser black-backed gull	*Laras fuscus*
Glaucous gull	*Larus hyperboreus*
Great black-backed gull	*Larus marinus*
Black-legged kittiwake	*Rissa tridactyla*

Table 3.D-2 (continued)
Birds Observed in New York City

Common Name	Scientific Name
Terns and Skimmer	
Gull-billed tern	*Gelochelidon nilotica*
Caspian tern	*Sterna caspia*
Royal tern	*Sterna maxima*
Sandwich tern	*Sterna sandvicensis*
Roseate tern	*Sterna dougallii*
Common tern	*Sterna hirundo*
Forster's tern	*Sterna forsetreri*
Least tern	*Sterna albifrous*
Black tern	*Chlidonias nigra*
Black skimmer	*Rynchopus nigra*
Pigeons and Doves	
Rock dove	*Columba livia*
Mourning dove	*Zenaida macroura*
Parrot	
Monk parakeet	*Myiopsittla monachus*
Cuckoos	
Black-billed cuckoo	*Coccyzus erythropthalmus*
Yellow-billed cuckoo	*Coccyzus americanas*
Owls	
Barn-owl	*Tyto aiba*
Eastern screech-owl	*Otus asio*
Great horned owl	*Bubo virginianus*
Snowy owl	*Nyctea scandiaca*
Barred owl	*Strix varia*
Long-eared owl	*Asio otus*
Short-eared owl	*Asio flammeus*
Northern saw-whet owl	*Aegolius acadicus*
Nightjars	
Common nighthawk	*Chordeiles minor*
Chuck-will's-widow	*Caprimulgus carolinensis*
Whip-poor-will	*Caprimulgus vociferus*
Swift	
Chimney swift	*Chaetura pelatgica*
Hummingbirds	
Ruby-throated hummingbird	*Archilochus colubris*
Kingfisher	
Belted kingfisher	*Megaceryle alcyon*
Woodpeckers	
Red-headed woodpecker	*Melanerpes erythrocephalus*
Red-bellied woodpecker	*Centurus carolinus*
Yellow-bellied sapsucker	*Sphryapicus varius*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*
Northern flicker	*Colaptes auratus*
Pileated woodpecker	*Dryocopus pileatus*

Table 3.D-2 (continued)
Birds Observed in New York City

Common Name	Scientific Name
Flycatchers	
Olive-sided flycatcher	*Nuttallornis borealis*
Eastern wood-pewee	*Contopus virens*
Yellow-bellied flycatcher	*Empidonax flaviventris*
Acadian flycatcher	*Empidonax virescens*
Alder flycatcher	*Empidonax alnorum*
Willow flycatcher	*Empidonax traillii*
Least flycatcher	*Empidonax minimus*
Eastern phoebe	*Sayornis phoebe*
Geat crested flycatcher	*Mylarchus criniths*
Eastern kingbird	*Tyrannus tyrannus*
Vireos	
White-eyed vireo	*Vireo griseus*
Blue-headed vireo	*Vireo solitarius*
Yellow-throated vireo	*Vireo flavifrons*
Warbling vireo	*Vireo gilvus*
Philadelphia vireo	*Vireo philadephicus*
Red-eyed vireo	*Vireo olivaceus*
Lark	
Horned lark	*Eremophila alpestris*
Swallows	
Purple martin	*Progne subis*
Tree swallow	*Iridoprocne bicolor*
Northern rough-winged swallow	*Stelgidopteryx ruficollis*
Bank swallow	*Riparia riparia*
Cliff swallow	*Petrochelidon pyrrhonota*
Barn swallow	*Hirundo rustica*
Jay and Crows	
Blue jay	*Cyanocitta cristata*
American crow	*Corvus brachyrhynchos*
Fish crow	*Corvus ossifragus*
Titmice	
Black-capped chickadee	*Parus atricapillus*
Tufted titmouse	*Parus bicolor*
Nuthatches	
Red-breasted nuthatch	*Sitta canadensis*
White-breasted nuthatch	*Sitta carolinensis*
Creeper	
Brown creeper	*Certhia familiaris*
Wrens	
Carolina wren	*Thryothorus ludovicianus*
House wren	*Troglodytes aedoh*
Winter wren	*Troglodytes troglodytes*
Marsh wren	*Cistothorus platensis*

Table 3.D-2 (continued)
Birds Observed in New York City

Common Name	Scientific Name
Kinglets	
Golden-crowned kinglet	*Regulus satrapa*
Ruby-crowned kinglet	*Regulus calendula*
Gnatcatcher	
Blue-gray gnatcatcher	*Polloptila Caerulea*
Thrushes	
Eastern bluebird	*Cialia sialis*
Veery	*Catharus fuscescens*
Gray-cheeked thrush	*Catharus minimus*
Bicknell's thrush	
Swainson's thrush	*Catharus ustulatus*
Hermit thrush	*Catharus guttatus*
Wood thrush	*Hylociachla mustelina*
American robin	*Turdus migratorius*
Mimids	
Gray catbird	*Dumetella carolinensis*
Northern mockingbird	*Mimus polyglottos*
Brown thrasher	*Toxostoma rufum*
Starling	
European starling	*Sturnus vulgaris*
Wagtail and Pipit	
American pipit	*Anthus spinolette*
Waxwing	
Cedar waxwing	*Bombycilla cedrorum*
Warblers	
Blue-winged warbler	*Vermivora pinus*
Golden-winged warbler	*Vermivora chrysaptera*
Tennessee warbler	*Vermivora peregrina*
Orange-crowned warbler	*Vermivora celata*
Nashville warbler	*Vermivora ruficapilla*
Northern parula	*Parula americana*
Yellow warbler	*Dendroica petechia*
Chestnut-sided warbler	*Dendroica pensulvanica*
Magnolia warbler	*Dendroica magnolia*
Cape May warbler	*Dendroica tigrina*
Black-throated blue warbler	*Dendroica caerulescens*
Yellow-rumped ('Myrtle') warbler	*Dendroica coronata*
Black-throated green warbler	*Dendroica virens*
Blackburnian warbler	*Dendroica fusca*
Yellow-throated warbler	*Dendroica dominica*
Pine warbler	*Dendroica pinus*
Prairie warbler	*Dendroica discolor*
Palm warbler	*Dendroica palmarum*
Bay-breasted warbler	*Dendroica castanea*
Blackpoll warbler	*Dendroica striata*
Cerulean warbler	*Dendroica cerulea*

Table 3.D-2 (continued)
Birds Observed in New York City

Common Name	Scientific Name
Black-and-white warbler	*Mniotilta varia*
American redstart	*Sexophaga ruticilla*
Worm-eating warbler	*Helmitheros vermivorus*
Ovenbird	*Seiurus aurocapillus*
Northern waterthrush	*Seiurus noveboracensis*
Louisiana waterthrush	*Seiurus motacilla*
Kentucky warbler	*Oporornis formosus*
Connecticut warbler	*Oporornis agilis*
Mourning warbler	*Oporornis philadelphia*
Common yellowthroat	*Geothlypis trichas*
Hooded warbler	*Wilsonia citrina*
Wilson's warbler	*Wilsonia pusilla*
Canada warbler	*Wilsonia canadensis*
Yellow-breasted chat	*Icteria virens*
Tanagers	
Summer tanager	*Piranga rubra*
Scarlet tanager	*Piranga olivacea*
Sparrows	
Eastern towhee	*Pipilo erythrophthalmus*
American tree sparrow	*Spizella arborea*
Chipping sparrow	*Spizella passerina*
Field sparrow	*Spizella pusilla*
Vesper sparrow	*Pooecetes gramineus*
Lark sparrow	*Chondestes grammacus*
Savannah sparrow	*Passerculus sandwichensis*
Baird's sparrow	*Ammodraus bairdii*
Grasshopper sparrow	*Ammodramus savannarum*
Le Conte's sparrow	*Passernerbulus caudacutus*
Nelson's sharp-tailed sparrow	*Ammospiza caudacuta*
Saltmarsh sharp-tailed sparrow	
Seaside sparrow	*Ammospiza maritima*
Fox sparrow	*Passerella iliaca*
Song sparrow	*Melospiza melodia*
Lincoln's sparrow	*Melospiza lincolnii*
Swamp sparrow	*Melospiza georgiana*
White-throated sparrow	*Zonotrichia albicollis*
White-crowned sparrow	*Zonotrichia leucophrys*
Dark-eyed junco	*Junco hyemalis*
Lapland longspur	*Calcarius lapponicus*
Snow bunting	*Plectrophenax nivalis*
Grosbeaks and Finches	
Northern cardinal	*Cardinalis cardinalis*
Rose-breasted grosbeak	*Pheucticus ludovicianus*
Blue grosbeak	*Guiraca caerulea*

Table 3.D-2 (continued)
Birds Observed in New York City

Common Name	Scientific Name
Indigo bunting	*Paserina cyanea*
Evening grosbeak	*Hesperiphona vespertina*
Purple finch	*Carpodacus purpureus*
House finch	*Carpodacus mexicanus*
Red crossbill	*Loxia curvirostra*
White-winged crossbill	*Loxia Leucoptera*
Common redpoll	*Carduelis flammea*
Pine siskin	*Carduelis pinus*
American goldfinch	*Carduelis tristis*
Blackbirds	
Bobolink	*Dolichonyx oryzivorus*
Red-winged blackbird	*Agelaius phoehiceus*
Eastern meadowlark	*Sturnella magna*
Rusty blackbird	*Euphagus carolinus*
Common grackle	*Quiscalus quiscula*
Boat-tailed grackle	*Quiscaluis major*
Brown-headed cowbird	*Molothrus ater*
Orchard oriole	*Icterus sparius*
Baltimore oriole	*Icterus galbula*
Weaver	
House sparrow	*Passer domesticus*

Source: New York City Audubon Society (2000).

Long-legged wading birds (herons, egrets, and ibises) form regionally significant colonies in the Arthur Kill and Kill van Kull (the Harbor Herons Complex), and on Hoffman Island in lower New York Bay, North and South Brother Islands in the East River, some of the small marsh islands in Jamaica Bay, and Huckleberry Island in the Long Island Sound Narrows. Abundant wading birds include great blue heron, little blue heron, tricolored heron, black-crowned night-heron, green heron, American bittern, snowy egret, glossy ibis, cattle egret, and great egret (NYCDPR, 1994; 1995, USFWS, 1997).

Raptors, such as northern harrier, osprey, common barn owl, and peregrine falcon breed in the New York City area. Overwintering species include northern harrier, rough-legged hawk, American kestrel, common barn owl, short-eared owl, long-eared owl, and peregrine falcon. Floyd Bennett Field in the Gateway National Recreational Area and Jamaica Bay are important raptor wintering grounds. Commonly observed raptors migrating through the area include American kestrel and sharp-shinned hawk, as well as merlin, northern harrier, and osprey (NRG, 1990a; USFWS, 1997). Other raptors observed in New York City parks include red-tailed hawks and great horned owls (NYCDPR, 1994; NRG, 1995b).

Many songbirds migrate through the New York City area, and about 172 species are believed to breed in the City. The large number of breeding songbirds can be attributed to the diversity of habitats as well as a mixing of northern and southern species in the New York City area. Song birds known to breed in New York City include: song sparrow, American robin, gray catbird, yellow warbler, red-winged blackbird, marsh wren, sharp-tailed and seaside sparrows, brown-headed cowbird black-capped chickadee, tufted titmouse, yellow-shafted flicker, American redstart, and blue winged

warbler (NRG 1991b, USFWS 1997). Grassland species known to breed at Floyd Bennett Field include: grasshopper sparrow, savannah sparrow, and bobolink (USFWS 1997). Other birds known to occur in New York City parks include American goldfinch, ring-necked pheasant, eastern meadowlark, bobolink, northern oriole, white-breasted nuthatch, yellow-bellied flycatcher, great crested flycatcher, hermit thrush, wood thrush, rufous-sided towhee; warblers such as chestnut-sided, hooded, bay-breasted, Wilson's, and Cape May; brown thrasher, ovenbird, American woodcock, northern cardinal, red-bellied woodpecker, downy woodpecker, wood peewee, red-eyed vireo, and scarlet tanager (NRG, 1991b, 1995b; NYCDPR, 1994).

Amphibians and Reptiles

Amphibians and reptiles are restricted to pockets of remaining terrestrial and freshwater habitats. Examples include redback salamander (*Plethodon cinereus*), spotted salamander (*Ambystoma maculatum*), Fowler's toad (*Bufo woodhousii fowleri)*, northern spring peeper (*Pseudacris c. crucifer*), green frog (*Rana clamitans*), bullfrog (*Rana catesbeiana*), wood frog (*Rana sylvatica*), snapping turtle (*Chelydra serpentina*), eastern painted turtle (*Chrysemys p. pictas*), spotted turtle (*Clemmys guttata*), wood turtle (*Clemmys insculpta*), box turtle (*Terrapene carolina carolina*), northern brown snake (*Storeria d. dekayi*), and eastern garter snake (*Thamnnophis s. sirtalis)* (NYCDPR, 1994; NRG, 1995b; USFWS, 1997).

Mammals

As is the case for terrestrial reptiles and amphibians, terrestrial mammals are limited to pockets of undeveloped areas that provide suitable habitat. Common small animals are those adapted to human disturbance. These include: meadow vole (*Microtus pennsylvanicus*), cottontail rabbit (Sylvilagus floridanus), gray squirrel (*Sciurus carolenensis*), raccoon (*Procyon lotor*), muskrat (*Ondatra zibethicus*), opossum (*Didelphis virginiana*), white-footed mouse (*Peromyscus leucopus*), and eastern chipmunk (*Tamais striatus*). Introduced species include the house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), and feral dogs (*Canis sp.*) and cats (*Felis sylvestris*) (USFWS 1997). Short-tail shrew (*Blarina brevicauda*) and southern flying squirrel (*Glaucomys sabrinus*) also occur in New York City parks (NYCDPR, 1994; NRG, 1995b). Bats that migrate through this area include little brown bat (*Myotis lucifugus*), silver-haired bat (*Lasionycteris noctivans*), red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*). Large mammals (e.g., deer, bears) are absent from New York City (USFWS, 1997).

Invertebrates

This section provides an overview of invertebrate life forms, some of which are morphologically similar and exhibit similar characteristics to mosquitoes. Some of these organisms may also be exposed during some time in their life cycles to adulticides under the proposed *Adult Mosquito Control Programs*. Therefore, it is important to understand how these other groups of organisms relate to insects other than mosquitoes.

Diversity of Life

There are over 5 million described species of animals? approximately 5 percent are vertebrates (have a backbone). There are five classes of vertebrates–mammals, birds, reptiles, amphibians, and fish. The other approximately 95 percent of animals are invertebrates (do not have a backbone). Commonly known invertebrates include, among other groups, arthropods (e.g., insects—the largest group with approximately 1 million species, spiders, crustaceans), molluscs (e.g., gastropods—snails; bivalves—clams; cephalopods—octopus), annelids (e.g., earthworms), and cnidarians (e.g., sea jellies, corals, sea anemones). To demonstrate the diversity of species in just one of these groups, there are more

species of molluscs than all of the species of vertebrates combined. In addition, approximately 85 percent of all animals belong to the invertebrate group of arthropods—joint-legged animals (Ruppert et al., 1994). Since arthropods other than mosquitoes may be exposed to the insecticides that would be applied under the *Adult Mosquito Control Programs*, it is important to understand the life histories and relative characteristics of these other groups of organisms.

Taxonomy

Organisms (i.e., plants and animals) are classified in an ordered system that indicates the natural relationships between species. This system—taxonomy—divides similar species into groups or categories. When presenting a discussion about the diversity of life, particularly insects, it is important to describe how living organisms are classified in the taxonomic classification system. The taxonomic classification of various groups of insects demonstrates the morphological (i.e., form and structure of an organism) and physiological similarities between species. The general order in which species are classified is (in hierarchal order): Kingdom, Phylum, Class, Order, Family, Genus, and Species. Species in the same genus are more closely related and more alike than species in the same family. For example, the taxonomic classification of a human is Phylum Chordata, Class Mammalia, Order Primate, Family Hominidae, Genus Homo, and Species sapiens. Until around 30 years ago, biologists only recognized two kingdoms—plant and animal. Today, living things are grouped into a five-kingdom classification system: Plantae, Animalia, Monera (bacteria), Protista (algae, protozoa, slime molds, and water molds), and Fungi.

Approximately 32 phyla of animals exist today. Some of the phyla in the kingdom Animalia include Porifera (sponges); Coelenterata (sea anemones, corals, and sea jellies), Platyhelminthes (flatworms and tapeworms), Annelida (leeches and earthworms), Mollusca (octopus, snails, nautilus, clams, and oysters), Arthropoda (crustaceans, insects, arachnids, millipedes, mites, and ticks), Echinodermata (sea stars and sea urchins), and Chordata (vertebrates, birds, fish, amphibians, reptiles, and mammals).

Since the Environmental Impact Statement (EIS) considers the potential significant adverse impacts of applying adulticides to control mosquito-borne pathogens, and mosquitoes belong to a group of animals (insects) which are within a larger group of physiologically similar and related organisms (arthropods) the following section will discuss some of the organisms which belong to the Phylum Arthropoda and the major groups of arthropods. Mosquitoes will be the main target of the *Adult Mosquito Control Programs*; however, mosquitoes are joint-legged, segmented animals with exoskeletons—characteristics which are common to approximately 85 percent of animals on Earth (Ruppert et al., 1994).

Arthropods

The word arthropod means "joint-legged." Arthropods are joint-legged, segmented animals with an exoskeleton (usually thick and rigid) made of chitin. The material in the exoskeleton that makes it so strong is called sclerotin. An example of the strength of this material is evidenced in the wood-boring beetle, which can bite through sheets of lead, silver, copper, or zinc. This means their mandibles, or jaws, are stronger than these substances. Arthropods include animals such as insects, spiders, centipedes, millipedes, and crustaceans. There are millions of species of arthropods, making this the most diverse and abundant group of organisms on Earth.

Characteristics of Arthropods

This section provides a brief overview of the three major groups of arthropods—crustaceans, spiders, and insects. Most arthropods have separate sexes. Fertilization is internal in terrestrial forms, but may

be external in aquatic species. Arthropods inhabit nearly every environment on Earth—freshwater, marine, and terrestrial.

Arthropod body types vary significantly. Some of the ways in which these three groups of arthropods differ include number of legs, whether or not they have antennae, number of body parts, whether or not they have wings, type (e.g., simple, compound) of wing, and number of eyes.

Crustaceans. The Class Crustacea—approximately 26,000 species—includes primarily aquatic organisms such as crabs, shrimp, and lobsters. Benthic invertebrates were previously discussed under "Aquatic Resources." Crabs (e.g., blue crabs, spider crabs) and lobsters are in the same Order (Decapoda). Crustaceans are covered by a continuous shield called a carapace. Most species are scavengers, but some are carnivorous and some are herbivorous. Many are economically important (e.g., lobsters, blue crab, shrimp) and serve as important links in marine food chains.

The two largest classes of Crustaceans include Copepods and Isopods. There are approximately 8,500 species of Copepods, mostly marine, many freshwater, and a few species that live in moss, soil-water films, and leaf litter. Marine copepods exist in enormous numbers. They are usually the most abundant and common group of organisms found in a plankton sample (e.g., free-floating, generally microscopic plants and animals). Most copepods feed on phytoplankton (i.e., plant plankton), making them the principal link between phytoplankton and higher levels of the food chain in many marine ecosystems. Copepods—approximately 0.04 inches to 0.20 inches—are the major component of the diet of many marine species.

Isopods, with approximately 4,000 species, are the second largest order of crustaceans. This order consists of an abundant group of marine species. Also included in this order are a considerable number of freshwater and terrestrial forms (e.g., pill bugs and sow bugs commonly found in leaf litter).

Spiders, Ticks, and Mites. The Class Arachnida—approximately 35,000 species worldwide, of which approximately 3,000 are located within North America—includes spiders, daddy-long-legs, ticks, and mites. Most spiders are carnivorous; some also eat plant juices. Most spiders are also venomous, but they are not usually harmful to humans. Spiders have chelicerae, which are two appendages used to capture prey. The majority of species in this class other than spiders suck mammalian blood, and some transmit diseases to humans (e.g., Lyme disease transmitted by deer ticks). Most arachnids are terrestrial, living on or near the ground; some live indoors (e.g., in homes and barns) and on the water.

Spiders lay eggs in a silken cocoon, hatch as larva, molt and leave the cocoon as a nymph, then undergo approximately four to 20 molts before maturing into adults. Young spiderlings are often cannibalistic.

Insects

Insects are in the Kingdom Animalia, Phylum Arthropoda, Class Insecta. There are many subclasses and suborders in which groups of similar insects are placed. Depending on the reference, there are between 26 and 32 orders of insects. The reason for this is some texts have merged one or more orders with similar species, while others have separated these orders. The City's open space and developed areas provide habitat for numerous terrestrial invertebrates including mosquitoes, butterflies, moths, dragonflies, mayflies, midges, blackflies, true bugs (e.g., waterstriders), beetles, and other insects, as well as spiders, ticks and crustaceans.

Because the adulticides evaluated in this EIS target insects, the following sections describe the insects that occur, or may occur, in the New York City region. Table 3.D-3 indicates the approximately 28 orders of insects and the approximate number of species grouped in each order, worldwide and in North America. Representatives of most of these orders occur in New York City. There are too many insect species for this document to discuss their diversity beyond classifying the various insect orders and providing some examples to relate this discussion to the impact of insecticide exposure on non-target organisms.

According to Ruppert et al. (1994), "Insects are the most successful animals on Earth. Evolutionary success can be measured in a number of ways, the number of species the group contains and the extent of their geographical distribution are significant and easy criteria for measuring success. Success is usually attributed to certain adaptive features that evolved in the ancestral members of the group. These features permitted an adaptive radiation of species colonizing many different habitats and filling new niches. The great success of insects might, therefore, be attributed to the evolution of five significant features: a waxy epicuticle, reducing desiccation (i.e., drying up); wings, enhancing access to food and other resources, as well as helping in evading predators; wing folding at rest, permitting utilization of confined microhabitats; a resistant egg shell, permitting exposure to more extreme environmental conditions; and a development that includes a larva, permitting the juvenile insect to utilize different resources than the adult."

Since insects are the largest group of arthropods, the following section provides an expanded discussion on these organisms. Insects are hexapods—they have six legs. Most insects have three body parts—head, thorax, and abdomen—two pairs of wings (attached to the thorax), two antennae, and two eyes. There are three times more insect species than any other group of animals. Therefore, it is the largest group of animals on Earth.

Table 3.D-3 below lists the various insect orders within the Class Insecta, an example(s) for each, the average size (length) of insects in that order, and the approximate number of species worldwide and in North America (NA). Estimates of the number of species in New York are not readily available.

Insects that are wingless are called Apterygotes (e.g., springtails, silverfish). Winged insects are called Pterygotes. Wingless insects typically live hidden in soil, under bark, and humus beneath rocks, rotting logs, or in tree trunk crevices. A bristle tail—a wingless insect from the Devonian period approximately 400 million years ago—is the earliest known fossil insect. Winged forms appeared later. There are two types of Pterygotes: insects incapable of flexing or folding their wings (Paleopteous) and insects capable of flexing or folding their wings (Neopterous). Some Paleopterous insects include mayflies, and dragonflies. Some Neopterous insects include beetles, earwigs, flies, mosquitoes, true bugs, aphids, cicadas, leafhoppers, ants, bees, wasps, termites, moths, butterflies, grasshoppers, crickets, roaches, mantids, walking sticks, stoneflies, thrips, and caddisflies (Ruppert et al., 1994).

Life Cycle, Habitat and Activity Patterns, Reproduction. Depending on the species, insects can go through different stages within their life cycles—egg, larva, pupa, and adult for those going through complete metamorphosis (e.g., mosquitoes, beetles), and egg, nymph, and adult for those going through incomplete metamorphosis (e.g., lice, termites). Unlike the larval stage of insects undergoing complete metamorphosis, the nymphs look like smaller versions of the adults but without wings or reproductive organs. For some insects, such as dragonflies, mayflies, stoneflies, blackflies, midges, craneflies, and mosquitoes, the larval or nymph stage is aquatic and has different habitat requirements from the terrestrial adult stage. For other insects, such as butterflies and moths, the various life stages

(egg, larva or caterpillar, pupa, and adult) are entirely terrestrial but may also have different requirements, such as a preferred food source.

Table 3.D-3
Insect Orders

Order	Example(s)	Average Size (Length)	Approx. No. of Species	
			Worldwide	North America
Anoplura	Sucking lice	0.25”	486	62
Coleoptera	Beetles	0.06”-5.1” (lg. tropical sp.)	350,000	30,000
Collembola	Springtails (wingless)	0.06”-0.25”	2,000	315
Dermaptera	Earwigs (some sp. wingless)	0.75”-1.4”	<1,000	20
Diptera	Flies, mosquitoes	0.1”-0.7”	120,000	17,130
Diplura	Two-pronged bristletail (wingless, blind)	<0.25”	650	25
Ephemeroptera	Mayflies	0.3”-0.75”	2,100	550
Embioptera	Web spinners	0.4”	150	10
Hemiptera	True bugs	0.3”-0.8”	40,000	4,500
Homoptera	Aphids, leaf hoppers, cicadas	0.25”-1.5”	45,000	6,700
Hymenoptera	Bees, wasps, ants	0.5”-1.0”	130,000	17,300
Isoptera	Termites (winged and wingless)	0.2”-1.0”	2,100	41
Lepidoptera	Butterflies, moths	0.4”-10.6” (wingspan)	140,000	11,000
Mallophaga	Chewing lice, bird lice	0.05-0.12”	2,675	318
Mecoptera	Scorpionflies, earwigflies	0.6”-1.0”	400	85
Microcoryphia	Jumping bristletails (wingless)	0.6”	350	25
Neuroptera or Megaloptera	Antlions, lacewings, dobsonflies	0.4”-2.75”	4,670	338
Odonata	Dragonflies, damselflies	0.75”-5.0”	5,000	450
Orthoptera	Roaches, grasshoppers, crickets, mantids	1.5”	24,000	1,000
Protura	Minute white insect (wingless, eyeless)	0.06”	118	20
Plecoptera	Stone flies	1.0”-3.0”	1,600	400
Psocoptera	Book lice, bark lice	0.04”-0.12”	1,100	150
Siphonaptera	Fleas (wingless)	<0.25”	16,000	250
Strepsiptera	Minute, beetle-like (only males have wings)	0.13”	300	60
Thysanoptera	Thrips (winged and wingless)	0.5 mm-0.13”	6,600	606
Thysanura	Bristletails, silverfish (wingless)	0.5”	250	40
Trichoptera	Caddis flies	0.4”-0.8”	4,900	1,200
Zoraptera	Resemble termites (winged and wingless)	0.13”	22	2

Source: Milne, 1980; Swan et al., 1972.

The larvae or nymphs of most insects are adapted for feeding and growing, while the adults of most insects are primarily adapted for reproduction and dispersal. Larvae and adults exploit a larger fraction of the environment between them because adults acquire different food habits (e.g., Neuroptera [antlions], Coleoptera [beetles], Trichoptera [caddis flies], Lepidoptera [butterflies and moths], Diptera [flies and mosquitoes], Hymenoptera [ants and bees]). The larvae of many insect species have chewing mouth parts for eating plants (e.g., caterpillars). The adult stage of many insect species has mouth parts adapted for sipping nectar (e.g., butterflies) or piercing skin to suck blood (e.g., female mosquitoes). Reproduction methods of insects include:

- Viviparous? giving birth to live young (e.g., some aphid species);
- Oviparous? laying eggs;
- Ovoviviparous? giving birth to living young (larvae), after hatching of ova in the mother (e.g., some mayfly species); and
- Parthenogenesis? asexual reproduction; development of egg without fertilization (e.g., some bee species).

Insect Habitats. Insects occupy both terrestrial and aquatic habitats and may be primarily active at night (nocturnal) or during the day. As stated above, insects live in nearly every habitat on Earth, including, (as parasites), the bodies of other insect species in other animals and plants.

The largest order of insects on Earth is Coleoptera (i.e., beetles), with approximately 350,000 species. There are aquatic and terrestrial beetle species.

Nocturnal insects include species of moths, earwigs, mosquitoes, crickets, fireflies, katydids, and some caddisflies. Some insects that are out during the day and feed on nectar, pollen, and plants include bees, butterflies, true bugs (e.g., waterstriders), aphids, and grasshoppers. Some insects that are common underground or in leaf litter include species of beetles, springtails, bristletails, proturans, termites, and silverfish. Some insects that are common in aquatic environments in at least one stage of their life cycle include species of mayflies, true bugs, dragonflies and damselflies, stoneflies, caddisflies, mosquitoes, blackflies, midges, and beetles. Insects may overwinter as adults, pupa, or eggs (Palmer et al., 1975).

Some insects that are found indoors or are parasitic include lice, fleas, earwigs, and some true bugs.

Insect Development. Diapause is a kind of hibernation, when an insect's body temperature is greatly reduced and metabolic processes are nearly halted. Most temperate zone insects diapause in winter and are active only in spring and/or summer, when it is warm and food is plentiful. Termination of diapause is usually triggered by warmer temperatures and/or longer day lengths (Milne, 1980).

Social Organizations Among Insects. Colonial organization (i.e., social organization) has evolved in two orders of insects: Isoptera (i.e., termites) and Hymenoptera (i.e., ants, bees, and wasps). Individuals that live in colonies cannot survive outside of the colonies. The different types of individuals in a colony are called castes. The principal castes are male, female (or queen), and worker. Most of the approximately 20,000 species of bees are solitary species (i.e., there are more than 1,000 species of social wasps, 16,000 species of social ants, and 2,700 species of social termites) (*Science News*, 2001). Only approximately 380 bee species? 2 major groups? are social (Science News, 2001).

Table 3.D-4 below lists the insect orders and the likely habitat in which to find the organisms in that order. Also described is the insect's feeding behavior (e.g., carnivorous, herbivorous).

Mosquitoes

A detailed discussion of mosquito biology and life history is included in Chapter 1, "Description of the Proposed Action." The Order Diptera, which consists of flies and mosquitoes, is one of the four largest groups of living organisms. There are more species in this order than there are in the Subphylum Vertebrata (approximately 41,700 species). Many Dipterans consume decaying organic matter or are predacious, a large proportion are parasitic on other insects and other organisms, and many consume liquid food, such as nectar and other plant juices. Adult flies are normally present during the day.

Table 3.D-4
Insect Habitats/Feeding Behaviors

Order	Example(s)	Habitat/Feed
Anoplura	Sucking Lice	Parasitic on domestic animals; human body louse; vectors of typhus fever.
Coleoptera	Beetles	Vegetation, soil, stream banks; mostly herbivores, some predatory, some aquatic sp. Fireflies feed on earthworms and snails.
Collembola	Springtails (wingless)	Moist leaf mold, soil, rotten wood and surface of quiet waters; feed on decaying plant material.
Dermaptera	Earwigs (some sp. wingless)	Mostly coastal regions in moist locations (garbage cans); Omnivorous.
Diplura	Two-pronged bristletail (wingless, blind)	Damp humus, decomposing wood, and beneath stones and bark; herbivorous and carnivorous.
Diptera	Flies, mosquitoes	Many habitats (stream edges, organic matter); Larvae often damage vegetables and domestic animals; many disease vectors; many valuable pollinators.
Embioptera	Web spinners	In silken tunnels; females herbivorous, males carnivorous.
Ephemeroptera	Mayflies	Around water; naiads may live 4 yrs. (males swarm in flying mating dance); important in food chain, food for fish, dragonfly nymphs, and birds; seen in spring and summer.
Hemiptera	True bugs	Terrestrial and aquatic sp.; herbivorous, predaceous (most aquatic forms), some carnivorous.
Homoptera	Aphids, leaf hoppers, cicadas	Phytophagous; leaf hoppers and aphids transmit 2/3 of known viral plant diseases of economic importance; cicadas develop underground.
Hymenoptera	Bees, wasps, ants	On plants and in ground; some plant feeders, many gather pollen, most feed on nectar, many predators and parasites; some economic importance.
Isoptera	Termites (winged and wingless)	Logs, buildings, soil; some eat decaying matter in soil; some colonies have mill of workers; pests.
Lepidoptera	Butterflies, moths	Larvae usually herbivores; adults feed little or not at all; moths feed on nectar; economic/medical importance.
Mallophaga	Chewing lice, bird lice	Feed on scales, feathers, hair, skin, and dried blood around wounds.
Mecoptera	Scorpionflies, earwigflies	Larvae feed on dead insects and organic matter, many adults omnivorous; many predaceous.
Microcoryphia	Jumping bristletails (wingless)	Beneath bark, stones, and in leaf mold; feed on algae, lichens, moss.
Neuroptera or Megaloptera	Antlions, lacewings, dobsonflies	Near ponds, streams; predaceous larvae; adults eat little or nothing; beneficial insects; important food source for freshwater fish, control black fly larvae.
Odonata	Dragonflies, damselflies	Many near freshwater; predaceous; highly beneficial predators of mosquito larvae; import food chain species.
Orthoptera	Roaches, grasshoppers, crickets, mantids	Many outdoors on plants; infest buildings; largely herbivorous; some agricultural pests; omnivores.
Plecoptera	Stone flies	On or under stones; Omnivorous, carnivorous, feed on algae, some eat little or not at all. Important food for fish, frogs, turtles and dragonfly naiads.
Protura	Minute white insect (wingless,eyeless)	Damp humus and soil; feed on decayed organic matter.

Table 3.D-4 (continued)
Insect Habitats/Feeding Behaviors

Order	Example(s)	Habitat/Feed
Psocoptera	Book lice, bark lice	In dark, damp places, bark, foliage, in rotten wood outdoors, some species infest homes, warehouses, and museums.
Siphonaptera	Fleas (wingless)	Feed on blood of mammals and birds; vectors of bubonic plague; some are disease vectors; can become pests to domesticated dogs, cats.
Strepsiptera	Minute, beetle-like (only males have wings)	Under stones, debris; mostly parasitic on other insects, males non-parasitic; eat bristletails.
Thysanoptera	Thrips (winged and wingless)	Some tropical and sub tropical; feed on sap in flowers, some predaceous and feed on mites and smaller insects; pests in citrus groves.
Thysanura	Bristletails, silverfish (wingless)	Soil, rotting wood, decaying leaves on forest floor, wood and around stones; in houses eat flour, books and clothing.
Trichoptera	Caddis flies	Naiads build portable cases of various materials; stream and lake bottoms; adults are non-eaters.
Zoraptera	Resemble termites (winged and wingless)	Live in colonies under dead wood; feed on mites and smaller insects.

As discussed below, there is vast diversity among insect life. This EIS considers the potential significant adverse impacts from the application of adulticides. Since other arthropods may be exposed to these insecticides, it is important to understand how these other groups of organisms relate to insects such as mosquitoes.

Tables 3.D-5 through 3.D-7 list insect orders that are larger, of comparable size, or smaller than the size of the average mosquito. The tables also provide some pertinent information, such as life cycles, breeding cycles, and behavior.

Given the magnitude of insect species diversity described above, and to maintain focus on the issues related to potential significant adverse impacts of the *Adult Mosquito Control Programs*, this EIS will cover only a few groups of organisms considered indicative of life forms that could be exposed to adulticides and consequently be impacted by control activities. The following sections describe the habitats and life cycles for some of the insect groups listed in the preceding sections that may occur in the New York City region. A summary of the species and habitats are included in Chapter 1, "Description of the Proposed Action."

Lepidoptera (Butterflies and Moths)

Habitat. Butterflies and moths are found in a variety of habitats, including open fields, woods, thickets, gardens, salt marshes, and roadsides. Some butterfly and moth species commonly found (usually from March through early November) in Jamaica Bay Wildlife Refuge and along perimeter areas of Jamaica Bay (e.g., Floyd Bennett Field) and Crooke's Point (Staten Island), include several swallowtail species—cabbage white, orange sulphur, american lady, red admiral, and several skipper species (Tanacredi, 1995). The City provides habitat for a variety of other insects, including Butterflies and moths, honey (*Apis mellifera*) and bumble bees (*Bombinae*), dragonflies, mayflies and other aquatic insects in the wetland, ponds and streams, and numerous terrestrial insects, such as grasshoppers, leaf hoppers, praying mantis, and beetles that would commonly be found in woodland and meadow areas.

Table 3.D-5
Insects That Are Larger Than Mosquitoes (Greater Than 0.15")

Insect Order	Characteristics (life cycle, breeding cycle, behavior)
Coleoptera	Larvae pupate underground. Life cycle 2 to 3 years. Overwinter as adult or late larval stage (4 months). Bee flies parasitize larvae of tiger beetles. There are 20,000 species of ground beetles. They are nocturnal; live under rocks and debris in daytime. Fireflies pupate underground for 10 days. 1 to 4 generations/year; mate in spring or summer.
Dermaptera	Average 2 broods with 30 eggs. Lay eggs in soil. Life cycle is 80 days. Overwinter in egg and adult stages. Nocturnal.
Diplura	Live under stones, logs, and debris. Eggs deposited in moist soil, leaves and litter. Both herbivorous and carnivorous. Some molt 30 times.
Diptera	Mosquitoes: Lay egg rafts—100 to 300 eggs—usually on water. Eggs hatch in 1 to 5 days, pupate in 1 to 2 weeks. Live approximately 2 to 3 weeks. Many generations/year, the last overwintering as adults. Species are active during the day and/or night. Other dipterans (e.g., flies): lay eggs in soil or decaying matter. Larvae of most are maggots and live in soil, decaying material, or as parasites. Some valuable pollinators of flowers. Some adult females overwinter and emerge in spring.
Embioptera	Live underground or under leaves. Males attracted to light.
Ephemeroptera	Lay 80 to 300 eggs on aquatic plants, 3 broods in 2 years. Some emerge in October, lay eggs that hatch in August of the following year. Naiad may have 3 broods/2 years; some parthenogenesis; some ovoviviparous.
Hemiptera	Lay 60 to 300 eggs, 1 to 3 broods; life cycle is 6 to 8 weeks; Water striders fly at night; overwinter in any shelter. Nymphs; live on plants and animals and in water
Hymenoptra	Some life cycles are 30 days. Worker ants live 4 to 7 years. Queens live 13 to 15 years. Worker bees live only a few weeks to months. Many pupate in nest or underground. Adult males may result from parthenogenesis.
Isoptera	Lay eggs at 1 to 3 day intervals. Hatch in 30 to 90 days. Workers live 3 to 5 years, queens live much longer. Not as common as ants but live longer.
Lepidoptera	Butterfly life cycle is approximately 31 days, with 2 to 3 broods. Caterpillars feed on foliage. Butterflies generally active during the day. Most moths nocturnal. Some daytime moths tend to be more striking than crepuscular or nocturnal ones. Some moth caterpillars may feed 2 years before reaching full size. 1 to 3 generations/year. Adults usually fly May through October. Life span average 2 weeks.
Microcoryphia	Outdoor species found under rocks, logs, and in rotten wood. Indoor species live on foods and materials in kitchens, bathrooms, and elsewhere. Mature in 3 to 24 months. Life cycle up to 2 ½ years. Firebrats prefer dark places such as furnaces and heating pipes. Nymphs resemble adults.
Neuroptera	Dobsonfly and alderfly females lay several thousand eggs on rocks and branches. Some pupate underground. Life cycle is 2 to 3 years. These are used as bait by anglers. Lacewings and antlions take up to 2 years to develop into adult. They are predaceous on aphids, Homopterans, small larvae and eggs of insects, and mites.
Odonata	May roost in large numbers overnight. Lay 200 to 300 eggs. Some molt more than 10 times. One to 2 broods per year. Eggs laid in or close to water. Naiads emerge from water in May then transform into adults. Adults fly May through August. Life cycle 1 to 5 years. Overwinter (naiads) and hatch in spring. Some require 2 years to mature.
Orthoptera	Live outside and inside. Roaches mature in 6 months to 1 year. Adult female can live more than 1 year. Lay many egg capsules from which 12 nymphs hatch. Walkingsticks lay eggs in ground in fall and hatch in spring. Grasshoppers lay pods containing 20 to 70 eggs. Cannibalism is prevalent among cricket species and praying mantis. Praying mantis matures in late summer/early autumn.

Table 3.D-5 (continued)
Insects That Are Larger Than Mosquitoes (Greater Than 0.15")

Insect Order	Characteristics (life cycle, breeding cycle, behavior)
Plecoptera	Lay approximately 1,000 to several thousand eggs. Some daytime, some nocturnal. Important food for game fish, frogs, turtles, and dragonflies. Some adults emerge in fall and winter, some in summer; naiads.
Thysanura	Indoor (households) and outdoor (soil) species. Similar life cycle to Microcoryphia species. Eggs hatch in 2 to 8 weeks. Mature in 2 years in South and longer in North. Maximum life span is 30 months (warm climates).
Trichoptera	Lay 300 to 1,000 eggs. Life cycle is 1 year (most is larval stage). Adult stage is approximately one month. Caddisfly naiads are an important source of food for fish; large percentage of food for eastern brook trout. Some daytime species. Most are nocturnal and are attracted to lights.

Source: Ruppert et al., 1994; Swan et al., 1972; Milne, 1980; Elzinga, 1987; Alden et al., 1999.

Table 3.D-6
Insects That Are of Comparable Size to Mosquitoes (Approximately 0.15")

Insect Order	Characteristics (life cycle, behavior)
Homoptera	Life cycles 1 week to 17 years. Cicadas live underground for 13 to 17 years. Lay eggs from late May to early July in slits made in bark and twigs. Eggs hatch in 6 to 7 weeks. Leafhoppers hibernate as eggs in bark. Eggs hatch in spring. Two to four broods. Life cycle 2 weeks. Aphids produce 80 to 100 offspring by parthenogenesis; viviparous in summer, oviparous in fall. Live on average 1 month. Some have 9 to 17 broods.
Mecoptera	Overwinter as pupa (larva is grublike) in soil. Adults eat flies, dead insects, and fruit. Live in wooded areas. Larvae live underground.
Zoraptera	Live under bark in rotten wood.

Source: Ruppert et al., 1994; Swan et al., 1972; Milne, 1980; Elzinga, 1987; Alden et al., 1999.

Table 3.D-7
Insects That Are Smaller Than Mosquitoes (Less Than 0.15")

Insect Order	Characteristics (life cycle, behavior)
Anoplura	Life cycle less than 2 weeks. Lives on animals; nymphs; most lay eggs on host.
Collembola	Lives in ground litter and soil. Overwinter in egg state. Swarm in millions; occur almost everywhere.
Mallophaga	Hosts are chickens, turkeys, pigeons, peacocks. Eggs hatch in 4 to 5 days, several molts, mature in 2 to 4 weeks after hatching; mate within 3 days of maturity.
Protura	Found in damp soil and decaying vegetation.
Psocoptera	Lay eggs singly or in groups of six. Mature in 14 to 40 days. Six to 12 broods. Life cycle varies from 24 to 110 days. Parthenogenic reproduction live in buildings or outdoors.
Siphonaptera	Lay approximately 70-500 eggs. For some, the larval stage is more than 30 days, pupa stage is 25 to 34 days, and adult stage is approximately 1 year. For other species, the cycle from egg to adult is 15 to 65 days or 27 to 40 days. Vectors of the plague.
Strepsiptera	Female is wingless. Give birth to larvae. Some parasitic. Ovoviviparous.
Thysanoptera	One generation in two weeks. One or many generations per year. Some overwinter in egg stage. Breed year round in warm climates; some parthenogenesis.

Source: Ruppert et al., 1994; Swan et al., 1972; Milne, 1980; Elzinga, 1987; Alden et al., 1999.

The variety of habitats present in New York City attracts a large number of butterflies. About 100 species occur in and around New York City (USFWS, 1997). Table 3.D-8 lists 84 species of butterflies that have been observed within New York City. Good areas to observe butterflies include Jamaica Bay, Prospect Park in the butterfly garden, Snug Harbor on Staten Island, Pelham Bay Park, and Van Cortland Park (Riepe, 2000a). While numerous butterfly species use the open spaces within New York City, there are anywhere from 7 to 10 times more moths that have been observed in this area (Riepe 2000b). Butterfly species that migrate through the City include monarch, mourning cloak, red admiral, and question mark. Typically, the spring migration for these species is dispersed and not very noticeable. The fall migration to the south for monarchs starts in late August, peaks in mid- to late-September, and tapers off around mid-October. For all four of these species, the migration route within New York City appears to be concentrated along the coast and the barrier islands—migrating monarchs are more abundant around Rockaway (Riepe, 2000b). Table 3.D-9 presents a list of moth species observed in the Jamaica Bay Wildlife Refuge, many of which would be expected in other green spaces within the City.

Characteristics and Life Cycle. Butterflies may live as adults from one week to eight months; the average life span is two weeks. Most moths and butterflies have multiple generations per year. Many pupate overwinter (often underground), some as caterpillars, and some as eggs. The time from egg to adult for most moths and butterflies is normally four to six weeks. The eggs of most butterflies are usually laid on the plant that the hatched caterpillar will eat. Caterpillars usually feed on foliage. Most butterfly species are common from late spring (May) to early fall (October). Not all species of butterflies and moths appear in the same month, therefore they have different life cycles, breeding cycles, and habits. Most species appear for around one month, in the span from April through August. Mourning cloak butterflies are among the earliest to emerge—mid-March. The Cloudless Sulphur butterfly appears the latest in the season—September. Most moths are active at night, some during the day, and some at dawn and dusk only. Many live in meadows and roadsides. Adults usually feed on nectar and/or fermenting tree sap; some do not have mouth parts.

Some butterfly species migrate and some do not. In some cases, there are migratory and non-migratory individuals within the same species (e.g., monarch butterflies). The non-migrating species live in communal roosts, to which they return on a nightly basis. There are two possible explanations for how non-migrating butterflies and other insects who live in roosts (e.g., wet meadows, brushy fields, woodlands) relocate their communal habitats: 1) they mark their nighttime roosts with a pheromone (prevalent among aposematic insects—insects with natural colors and bright markings that warn predators that it is poisonous—such as monarchs and ladybird beetles); and 2) since they live for weeks or months, they learn by sight the locations of their communal sleeping sites. Some experiments have disproved the first hypothesis.

The following section describes the life cycle, behaviors, and habitats of monarch butterflies, short-lived insects, and social insects.

Monarchs

A discussion on monarch butterflies is provided below. Monarch butterflies are discussed because, in addition to being a very recognizable and well known species of butterfly, it also migrates through New York City. In the U.S., there are migrant and non-migrant (i.e., resident) populations. Migrants fly to and from Mexico, and resident populations normally exist in warm locations such as Florida and California.

Table 3.D-8
Butterflies Observed Within New York City

Common Name	Scientific Name
Acadian hairstreak	*Satyrium acadica*
American copper	*Lycaena phlaeas*
American lady	*Vanessa virginiensis*
American snout	*Libytheana carinenta*
Appalachian azure	*Celastrina neglectamajor*
Appalachian brown	*Satyrodes appalachia*
Aprodite fritillary	*Speyeria cybele*
Baltimore	*Euphydryas phaeton*
Banded hairstreak	*Satyrium calanus*
Birtgerb cloudywing	*Thorybes pylades*
Black dash	*Euphyes conspicua*
Black swallowtail	*Papilio polyxenes*
Broad-winged skipper	*Poanes viator*
Cabbage white	*Pieris rapae*
Checkered white	*Pieris rapae*
Clouded skipper	*Lerema accius*
Clouded sulphur	*Colias philodice*
Cloudless sulphur	*Phoebia sennae*
Cobweb skipper	*Hesperia metea*
Common buckeye	*Junonia coenia*
Common checkered skipper	*Pyrgus communis*
Common sootywing	*Pholisora catullus*
Common wood nymph	*Cercyonis pegala*
Compton tortoiseshell	*Nymphalis vau-album*
Coral hairstreak	*Satyrium titus*
Crossline skipper	*Polites origenes*
Delaware skipper	*Atrytone delaware*
Dreamy duskywing	*Erynnis icelus*
Dun skipper	*Euphyes vestris*
Dusted skipper	*Atrytonopsis hianna*
Eastern comma	*Polygonia comma*
Eastern tailed blue	*Everes comyntas*
Eastern tiger swallowtail	*Papilo glaucus*
European skipper	*Thymelicus lineola*
Fiery skipper	*Hylephila phyleus*
Gray hairstreak	*Strymon melinus*
Great spangled fritillary	*Speyeria cybele*
Hackberry emperor	*Asterocampa celtis*
Harvester	*Feniseca terquinius*
Hickory hairstrak	*Satyrium liparops*
Hoary edge	*Acholarus lyciades*
Hobomok Skipper	*Poanes hobomok*
Horace's duskywing	*Erynnis baptisiae*
Indian skipper	*Hesperia sassacus*
Juvenal's duskywing	*Erynis juvenalis*
Least skipper	*Ancyloxpha numitor*
Little glassywing	*Pompeius verna*
Little wood satyr	*Megiato cymela*
Little yellow	*Eurema lisa*

Table 3.D-8 (contined)
Butterflies Observed Within New York City

Common Name	Scientific Name
Long dash	*Polites mystic*
Long-tailed skipper	*Urtanus proteus*
Marine blue	*Leptotes marina*
Monarch	*Danaus plexippus*
Mourning cloak	*Nymphalis antiopa*
Northern broken dash	*Wallengrenia egeremet*
Northern cloudy wing	*Thorybes pylades*
Ocola skipper	*Panoquino ocola*
Orange sulphur	*Colias eurytheme*
Painted lady	*Vanessa cardui*
Pearl crescent	*Phyciodes tharos*
Peck's skipper	*Polites peckius*
Pipevine swallowtail	*Battus Philenor*
Question mark	*Polygonia interrogationis*
Red admiral	*Vanessa atalanta*
Red-banded hairstreak	*Alyopis cecrops*
Red-spotted purple	*Limenitis arthemis astyanax*
Sachem	*Atalopedes campestris*
Salt marsh skipper	*Panoquina panoquina*
Silver-spotted skipper	*Epargyreus clarus*
Silvery checkerspot	*Chlosyne nycteis*
Sleepy duskywing	*Erynnis brizio*
Small tortoiseshell	*Nymphalis urticae*
Southern (Northern) hairstreak	*Satyrium favorius ontario*
Spicebush swallowtail	*Papilio Troilus*
Spring azure	*Celastrina ladon*
Striped hairstreak	*Satyrium liparops*
Swarthy skipper	*Nastra lherminier*
Tawny emperor	*Asterocampa clyton*
Tawny-edged skipper	*Polites themistocles*
Variegated fritillary	*Euptoieta claudia*
Viceroy	*Limenitis archippus*
White m hairstreak	*Parrhasius m-album*
Wild indigo duskywing	*Erynnis baptisiae*
Zabulon skipper	*Poanes zabulon*

Sources: Ingraham et al. (undated), Cech (1993), North American Butterfly Association (2000).

Table 3.D-9
Moths Observed Within the Jamaica Bay Wildlife Refuge

Common Name	Scientific Name
Saturniidae (Giant Silkworm Moths and Emperors)	
Pink-striped oakworm moth	*Anisota virginiensis*
Polyphemus moth	*Antheraaea polyphemus*
Luna moth	*Actias luna*
Ailanthus silkmoth	*Samia cynthia*
Io moth	*Automeris io*
Promethea moth	*Callosamia promethea*
Cecropia moth	*Hyalophora cecropia*
Arctiidae (Tiger Moths and Allies)	
Yellow-collared scape moth	*Cisseps fulvicollis*
Virginia ctenucha	*Ctenucha virginica*
Banded tussock moth	*Halysidota tessellaris*
Milkweek tussock moth	*Euchaetes egle*
Pink-legged tiger moth	*Spilosoma latipennis*
Virginian tiger moth	*Spilosoma virginica*
Delicate cycnia or dogbane	*Cycnia tenera*
Salt marsh moth	*Estigmene acrea*
Isabella tiger moth	*Pyrrhartia isabella*
Virgin tiger moth	*Grammia virgo*
Arge moth	*Grammia arge*
Banded tiger moth	*Apantesis vittata*
Harnessed moth	*Apantesis phalerata*
Bella moth	*Utetheisa bella*
Giant leopard moth	*Ecpantheria scribonia*
Noctuidae	
Eight-spotted forester	*Alypia octomaculata*
American dagger moth	*Acronicta americana*
Lobelia dagger moth	*Acronicta lobeliae*
Afflicted dagger moth	*Acronicta afflicta*
Tesellate dart	*Euxoa tessellata*
Rubbed dart	*Euxoa detersa*
Old man dart	*Agrotis vetusta*
Venerable dart	*Agrotis venerabilis*
Ipsilon dart	*Agrotis ipsilon*
Flame-shouldered dart	*Ochropleura plecta*
Dingy cutworm moth	*Feltia jaculifera*
Bent-line dart	*Choephora fungorum*
Bristly cutworm moth	*Lacinipolia renigera*
Snow dart	*Euagrotis illapsa*
Greater black-letter dart	*Xestia dolosa*
Smith's dart	*Xestia smithii*
Rustic quaker	*Orthodes crenulata*
Many-lined wainscot	*Leucania multilinea*
Armyworm moth	*Pseudaletia unipuncta*
The Pink-streak	*Faronta rubripennis*
American bird's-wing moth	*Dypterygia rozmani*
Gray half-spot	*Nedra ramosula*
Copper underwing	*Amphipyra pyramidoides*

Table 3.D-9 (continued)
Moths Observed Within the Jamaica Bay Wildlife Refuge

Common Name	Scientific Name
Pink-shaded fern moth	*Callopistria mollissima*
The Wedgeling	*Galgula partita*
Pink star moth	*Derrima stellata*
Grateful midget	*Elaphria grata*
Beautiful wood-nymph	*Eudryas grata*
Pearly wood-nymph	*Eudryas unio*
Yellow-striped armyworm moth	*Spodoptera ornithogalli*
Orbed narrow-wing	*Magusa orbifera*
	Marathyssa sp.
Grapevine epimenis	*Psychomorpha epimenis*
Corn earworm moth	*Heliothis zea*
Tobacco budworm moth	*Heliothi virescens*
Primrose moth	*Schinia florida*
Goldenrod flower moth	*Schinia nundina*
Brown flower moth	*Schinia saturata*
Ragweed flower moth	*Schinia rivulosa*
Arcigera flower moth	*Schinia arcigea*
Black-bordered lemon	*Thiptera nigrofimbria*
Pink-barred lithacodia	*Lithacodia carneola*
Tufted bird-dropping moth	*Cerma cerintha*
Common spragueia	*Spragueia leo*
Small bird-dropping moth	*Tarachidia eratrioides*
Olive-shaded bird-dropping moth	*Tarachidia candefacta*
Large paectes	*Paectes abrostoloides*
Celery looper	*Anagrapha falcifera*
Common looper	*Autographa precationis*
Graphic moth	*Drasteria graphica*
Girlfriend underwing	*Catocala amica*
Wonderful underwing	*Catocala mira*
Little nymph	*Catocala micronympha*
Ultronia underwing	*Atocala ultronia*
Woody underwing	*Catocala grynea*
Praeclara underwing	*Catocala praeclara*
Judith's underwing	*Catocala judith*
Mourning underwing	*Catocala flebilis*
The Little Wife	*Catocala muliercula*
Bay or Badia underwing	*Catocala badia*
Sleepy or Pink underwing	*Catocala concumbens*
Herodias underwing	*Catocala herodias*
Ilia underwing	*Catocala ilia*
Locust underwing	*Euparthenos nubilis*
The Penitent	*Catocala piatrix*
The Sweetheart	*Catocala amatrix*
Mother underwing	*Catocala parta*
Darling underwing	*Catocala cara*
Lunate zale	*Zale lunata*
Colorful zale	*Zale mineria*
Green-dusted zale	*Zale aeruginosa*

Table 3.D-9 (continued)
Moths Observed Within the Jamaica Bay Wildlife Refuge

Common Name	Scientific Name
Horrid zale	*Zale horida*
Forage looper moth	*Caenurgina erechtea*
Double-lined doryodes	*Doryodes bistrialis*
Black-dotted brown	*Cissusa spadix*
Red-lined panopoda	*Panopoda rufimargo*
The Herald	*Scoliopteryx libatrix*
Baltimore bomolocha	*Bomolocha baltimoralis*
American idia	*Idia americalis*
Common idia	*Idia aemula*
Smoky idia	*Idia Scobialis*
Glossy black idia	*Idia lubricalis*
Variable zanclognatha	*Zanclognatha laevigata*
Chocolate renia	*Renia nemoralis*
	Noctua probole
Geometriddae (Inchworm Moths)	
Red-bordered emerald	*Nemoria lixaria*
Wavy-lined emerald	*Synchlora aerata*
Soft-lined wave	*Scopula inductata*
Common tan wave	*Pleuroprucha insulsaria*
Packard's wave	*Cyclophora packardi*
Chickweed geometer	*Haematopis grataria*
Drab brown wave	*Lobocleta ossularia*
Ferguson's scallop shell	*Hydria prunivorata*
Large lace-border	*Scopula limboundata*
Lesser maple spanworm moth	*Itame pustularia*
Pale beauty	*Campaea perlata*
Lesser grapevine looper moth	*Eulithis diversilineata*
The Gem	*Orthonama obstipata*
Bent-line carpet	*Orthonama centrostrigaria*
Dimorphic gray	*Tornos scolopacinarius*
Blurry chocolate angle	*Semiothisa transitaria*
Faint-spotted angle	*Semiothisa ocellinata*
One-spotted variant	*Hypagyrtis unipunctata*
The Saw-wing	*Euchlaena serrata*
Obtuse euchlaena	*Euchlaena obtusaria*
	Melanolophia sp
Common gray	*Anavitrinella pampinaria*
Small purplish gray	*Anacamptodes humeria*
Ruddy metarranthis	*Metarranthis duaria*
Oak besma	*Besma quercivoraria*
Juniper geometer	*Patalene olyzonaria*
Pepper-and-salt geometer	*Biston betularia*
Horned spanworm moth	*Nematocampa limbata*
Honest pero	*Pero honestaria*
Curve-toothed geometer	*Eutrapela clemataria*
Variable antepione	*Antepione thisoaria*
Yellow slant-line	*Tetracis crocallata*
Large maple spanworm	*Prochoerodes transversata*
Confused eusarca	*Eusarca confusaria*

Table 3.D-9 (continued)
Moths Observed Within the Jamaica Bay Wildlife Refuge

Common Name	Scientific Name
Pyralidae (Pyralid Moths)	
	Urola nivalis
Grape leaffolder moth	*Desmia funeralis*
Hawaiian beet webworm	*Spoladea recurvalis*
Spotted beet webworm	*Hymenia perspectalis*
Melonworm moth	*Diaphania hyalinata*
Celery webworm moth	*Nomophila nearctica*
Garden webworm moth	*Achyra rantalis*
Phlyctaenia coronata	*Phlyctaenia coronata*
Celery leaftier moth	*Udea rubigalis*
	Blepharomastix ranalis
	Pyrausta signatalis
	Crambus agitatellus
Crambus laqueatellus	*Crambus laqueatellus*
Vagabond crambus	*Agriphila vulgivagella*
	Tetralopha asperatella
Clover hayworm moth	*Hypsopygia costalis*
	Herculia olinalis
Lasiocampidae (Tent Caterpillar Moths)	
Large tolype	*Tolype velleda*
Eastern tent caterpillar moth	*Malacosoma americanum*
Forest tent caterpillar moth	*Malacosoma disstria*
Notodontidae (Prominents)	
Variable oakleaf caterpillar moth	*Lochmaeus manteo*
Spotted datana	*Datana perspicua*
Lymantriidae (Tussock Moths)	
White-marked tussock moth	*Orygia leucostigma*
Gypsy moth	*Lymantria dispar*
Thyatiridae (Thyatirid Moths)	
Tufted thyatirid	*Pseudothyatira cymatophoroides*
Drepanidae (Hooktip Moths)	
Arched hooktip	*Drepana arcuata*
Cossidae (Carpenterworm and Leopard Moths)	
Carpenterworm moth	*Prionoxystus robiniae*
Leopard moth	

Source: Tudor et al. (2000)

Habitat. Monarchs navigate by means of a "sun-compass" on fair days, and a "geomagnetic compass" on cloudy days (Waldbauer, 2000). Those that migrate south from southern Canada at the beginning or middle of the two-month migration period in late summer contain large quantities of body fat; these are likely to reach the Mexico overwintering sites. Those that leave toward the end of the migration period have only small quantities of fat and are far less likely to make it to Mexico. In the fall (September to October), monarchs migrate south from eastern, Midwest, and western States. In 1977, approximately 14.25 million monarchs were found overwintering on 3.7 acres approximately 100 miles west of Mexico City. There are approximately 12 overwintering sites in Mexico (Waldbauer, 2000; Tanacredi, 1995; Glassberg, 1993).

Characteristics and Life Cycle. Monarchs are bright orange and black, and their scales have a bitter taste (especially their wings). They are toxic to most predators, with the exception of some birds and small mammals. Cardenolides from the milkweed plants that monarchs ingest render the monarchs toxic. Their wings have the highest concentration of cardenolides of any body part. There are other butterflies that mimic the appearance of monarchs to avoid being eaten. In the Mexico overwintering sites, only two species of birds eat large numbers of the monarchs—the black-headed grosbeak and the black-backed oriole. The number of monarchs consumed by these birds and mice amounts to about 10 percent of the number overwintering in Mexico (Waldbauer, 2000). Reproductive diapause—a period of suspended development—occurs in the generation of North American monarchs that mature in late August and migrate to Mexico, stopping over in Texas and northern Mexico and loading up on fall flowering plants. This is induced by relatively short days and lower temperatures in late August. In this state, their eggs do not develop, nor do their reproductive organs; and their desire to mate is inhibited. Controlled experiments have shown monarchs to remain in reproductive diapause at day lengths of 11 hours or less. These migrating individuals probably live for 8 to 10 months, some for possibly 12 months. Once the reproductive organs have developed and mating has taken place, however, the life span for migrants is the same as that for nonmigrants. In late January or early February, when temperatures increase and days lengthen, reproductive diapause is terminated. At this time their eggs don't develop, and their desire to mate is still inhibited. By mid-March mating becomes intense.

Around the end of March/beginning of April, monarchs leave the fir forests in the mountains of Mexico and move northward to repopulate their breeding range in the eastern United States and Canada. Along the way they drink nectar from blossoms and lay eggs on newly emerging milkweed plants. Most of the males, which copulate as often as possible, will die along the way.

More than 400 developing eggs have been counted in the ovaries of one female monarch. The total amount laid is thought to probably be considerably less, a minimum of 100 or 200 eggs. However, Fred Urquhart—the Canadian monarch butterfly expert who developed a tagging device, the alartag, to track migrating monarchs—has written that 700 eggs are laid by females. In resident populations (in places such as southern California, Florida, southern Mexico, some islands of the Pacific Ocean, where breeding populations occur throughout the year), the adult female monarch life span is between 30 and 40 days (Urquhart, 1987).

Female monarchs spend most of their time seeking the nectar from plants (i.e., milkweed) that fuel their flight, and mating with males, which can occur as much as seven times in their adult life. The eggs are laid one at a time, glued to the underside of a leaf—one egg per leaf, and only a few eggs are laid on any one plant. In the warm weather of mid-summer, the embryo in the egg develops rapidly, and the larval caterpillar chews its way through the egg shell after only 3 or 4 days. During the cooler weather of early and late summer, embryonic development may require as much as 6 days. The newly hatched larva first eats the shell of its egg, but after that eats nothing but the leaves or occasionally the blossoms of the milkweed plant on which it was placed. The caterpillar takes about two weeks to complete its growth, molting its skin four times and increasing its weight by a factor of 2,000 or 3,000. The pupa hangs suspended on the underside of a tree limb, leaf, or on a house, for about two weeks as the transformation to a butterfly takes place. Monarchs that emerge earlier in the summer or in the spring do not enter diapause and commence reproductive activity within days of their emergence. Adults that emerge in late August are in reproductive diapause, will migrate to Mexico, and will not lay eggs until they move north from Mexico the following spring. There will be several generations during spring and summer, the number varying with the latitude (Urquhart, 1987).

The viability of monarchs is threatened by the loss of habitat in their wintering grounds in the mountains of Mexico. Logging activities are thriving outside of, and sometimes illegally inside of, some of the sanctuaries that protect these butterflies (*New York Times*, 2001).

(Ephemeroptera) Mayflies

Habitat. Each species of mayfly has its own preferred habitat. They are found in swift-flowing streams, slow-moving rivers, and ponds and lakes of all types.

Characteristics and Life Cycle. Some adult mayflies survive a week or more, but most live only a day or two, and a few for less than an hour. All spend most of their entire lives—in some species 364 days of the year—as aquatic nymphs. The nymphs molt many times (a primitive characteristic), in some species 20 or more times, and in a few as many as 50 times. When the nymphs of some species are fully grown, (some adults emerge underwater and some emerge after leaving the water), their skin immediately splits into the first adult stage. They molt into the second stage about a day later. The males and females swarm and mate, and the males die soon thereafter. The females lay their eggs on the water or crawl below the surface, and then also die soon thereafter. They have many predators–birds, other insect species (e.g., dragonflies), spiders, frogs, and fish (e.g., trout, bass, pickerel).

Odonata (Dragonflies and Damselflies)

Habitat and Feeding Behavior. Dragonflies and damselflies live near ponds, marshes, and rivers. These insects are predaceous—living by taking prey (Milne, 1980). In laboratory settings, some species have eaten 25 to 40 flies in two hours (Lamborn, 1890).

Characteristics and Life Cycle. The eggs of these insects are deposited in or close to water. Naiads are aquatic predators that capture insects, tadpoles, worms, and small fish. Some species may spend four years in the naiad stage. Naiads usually emerge from the water in May or June to transform into adults. Adults may be found flying from spring to fall (Milne, 1980). Adults of species that live in temperate zones live approximately one month, though some species can live six months as adults. Dragonflies and damselflies mate in flight.

The following two tables (Tables 3.D-10 and 3.D-11) list the dragonflies and damselflies that may occur in two New York City counties. Their breeding status is also included.

Hymenoptera (Bees)

Various types of insects in the order Hymenoptera include hornets, yellow jackets, wasps, and cicada killers. Most bees are solitary. However, honey bees and bumble bees—the only bees to produce and store honey—are social. Bees are important in the pollination of many plants, including commercial crops. Most female bees have a pollen-collecting apparatus; males do not collect pollen and lack this structure. Many bees are parasitic; these species usually do not have a pollen basket (Milne, 1980). Temperate colonies of social wasps and bumble bees die off in autumn and new colonies are founded in spring by mated queens that survive winter by diapausing in sheltered locations. Some bumble bee and wasp queens overwinter, some as individuals and some as groups (Waldbauer, 2000).

Communication

Pheromones—chemical secretions that influence the behavior or development of other members of the same species—are used by social and non-social insects to communicate. Pheromones are used to mark territories or trails (e.g., some ant species) or attract mates (e.g., some moth species). Other examples of communication between organisms, such as insects, include producing songs (e.g., crickets)

Table 3.D-10
Damselflies of New York City Area, Current Records of Occurrence and Breeding

Scientific Name	Common Name	Queens	Richmond
BROAD-WINGED DAMSELS			
Calopteryx maculata	Ebony Jewelwing		X
SPREADWINGS			
Scientific Name	**Common Name**	**Queens**	**Richmond**
Archilestes grandis	Great Spreadwing		U
Lestes congener	Spotted Spreadwing		H
Lestes eurinus	Amber-winged Spreadwing	U	H
Lestes forcipatus	Sweetflag Spreadwing	X	H
Lestes rectangularis	Slender Spreadwing	X	X
POND DAMSELS			
Scientific Name	**Common Name**	**Queens**	**Richmond**
Amphiagrion saucium	Eastern Red Damsel	X	H
Anomalagrion hastatum	Citrine Forktail	X	H
Argia apicalis	Blue-fronted Dancer		X
Argia fumipennis violacea	Violet Dancer		X
Enallagma aspersum	Azure Bluet	X	H
Enallagma civile	Familiar Bluet	X	X
Enallagma doubledayi	Atlantic Bluet		X
Enallagma durum	Big Bluet	X	
Enallagma geminatum	Skimming Bluet	X	X
Enallagma pictum	Scarlet Bluet		X
Enallagma signatum	Orange Bluet	X	X
Enallagma vesperum	Vesper Bluet	U	
Ischnura posita	Fragile Forktail	X	X
Ischnura ramburii	Rambur's Forktail	X	H
Ischnura verticalis	Eastern Forktail	X	X
Nehallenia gracilis	Sphagnum Sprite		X
Nehallenia irene	Sedge Sprite		H

Notes:
X = occurs and breeds; U = Unconfirmed; S = Stray, breeding possible but not regular if oc curring; H = Historical, may no longer occur.
No data for Manhattan, Bronx, Brooklyn.
Source : Walter, S., 1999. New York Area County Records, Damselflies.

Table 3.D-11
Dragonflies of New York City Area, Current Records of Occurrence and Breeding

DARNERS			
Scientific Name	**Common Name**	**Queens**	**Richmond**
Aeschna canadensis	Canada darner		H
Aeschna clepsydra	Mottled darner		H
Aeschna umbrosa	Shadow darner	X	H
Aeschna verticalis	Green-striped darner		H
Anax junius	Green darner	X	X
Anax longipes	Comet darner	S	H
Basiaeschna janata	Springtime darner		H
Epiaeschna heros	Swamp darner	X	X
CLUBTAILS			
Scientific Name	**Common Name**	**Queens**	**Richmond**
Arigomphus villosipes	Unicorn clubtail	S	X
Gomphus exilis	Lancet clubtail		H
Hagenius brevistylus	Dragonhunter		H
BASKETTAILS, EMERALDS			
Scientific Name	**Common Name**	**Queens**	**Richmond**
Dorocordulia libera	Racket-tailed emerald		H
Epitheca cynosura	Common baskettail		X
Epitheca princeps	Prince baskettail	X	
Somatochlora linearis	Mocha emerald		X
SKIMMERS			
Scientific Name	**Common Name**	**Queens**	**Richmond**
Celithemis elisa	Calico pennant	S	H
Celithemis eponina	Halloween pennant		X
Erythemis simplicicollis	Eastern pondhawk	X	X
Erythrodiplax berenice	Seaside dragonlet	X	X
Leucorrhinia intacta	Dot-tailed whiteface	X	H
Libellula axilena	Bar-winged skimmer	S	S
Libellula cyanea	Spangled skimmer		X
Libellula flavida	Yellow-sided skimmer		X
Libellula incesta	Slaty skimmer	S	X
Libellula luctuosa	Widow skimmer	X	X
Libellula lydia	Common whitetail	X	X
Libellula needhami	Needham's skimmer	X	S
Libellula pulchella	Twelve-spotted skimmer	X	X
Libellula quadrimaculata	Four-spotted skimmer		H
Libellula semifasciata	Painted skimmer	X	X
Libellula vibrans	Great Blue skimmer	X	X
Nannothemis bella	Elfin skimmer		X
Pachydiplax longipennis	Blue dasher	X	X
Pantala flavescens	Wandering glider	X	X
Pantala hymenaea	Spot-winged glider	X	X
Perithemis tenera	Eastern amberwing	X	X

Table 3.D-11 (continued)
Dragonflies of New York City Area, Current Records of Occurrence and Breeding

Scientific Name	Common Name	Queens	Richmond
Sympetrum janeae	Jane's meadowhawk	X	X
Sympetrum semicinctum	Band-winged meadowhawk		H
Sympetrum vicinum	Yellow-legged meadowhawk	X	X
Tramea carolina	Carolina saddlebags	X	X
Tramea lacerata	Black saddlebags	X	X
SPIKETAILS			
Scientific Name	**Common Name**	**Queens**	**Richmond**
Cordulegaster maculata	Twin-spotted spiketail		H
Didymops transversa	Stream cuiser		X

Notes:
X = occurs and breeds; U = Unconfirmed; S = Stray, breeding possible but not regular if occurring; H = Historical, may no longer occur.
Source: Walter, S., 1999. New York Area County Records, Dragonflies.

and the bioluminescent flashings of fireflies, which function as a sexual attractant (Ruppert et al., 1994).

Habitat. Yellow jackets overwinter in litter and soil. Hornets, which were brought to America in the mid-1800's, make hives out of wood pulp and saliva (i.e., paper) and nest in trees. Most species in this order live in open fields and gardens (e.g., honey bees, ichneumons), and some species live in woodland edges (e.g., carpenter ants and bees, hornets) (Alder et al., 1999).

Characteristics and Life Cycle. Honeybees were brought to America in the 17th century. They live in colonies with 20,000 to 80,000 individuals, all the offspring of one queen—the only member of the colony capable of reproducing, although in the absence of a queen, normally sterile workers can lay unfertilized eggs that will become drones (males). The colony includes a few hundred or a few thousand drones and nearly 50,000 workers, all of the latter sterile females. A scout, or worker that has been sent out to look for new sources of pollen and nectar, returns to the hive and upon returning to the hive, performs a waggle dance. The dance "conveys two crucial pieces of information, the distance to the new resource and the direction in which it lies." The longer the waggle run's duration, the greater the distance to the food source (Waldbauer, 2000).

Natural Predators

Ecology

Insects serve as prey (i.e., food) for insect predators, such as dragonflies and praying mantis, as well as spiders, reptiles, amphibians and insectivorous birds, such as warblers. Each of the five vertebrate groups contain predators of insects. Larger insects often eat smaller ones that they are able to handle. Some insects also eat other invertebrates (e.g., worms, snails). Daytime insect predators include spiders, dragonflies and praying mantis.

Daytime vertebrates that feed on insects include birds. Insects consist of approximately 50 to 60 percent of the diet of birds. The actual number of insects eaten varies on the bird species. Some flickers have been found with over 5,000 ants in their stomachs. Some insectivorous birds consume an average of 100 insects per day (Elzinga, 1987). A large number of birds, including warblers, woodpeckers, swallows, and vireos, feed upon insects in their juvenile and adult lives.

Benefits from Arthropods

Terrestrial insects are important pollinators and can control certain plant pests (Alder et al., 1999). Beneficial insects (e.g., bees, flies) pollinate many plants and important commercial crops. Bees, wasps, butterflies, moths, and flies are the principal pollinators (Ruppert et al., 1994; Alder et al., 1999). Some insects, such as dragonflies, lady beetles, and praying mantis, also eat other insects. Spiders are also useful in controlling insect populations, especially in human dwellings. Many crustaceans are scavengers of aquatic environments and break down organic material in the ecosystem. Termites in rain forests turn dead vegetable matter into humus and aerate the soil.

FOOD CHAINS AND FOOD WEBS

The energy stored by plants that is passed along through the ecosystem in a series of steps of eating and being eaten is known as the food chain. Food chains can be represented by diagrams consisting of a series of arrows, each pointing from one species to another, for which it is a source of food. For example, marsh vegetation is eaten by a grasshopper, the grasshopper is consumed by a shrew, and the shrew by a marsh hawk or an owl. Food chains, however, do not describe the complexity of the interrelationships of organisms. Since no one organism generally lives wholly on another, the resources are shared, especially at the beginning of the food chain (i.e., plants); there are more organisms (i.e., greater biomass) at the plant end of the food chain than the carnivorous predator end. Marsh plants are eaten by a variety of invertebrates, birds, mammals, and fish; and some of the animals are consumed by several predators. Food chains become interlinked in food webs, and their complexity varies within and between ecosystems (Smith, 1990).

Arthropod Food Webs

There are a number of food webs that occur within the arthropods. For example, mites and springtails are extremely important detritus—decaying matter—feeders. These herbivores are preyed upon by small spiders and predaceous mites. The predaceous mites feed on worms, molluscs, insects, and other arthropods. Some spiders feed on mites; springtails, snails, small spiders, and cave crickets are preyed upon by carabid beetles. Medium-sized spiders feed on cave crickets and other insects. The medium-sized spiders are also part of the diet of some beetle species. Beetles, spiders, and snails are eaten by birds and small mammals (Smith, 1990). Similarly, in aquatic food webs, phytoplankton and zooplankton are at the base of the food chain. Crustaceans and mollusks filter feed on these organisms (e.g., algae and copepods, respectively). And these larger invertebrates are fed upon by fish and waterfowl.

Endangered Species

The New York Natural Heritage Program (NYNHP) a joint venture of NYSDEC and The Nature Conservancy (TNC) since 1985, is an ongoing, systematic, scientific inventory on rare plants and animals native to New York State. NYSDEC, Division of Fish, Wildlife and Marine Resources, Wildlife Resources Center, maintains the NYNHP files. Requests for information on threatened or endangered species, other species of special concern, as well as special habitat areas in and within the five boroughs of New York City were submitted to NYNHP on April 20, 2000 (animals), and June 1, 2000 (plants). Table 3.D-12 presents a list of rare, threatened or endangered animal species observed within the five boroughs of New York City compiled by NYNHP. Table 3.D-13 presents a list of rare, threatened or endangered plant species for the five boroughs, as compiled by NYNHP. Appendix 3.D-2, "Endangered Species Correspondence," contains copies of the cover letters from NYNHP.

Table 3.D-12
List of Rare, Threatened, or Endangered Animal Species Observed Within New York City According to NYNHP May 2000

Common Name	Scientific Name	State Status(1)	Federal Status(2)
BRONX			
Barn owl	*Tyto alba*	Protected	NS
Great egret	*Ardea alba*	Protected	NS
Cattle egret	*Bubulcus ibis*	Protected	NS
Snowy egret	*Egretta thula*	Protected	NS
Glossy ibis	*Plegadis falcinellus*	Protected	NS
Noctuid moth	*Amphidoea erepta ryensis*	Unprotected	NS
BROOKLYN			
Barn owl	*Tyto alba*	Protected	NS
Great egret	*Ardea alba*	Protected	NS
Cattle egret	*Bubulcus ibis*	Protected	NS
Snowy egret	*Egretta thula*	Protected	NS
Glossy ibis	*Plegadis falcinellus*	Protected	NS
Peregrine falcon	*Falco peregrinus*	Endangered	NS
Pied-billed grebe	*Podilymbus podiceps*	Threatened	NS
QUEENS			
Piping plover	*Charadrius melodus*	Endangered	LE-LT (Endangered in Great Lakes Watershed, threatened for rest of Coastal NY)
Least tern	*Sterna antillarum*	Threatened	PS
Forster's tern	*Sterna forsteri*	Protected	NS
Roseate tern	*Sterna dougallii*	Endangered	PS (Endangered for southeastern coastal portions of NY)
Common tern	*Sterna hirundo*	Threatened	NS
Black skimmer	*Rynchops niger*	Protected-Special Concern	NS
Barn owl	*Tyto alba*	Protected	NS
Short-eared owl	*Asio flammeus*	Endangered	NS
Northern harrier	*Circus cyaneus*	Threatened	NS
Peregrine falcon	*Falco peregrinus*	Endangered	NS
MANHATTAN			
Peregrine falcon	*Falco peregrinus*	Endangered	NS
STATEN ISLAND			
Peregrine falcon	*Falco peregrinus*	Endangered	NS
Eastern mud turtle	*Kinosternon subrubrum*	Endangered	NS
Yellow-sided skimmer (dragonfly/damselfly)	*Libellula flavida*	Unprotected	NS
Great egret	*Ardea alba*	Protected	NS
Cattle egret	*Bubulcus ibis*	Protecgted	NS
Snowy egret	*Egretta thula*	Protected	NS
Tricolored (Louisiana) heron	*Egretta tricolot*	Protected	NS
Glossy ibis	*Plegadis falcinellus*	Protected	NS
Little blue heron	*Egretta caerulea*	Protected	NS

Table 3.D-12 (continued)
List of Rare, Threatened, or Endangered Animal Species Observed Within New York City According to the New York Natural Heritage Program May 2000

Common Name	Scientific Name	State Status(1)	Federal Status(2)
Yellow-crowned night-heron	*Nyctanassa violacea*	Protected	NS
Least bittern	*Ixobrychus exilis*	Threatened	NS
Pied-billed grebe	*Podilymbus podiceps*	Threatened	NS
Southern leopard frog	*Rana sphenocephala*	Game species - Special Concern	NS
Fence lizard	*Sceloporus undulatus*	Threatened	NS
Arogos skipper (butterfly/skipper)	*Atrytone arogos arogos*	Endangered	NS

Notes:

(1) State Status:
- Endangered—any species meeting one of the following (1) any native species in imminent danger of extirpation or extinction in New York; (2) any species listed as endangered by the U.S. Department of the Interior, as enumerated in the Code of Federal Regulations (CFR) 50 CFR 17.11.
- Threatened—any species meeting one of the following (1) any native species likely to become an endangered species within the foreseeable future in New York; (2) any species listed as threatened by the U.S. Department of the Interior, 50 CFR 17.11.
- Special concern—those species not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York. These species receive no additional legal protection under Environmental Conservation Law (ECL) section 11-0535.
- Protected—wildgame, protected wild birds, and endangered species of wildlife.
- Unprotected—species may be taken at any time without limit; but license may be required.
- Game—any variety of big game or small game species as stated in the ECL, may have an open season for at least part of the year, and are protected at other times.

(2) Federal Status:
- NS—No status.
- LE-LT—The taxon is formally listed as endangered in part of its range and threatened in other parts.
- PS—Partial status: the species is listed in parts of its range and not in others, or one or more subspecies or varieties is listed, while others are not listed.

The USFWS is responsible for the management of Federally-listed, or proposed, rare, threatened or endangered non-marine species. A request for information on these species within the vicinity of the study area was submitted to the USFWS on June 1, 2000. The USFWS (Stilwell, 2000; Appendix 3.D-2), reported that the piping plover (*Charadrius melodus*), a Federally-listed threatened and State-listed endangered species, and the seabeach amaranth (*Amaranthus pumilus*), a Federally-listed threatened and State-listed endangered plant, are known to occur in proximity to the Atlantic Ocean within New York City. A State-listed endangered and Federal species of concern butterfly, the Arogos skipper (*Atrytone arogos arogos*), has been recorded for Staten Island. These species are described briefly below.

The piping plover is one of the first shore birds to arrive in the New York City area (Borough of Queens) for breeding, starting from early to mid-March. Nests are placed on open, generally grassless sand beaches or dredged spoil areas, well above the high tide mark and often are associated with least tern nests. Piping plover forage on beaches and dunes where they feed on marine worms, insect larvae, beetles, crustaceans, mollusks, and other small marine animals and their eggs. Population decline in this species is attributed to coastal development, recreational activities and disturbance from off-road vehicles (NYSDEC, 2000e; USFWS, 2000). There were 245 breeding pairs of piping plover in New York in 1998.

Table 3.D-13
List of Rare, Threatened, or Endangered Plant Species Observed Within New York City According to NYNHP June 2000

Common Name	Scientific Name	State Status(1)	Federal Status(2)
BRONX			
Wingstem	*Verbesina alternifolia*	Threatened	NS
Yellow giant-hyssop	*Agastache nepetoides*	Threatened	NS
Globose flatsedge	*Cyperus echinatus*	Endangered	NS
Persimmon	*Diospyros virginiana*	Threatened	NS
Slender spikerush	*Eleocharis elliptica var pseudopter*	Endangered	NS
Short-fruit rush	*Juncus brachycarpus*	Unprotected	NS
Slender blue flag	*Iris prismatica*	Unprotected	NS
False lettuce	*Lactuca floridana*	Unprotected	NS
Hairy field beadgrass	*Paspalum leave var pilosum*	Unprotected	NS
Northern gamma grass	*Tripsacum dactyloides*	Unprotected	NS
Bicknell's sedge	*Carex bicknellii*	Threatened	NS
Golden-seal	*Hydrastis canadensis*	Threatened	NS
Jacob's ladder	*Smilax pulverulenta*	Endangered	NS
Schweinitz's flatsedge	*Cyperus scheinitzii*	Rare	NS
Seabeach knotweed	*Polygonum glaucum*	Unprotected	NS
Red pigweed	*Chenopodium rubrum*	Threatened	NS
Woodland bluegrass	*Poa sylvestris*	Unprotected	NS
Roland's sea-blite	*Suaeda rolandii*	Unprotected	NS
Minute duckweed	*Lemna perpusilla*	Unprotected	NS
QUEENS			
Yellow giant-hyssop	*Agastache nepetoides*	Threatened	NS
Smartweed dodder	*Cuscuta polygonorum*	Endangered	NS
Lance-leaved loosestrife	*Lysimachia hybrida*	Threatened	NS
Seabeach amaranth	*Amaranthus pumilus*	Endangered	LT
Dune sandspur	*Cenchrus tribuloides*	Threatened	NS
Seabeach knotweed	*Polygonum glaucum*	Unprotected	NS
Schweinitz's flatsedge	*Cyperus scheinitzii*	Rare	NS
Evening primrose	*Oenotheroa parviflora var oakesiana*	Unprotected	NS
Rough rush-grass	*Sporobolus clandestinus*	Unprotected	NS
Woodland agrimony	*Agrimonia rostellata*	Threatened	NS
Thicket sedge	*Carex abscondita*	Threatened	NS
Fringed boneset	*Eupatorium hyssopifolium var lacini*	Threatened	NS
Scirpus-like rush	*Juncus scirpoides*	Unprotected	NS
Northern gamma grass	*Tripsacum dactyloides*	Unprotected	NS
Cat-tail sedge	*Carex typhina*	Threatened	NS
Opelousa smartweed	*Polygonum hydropiperoides*	Unprotected	NS
Saltmarsh aster	*Aster subulatus*	Threatened	NS
Cut-leaved evening-primrose	*Oenothera laciniata*	Unprotected	NS
Willow oak	*Quercus phellos*	Endangered	NS
Narrow-leaf sea-blite	*Suaeda linearis*	Unprotected	NS
Roland's sea-blite	*Suaeda rolandii*	Unprotected	NS
BROOKLYN			
Yellow flatsedge	*Cyperus flavescens var flavescens*	Endangered	NS
Retrorse flatsedge	*Cyperus retrorsus*	Endangered	NS

Table 3.D-13 (continued)
List of Rare, Threatened, or Endangered Plant Species Observed Within New York City According to NYNHP June 2000

Common Name	Scientific Name	State Status(1)	Federal Status(2)
STATEN ISLAND			
Button-bush dodder	*Cuscuta cephalanthi*	Endangered	NS
Persimmon	*Diospyros virginiana*	Threatened	NS
Soapwort gentian	*Gentiana soponaria*	Rare	NS
Scirpus-like rush	*Juncus scirpoides*	Unprotected	NS
Willow oak	*Quarcus phellos*	Endangered	NS
Rose-pink	*Sabatia angularis*	Endanagerd	NS
Fringed boneset	*Eupatorium hyssopifolium var lacini*	Threatened	NS
Velvety lespedeza	*Lespedeza stuevei*	Rare	NS
Virginia pine	*Pinus virginiana*	Endangered	NS
Hop sedge	*Cyperus lupilinus ssp*	Threatened	NS
Dune sandspur	*Cenchrus tribuloides*	Threatened	NS
Evening primrose	*Oenotheroa parviflora var oakesiana*	Unprotected	NS
Green milkweed	*Asclepia viridiflora*	Threatened	NS
Globose flatsedge	*Cyperus echinatus*	Endangered	NS
Velvet panic grass	*Panicum scoparium*	Unprotected	NS
Sweetbay magnolia	*Magnolia virginiana*	Unprotected	NS
Northern gamma grass	*Tripsacum dactyloides*	Unprotected	NS
Wingstem	*Verbesina alternifolia*	Threatened	NS
American strawberry-bush	*Euonymus americanus*	Endangered	NS
Nantucket juneberry	*Amelanchier nantucketensis*	Endangered	NS
Glaucous sedge	*Carex flaccosperma var glaucodea*	Endangered	NS
Southern dodder	*Cuscuta obtusiflora var glandulosa*	Endangered	NS
Featherfoil	*Hottonia inflata*	Threatened	NS
Swamp cottonwood	*Populus heterophylla*	Threatened	NS
Possum-haw	*Viburnum nudum var nudum*	Endangered	NS
Primrose violet	*Viola primulifolia var prim ulifolia*	Unprotected	NS
Purple everlasting	*Gnaphalium purpureum*	Rare	NS
Angled spikerush	*Eleocharis quadrangulata*	Endangered	NS
Lowland fragile fern	*Cystopteris protrusa*	Endangered	NS
Jacob's ladder	*Smilax pulverulenta*	Endangered	NS
Yellow giant-hyssop	*Agastache nepetoides*	Threatened	NS
White boneset	*Eupatorium leucolepis var leucolepi*	Endangered	NS

Notes:

(1) State Status:

- Endangered—listed species are those with: (1) 5 or fewer extant sites, or (2) fewer than 1,000 individuals, or (3) restricted to fewer than 4 USGS 7 ½ minute topographical maps, or (4) listed as endangered by the U.S. Department of the Interior, as enumerated in CFR 50 CFR 17.11.
- Threatened—listed species are those with: (1) 6 to fewer than 20 extant sites, or (2) 1,000 to fewer than 3.000 individuals, or (3) restricted to not less than 4 or more than 7 USGS 7 ½ topographical maps, or (4) listed as threatened by the U.S. Department of the Interior, 50 CFR 17.11.
- Rare—listed species have (1) 20 to 35 extant sites, or (2) 3,000 to 5,000 individuals Statewide.
- Unprotected—No State status.

(2) Federal Status:

- NS—No status.
- LT—The element is formally listed as threatened.

The sea beach amaranth is an annual herb found on coastal beaches that grows in a branching formation about a foot in diameter. On ocean beaches it is found above mean high tide before the dune area, in sparsely vegetated areas protected from foot traffic and vehicles. It is often associated with saltwort (*Salsola kali*), sea rocket (*Cakile edentula*), and seabeach knotweed (*Polygonum glaucum*) (USFWS, 1997). This species usually occurs on beaches over 20 meters wide (NYNHP, 1999) that are not stabilized by vegetation (USFWS, 1997), and can be observed in association with piping plover nesting areas (Weldy, 2000).

The Arogos skipper, a State-listed endangered and Federal butterfly species of concern, is currently reported from only one location in the entire State of New York—a site within the serpentine barrens of Staten Island, one of four rare plant communities recognized by the NYNHP. As a species of concern, USFWS is monitoring this butterfly's status throughout much of its range, and encourages Federal agencies and other appropriate parties to consider this species in the planning process. The NYNHP files list the Arogos skipper site as restorable, and USFWS believes its loss would jeopardize the possibility for this butterfly to be restored or rediscovered.

Because of the presence of these species of special concern within New York City, USFWS has requested that:

- The environmental documents associated with this project evaluate potential direct, indirect, and cumulative effects on the piping plover, seabeach amaranth, and Arogos skipper and/or their habitat, and include appropriate measures, to protect these three species; and
- The project's environmental documents be submitted to the Cortland, New York FWS office to determine the need for further consultation pursuant to Section 7 of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 USC 1531 et seq.).

Except for the piping plover, seabeach amaranth, Arogos skipper, and occasional transient individuals, no other Federally listed or proposed endangered or threatened terrestrial species under USFWS jurisdiction are known to exist in the project impact area.

The Federally- and State-listed endangered shortnose sturgeon (*Acipenser brevirostrum*) is the only threatened or endangered fish species with the potential to occur in the New York City area. In New York, the shortnose sturgeon is only found in the lower portion of the Hudson River from the southern tip of Manhattan upriver to the Federal dam at Troy. This species is anadromous. From April through May it migrates up the Hudson River from its mid-Hudson River overwintering area to spawn near Coxsackie. As they mature, young sturgeon eventually move downriver into the most brackish parts of the lower Hudson (NYSDEC 2000d). The diet of the shortnose sturgeon includes insects, crustaceans, mollusks, and annelids (USFWS 1997).

According to USFWS (1997), and the information presented in Meylan and Sadove (1986), Gerle and Sadove (1996), and Morreale et al. (1992), four State- and Federally-listed turtle species have the potential to occur in the vicinity of the site. Endangered or threatened marine species are under the responsibility of the National Marine Fisheries Service (NMFS). The four sea turtles include the State and Federally-listed endangered leatherback sea turtle (*Dermochelys coriacea*), the State- and Federally-listed endangered Atlantic (Kemp's) ridley sea turtle (*Lepidochelys kempii*), the State- and Federally-listed threatened loggerhead sea turtle (*Caretta caretta*), and the State- and Federally-listed threatened green sea turtle (*Chelonia mydas*).

In New York, the leatherback sea turtle is found in Long Island waters (NYSDEC, 1999a) from May through November (USFWS 1997). Leatherback turtles are water column feeders, where they eat a variety of soft-bodied invertebrates, such as jellyfish (USFWS, 1997).

Loggerhead sea turtles are the most abundant sea turtle occurring in the U.S. (USFWS, 1997), and the only sea turtles that still regularly nest on the U.S. Atlantic Coast beaches from New Jersey to Texas. They prefer estuaries, coastal streams, and salt marshes and some individuals may become stranded on New York City beaches during migrations in the summer. Most observations in New York have occurred in Long Island waters (NYSDEC, 2000b). Loggerheads are omnivorous, feeding on a variety of benthic and pelagic invertebrates and sea grass species (USFWS, 1997). The Atlantic ridley sea turtle is the smallest member of the sea turtle family and is also considered the most endangered. It is the second most abundant endangered sea turtle found in the New York Bight area, occurring from June to October (USFWS, 1997). Long Island's waters have been identified as critical habitat for immature Atlantic ridleys during the early stages of life, years 2 to 5 (NYSDEC, 1999c), but some Atlantic ridleys are also found in Jamaica Bay. Atlantic ridley feed on green (*Carcinus maenas*) and spider crabs (*Libinia spp*.) (USFWS, 1997).

The threatened green sea turtle inhabits shallow waters (shoals and lagoons) where it feeds on submerged vegetation, such as grasses and algae. In the New York Bight area, green turtles are found from June through October in association with submerged aquatic vegetation such as *Ulva* and *Codium spp*. (USFWS, 1997). Individual green sea turtles occasionally become stranded on or near the shores of New York. The New York State amphibian and reptile atlas indicates most of the occurrences of the green sea turtle to be in Long Island waters (NYSDEC, 2000c).

As presented in Table 3.D-12, many of the sensitive animal species found in New York City are birds. The majority of these sensitive bird species are shorebirds as is the case for the piping plover and the terns, or wading birds, such as the egrets, ibis, herons, and bitterns associated with wetlands and shallow-water areas. The remaining birds are waterfowl, such as the pied-billed grebe, or raptors, such as the barn owl, short-eared owl, northern harrier, and peregrine falcon. Many of the species are associated with the small undeveloped islands in the East River, New York Harbor, Arthur Kill, and Newark Bay, and with Gateway National Recreational Area, Jamaica Bay, JFK Airport, and some of the New York City parks and State parks within the City. Of the birds discussed below as species of special concern, four are listed as endangered by the State (piping plover, roseate tern, short-eared owl, and peregrine falcon), and five are listed as threatened by the State (least tern, pied-billed grebe, common tern, northern harrier, and least bittern). Piping plover, described earlier, is also a Federally-listed threatened species, the roseate tern is Federally-listed endangered in southeastern New York, and the least tern is Federally-listed in some portions of its range.

Roseate terns arrive to breed in New York in late April or early May and are always found nesting with common terns. Nests are built in sand, shall or gravel, within dense grass clumps or under boulders or rip-rap. In the New York City area, this species breeds primarily in a few colonies on Long Island (NYSDEC, 2000f), with additional nesting sites at Breezy Point in Queens (USFWS, 1997). Threats to this species include changes in vegetation, competition with gulls for nesting areas, and predation from species such as raccoons (NYSDEC, 2000f).

The State-threatened least tern arrives in New York, mostly Long Island, to breed by late April to mid-May, and departs by late August to early September for wintering areas on the Gulf Coast, Central America, and Peru and Brazil in South America. It breeds in colonies of up to 200 birds, and is frequently associated with piping plover nests. Nests are built in sand, shell, or gravel on broad level expanses of beach, dredge spoil, and other open shoreline areas. Declines are attributed to development in coastal areas and disturbance from recreational activities (NYSDEC, 2000h). The common tern is considered threatened by NYSDEC, but is the most widespread and abundant tern in New York. It arrives to breed in New York (mostly Long Island) from late April to mid-May, and

may nest in large colonies of several hundred to several thousand birds that can include roseate, least and gull-billed terns, and black skimmers. The common tern and least tern both feed primarily on small fish. As with other beach nesting species, declines of the common tern can be attributed to development in coastal areas and disturbance from recreational activities (NYSDEC, 2000i).

The short-eared owl is found in freshwater and salt marshes, and open grassland. Nests are built on the ground, often in weeds or beneath a bush. It feeds at night—small rodents are the primary prey (Bull and Farrand, 1977). Peregrine falcons have been reintroduced into the City by NYCDEP. Within New York City, peregrine falcons nest on manmade structures such as skyscraper ledges, tall towers, and bridges at heights 50 to 200 feet off the ground. Starlings and pigeons are the primary prey in urban areas, as well as songbirds, shorebirds, and ducks (NYSDEC, 2000g, USFWS, 1999). There are 12 pairs of peregrine falcons nesting in the New York City area (NYCDEP, 2000). In 1998, 38 pairs of peregrine falcons were reported for the State of New York (NYSDEC, 2000g). The State-threatened northern harrier is a marsh species that can cover up to 100 miles a day feeding on rodents and small birds. Some breeding does occur in New York City—nests are built in marshes, grasslands, meadows, and cultivated fields. Declines in this species are attributed to habitat loss due to development of wetlands and changes in land use (NYSDEC, 2000j).

The State-listed threatened pied-bill grebe (Brooklyn and Staten Island) and least bittern (Staten Island) are both found most commonly in marshes and ponds. The pied-billed grebe nests in floating dead marsh vegetation anchored to adjacent plants. It feeds on small fish, crustaceans and aquatic insects but is especially fond of crayfish. The least bittern is a tiny heron that nests on a platform of dead cattails or reeds, usually over water (Bull and Farrand, 1977).

The State-listed endangered eastern mud turtle is a small aquatic turtle found in shallow, slow-flowing, fresh or brackish bodies of water with soft-bottoms and abundant vegetation, although they often leave the water in mid-summer. New York is the northern limit of this species' range, where the majority of the known locations are on Long Island. This species has been impacted due to human activities, such as wetland filling and draining, and fragmentation of habitat by roads (NYSDEC 1999b, NYSDEC 2000a). The State-listed threatened fence lizard is one of New York's rarest reptiles. Within New York City it occurs on Staten Island (Finton et al., 2000). The fence lizard prefers dry open woodlands and brushland in sunny locations where it can be found on trees, fence rails or rotting logs. They eat mainly insects (ants and beetles preferred), but may also eat smaller lizards and snails (Columbus State University 2000).

Unique Habitats

Staten Island possesses some unique habitats that include forested wetlands containing sweet gum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), swamp white oak (*Quercus bicolor*), white ash (*Fraxinus americana*), pin oak (*Quercus palustris*), sweet bay magnolia *(Magnolia virginiana)*, spice bush *(Lindera benzoin)*, and skunk cabbage *(Symplocarpus foetidus*), as well as green brier, oak hybrid forests, and serpentine barrens.

The serpentine barrens occur in the northern portion of Staten Island in areas underlain by serpentine rock. This is the only occurrence of this rock type in the region. The serpentine group are metamorphic rocks derived from hydrous magnesium silicates like olivine, pyroxenes, and amphiboles—they have a mottled green pattern like that of a snake. The chemical properties of serpentine soils (high magnesium content) and the dry (xeric) conditions limit the types of vegetation capable of growing on them. The unique plant community that grows on these soils is considered globally rare. The plant community forming the serpentine barrens on Staten Island is a grassland, dominated by little bluestem (*Schizachyrium scoparium*), panic grasses (*Panicum spp*.), Indian grass

(*Sorghastrum nutans*), and poverty grass (*Danthonia spicata*), followed by forbs and a few trees and shrubs. Rare plants found in the barrens include globose flatsedge (*Cyperus echinatus*), velvet panic grass (*Panicum scoparium*), green milkweed (*Asclepia viridiflora*), St. John's wort (*Hypericum dissimulatum*), and pine barrens gerardia (*Agalinis virgata*). Trees and shrubs do occur here but are scattered and commonly stunted. They can include gray birch, black oak, sassafras, bayberry and shining sumac (NRG 1991b, USFWS 1997). These barrens supported the region's only known population of the endangered butterfly called the Arogos skipper (*Atrytone a. arogos*). This butterfly is currently not believed to be present in this area (USWFS, 1997).

REPRESENTATIVE AREAS

The following sections describe the existing conditions within the Representative Areas selected for evaluation as part of this EIS. While general information is provided on land use, the reader should refer to Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning," for a detailed description of land use and neighborhood character for each of these areas. The following information is based on the results of the site visits conducted from July 11 through 14, 2000, as well as existing information on the various areas. Appendix 3.D-3 contains photographs of each Representative Area.

College Point

The College Point Representative Area is located in northern Queens. It includes the area between Flushing Bay, the East River, and the Whitestone Expressway (see Figure 3.B-1, in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning"). The College Point Representative Area is mostly developed with the exception of open space areas contained in Herman A. MacNeil Park, Frank Golden Park, Powell's Cove Park, Poppenhusen Playground, College Point Park, and the former Flushing Airport.

The developed areas contain a variety of single-family homes on large and small lots, low-rise multifamily housing, industrial and commercial areas such as the College Point Industrial Park, the New York Times complex adjacent to the Whitestone Expressway off Linden Street, office buildings, a major new installation of retail stores along 20th Avenue between the Whitestone Expressway and 130th Street, and a large new movie theater in the area between 28th Avenue, Linden Street and the Whitestone Expressway. The developed areas provide little in the way of significant habitat other than occasional shade trees and grassy areas associated with homes, industrial, or commercial areas.

The habitats provided by the open space areas listed above include landscaped parkland with recreational facilities such as MacNeil Park, Frank Golden Park, College Point Park, Poppenhusen Playground, and portions of Powell's Cove Park, as well as the more natural and less developed open space that provides a complex of different habitat types such as a portion of Powell's Cove Park, and the former Flushing Airport, and the vacant land surrounding it. A general description of the habitats present in these areas is presented below. According to the NYNHP, there are no rare, threatened, or endangered animal species or plant species recorded for this section of Queens (NYNHP, 2000a and 2000b).

Landscaped Parks

The landscaped parks within the College Point Representative Area provide limited habitat for wildlife. Highly developed parks such as Poppenhusen Playground (80 percent of park is paved), and College Point Park have limited vegetation and provide little in the way of natural resources. These two open space areas are described in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning," and will not be considered further in this chapter.

Herman MacNeil Park (Appendix 3.D-3, Pictures 1 through 3) is located between Poppenhusen Avenue, College Point Boulevard, 115th Street, and the East River. It consists of 29 acres that contain facilities such as walking paths, playground, basketball courts, baseball diamond, and handball courts. The vegetation in the upland areas consists of mature shade trees such as white oak, red maple, and flowering dogwood surrounded by open grassy areas. In addition to gray squirrel and pigeon, observed in this area, this landscaped area should also provide habitat for some of the songbirds listed in Table 3.D-2 that are common to urban areas such as mourning dove, American robin, mockingbird, European starling, brown-headed cowbird, crow, and house sparrow. At the eastern edge of the park along the East River is a small cove with a small tidal mud flat area, surrounded by a narrow fringe of tidal emergent marsh dominated by *Spartina* (Appendix 3.D-3, Pictures 1 and 2), and then a large riprap (loose assemblage of broken bones) and wall (Appendix 3.D-3, Picture 3). This fringe marsh area extends west from the cove along the waterfront until the point, at which point the wetland ends and the shoreline is riprap. Figure 3.D-1 presents the approximate NYSDEC mapped tidal wetlands boundary for this area, which approximates what was observed during the site visit. The remaining shoreline along the East River on the western border of the College Point Representative Area is riprapped or bulkheaded and provides little habitat for wildlife. The eastern side of the cove is vegetated trees and shrubs common to the disturbed urban land of New York City including: black locust, tree-of-heaven, catalpa, cottonwood, multiflora rose, Norway maple, box elder (*Acer negundo*), Japanese knotweed, and mugwort. While not a high quality habitat, this wooded area should provide habitat to the more common songbirds found in the City, including American robin, house sparrow, mourning dove, mocking bird, red-winged blackbird, American crow, European starling, and occasional warblers. The tidal marsh should provide habitat for waterfowl, shorebirds and wading birds. Species observed in the marsh during the site visit included great egret, snowy egret, and cormorant. Other groups of birds likely to use this area occasionally include herons, gulls, and sandpipers.

Frank Golden Park, located on 14th Road between 132nd and 138th Streets is an 11-acre park containing playing fields, playground areas, basketball courts and a walking path. The area has scattered trees and provides little in the way of habitat.

Powell's Cove Park (Appendix 3.D-3, Pictures 4 through 7) is located along the waterfront of the East River almost in the center of the Representative Area. This park lines much of the cove with the exception of the western side occupied by Tallman Island Water Pollution Control Plant. The park includes open lawn areas rimmed with trees (yellow birch and locust), a waterfront walkway and some riparian (i.e., along banks of rivers and streams) woodland areas that are being restored along with the tidal wetlands. The riparian woodland area contains tree-of-heaven, black locust, box elder (*Acer negundo*), mulberry (*Morus sp.*), Norway maple, back willow, black cherry, and Japanese knotweed. Wildlife observed during the site visit included gray squirrel, American robin, and mockingbird. Powell's Cove has a tidal mudflat, then a wetland fringe approximately 30 to 60 feet wide dominated by *Spartina*. Figure 3.D-1 presents the approximate NYSDEC tidal wetlands boundary for Powel's Cove. The tidal marsh is currently being restored and enlarged. The western shoreline at the mouth of the cove is riprapped. Wildlife observed during the site visit in the tidal wetland, mudflats, and waters within the cove include: mallard, black-crowned night heron, lesser black-backed gull, and great egret.

Aquatic Resources of the East River

Zooplankton found within the East River off Powell's Cove and MacNeil Park are likely to be similar to those described earlier for the New York Harbor, with copepods such as *Acartia tonsa, Acartia*

hudsonica, *Eurytemora affinis*, and *Temora longicornis* predominating. The larger *Neomysis americana* (mysid shrimp) has been found year round in the East River (Con Edison, 1982). Decapod larvae (e.g., blue crab *Callinectes sapidus*, and the crab *Ovalipes ocellatus* (Con Edison, 1982, Malcolm Pirnie, Inc. 1982) have also been reported for the East River and are likely to occur in the vicinity of this Representative Area.

Over 100 macroinvertebrate taxa had been identified for the East River, most of which were either crustaceans or polychaete worms (Coastal Environmental Services 1987). Invertebrates likely to occur on the hard substrates such as the large riprap observed within the Representative Area include mussells, barnacles, and the polychaete *Sabellaria vulgaris*. Invertebrates likely to occur in the soft substrates would include oligochaete worms, the soft-shelled clam *Mya arenaria*, and a variety of flatworms, nemerteans, polychaetes, and crustaceans.

Marine, estuarine, and anadromous fish use the East River. Marine species likely occur in the vicinity of this Representative Area during some portion of the year include: winter flounder (*Pseudopleuronectes americanus*), bay anchovy (*Anchoa mitchilli*), weakfish (*Cynoscion regalis*), cunner (*Tautogolabrus adspersus*), Atlantic silverside (*Menidia menidia*), Atlantic menhaden (*Brevoortia tyrannus*), black sea bass (*Centropristis striata*), and spotted hake (*Urophycis regius*). The common estuarine species inhabiting the study region include mummichog (*Fundulus heteroclitus*), hogchoker (*Trinectes maculatus*), and white perch (*Morone americana*). These species migrate within the estuary and would occur in the East River during certain seasons (Con Edison 1982). Atlantic tomcod (*Microgadus tomcod*), striped bass (*Morone saxatilis*), alewife (*Alosa pseudoharengus*), and American shad (*Alosa sapidissima*) are the most common anadromous fish occurring in the East River, on their way to the upstream Hudson River freshwater spawning grounds. They may also use the upper East River during fall and winter months as they migrate to sea through Long Island Sound.

Vacant Land—Flushing Airport

The Flushing Airport operated from 1927 until 1979 when it ceased operation because of maintenance and management problems. Because of its low elevation and poor drainage system (the airport was constructed on filled marshland) the site is frequently flooded (AKRF, 1997). Located southeast of 20th Avenue and 132nd Street, the 77-acre undeveloped area is currently owned by the New York City Economic Development Corporation. Groundwater on the site is found from just below to approximately 3 feet below the ground surface (EEA, Inc. 1994). Adjacent to the southwestern boundary of the Flushing Airport property are several undeveloped parcels associated with the College Point Corporate Park.

The Flushing Airport property has had little vegetation management since the airport operations ceased and now consists of a mixture of ruderal—growing in rubbish, poor land, or waste—habitats, early successional woodlands composed of saplings and shrubs, some open woodland areas, emergent wetland areas dominated by *Phragmites*, isolated areas of standing water, as well as open water areas that appear to be connected to Mill Creek through several culverts. The entire Flushing Airport site drains to Mill Creek (EEA, 1996). While the airport was in operation, a pump station and system of drainage ditches controlled drainage while the airport was operating. Pumping to control drainage was stopped in 1984 when the airport was closed. Since that time, the runway, aprons and taxiway contain areas of standing water between 1 to 3 feet deep (EEA, 1996).

Standing water was observed in the paved areas of the airport at the time of the site visit in July 2000 (see Appendix 3.D-3, Pictures 8, 9, and 10). Surrounding the paved areas were stands of emergent wetland vegetation dominated by *Phragmites* with some purple loosestrife (*Lythrum salicaria*). Both

the USFWS and the NYSDEC have mapped freshwater emergent wetlands on the site (EEA, 1996). Figure 3.D-1 shows the approximate locations of the NYSDEC freshwater wetlands within the Flushing Airport property. Other plant species that have been observed in the emergent wetland areas include spike rush (*Eleocharis sp.*) and switchgrass (*Panicum virgatum*) (EEA, 1996).

At the time of the site visit in July 2000, the uplands surrounding the emergent wetland areas consisted of ruderal vegetation typical of disturbed, poor quality soil such as sweet meadow clover, mugwort (*Artemisia vulgaris*), goldenrod (*Solidago spp.*), and fleabane. Scattered areas of trees occurred toward the eastern portion of the property consisting of cottonwood (*Populus deltoides*), and mulberry (*Morus sp.*). Other upland vegetation recorded for the airport property include: English plantain (*Plantago lanceolata*), Queen Anne's lace (*Daucus carota*), common mullein (*Verbascum thapsus*), tree-of-heaven (*Ailanthus altissima*), groundsel bush (*Baccharis halimifolia*), multiflora rose (*Rosa multiflora*), and smooth sumac (*Rhus glabra*) (*EcolSciences* 1992; EEA, 1996).

Birds observed on the Flushing Airport property during the site visit were primarily associated with the wetland areas and included: American robin, red-winged blackbird, black-crowned night heron, common yellowthroat, killdeer, sandpipers, great egret, mallard, and Canada goose. Other birds that have been documented on the site associated with the wetland areas include snowy egret, great blue heron, American black duck, greater yellowlegs, ring-billed gull, herring gull, tri-colored heron, glossy ibis, American wigeon, and common gallinule. Ring-necked pheasant, tree swallow, barn swallow, marsh wren, gray catbird, tree sparrow, song sparrow and swamp sparrow are also known to occur on the site. Northern harrier have been observed foraging on the site (*EcolSciences*, 1992; EEA, 1996), and one or two barn owls were recorded as nesting in the abandoned hangars in 1990 and 1991 (*EcolSciences*, 1992).

Wildlife observed on the airport property during the site visit include eastern cottontail (*Sylvilagus floridanus*) and meadow vole (*Microtus pennsylvanicus*). Other species documented or expected for the site include raccoon (*Procyon lotor*), muskrat (*Ondatra zibethicus*), Norway rat (*Rattus norvedicus*), and short-tail shrew (*Blarina brevicauda*) (EEA, 1996). Reptiles and amphibians recorded as using the airport site year round include eastern painted turtle (*Chrysemys picta*), snapping turtle (*Chelydra serpentina*), and Fowler's toad (*Bufo woodhousei fowleri*) (EEA, 1996).

The undeveloped land between Ulmer Street and Linden Place and north of 28th Street that is part of the College Point Corporate Park has open water areas (Appendix 3.D-3, Picture 11) with 4 to 5 foot high vegetated banks that appear to be connected to Mill Creek (or are part of Mill Creek), through large culverts. Vegetation surrounding these open water areas includes *Phragmites*, mugwort, cottonwood, locust, and curly dock. Birds observed using these areas include great blue heron, red-winged blackbird, green heron, sandpiper, snowy egret, song sparrow, great egret, and pigeons. Other birds expected to occur in this area include mute swan, red-tailed hawk, black-crowned night heron, marsh wren, gray catbird, common yellowthroat, field sparrow, swamp sparrow, common grackle, greater yellowlegs, laughing gull, and house sparrow (AKRF, 1997).

Jamaica Bay and Environs/Paerdegat Basin Area

The Paerdegat Basin Representative Area (see Figure 3.B-2 in Chapter 3.B "Land Use, Community Facilities, Public Policy and Zoning") consists primarily of residential development, with two- to three-story, semi-detached and attached houses. Commercial and industrial land uses are found in the western portion of this area. While the residential areas contain some shade trees, they provide little in the way of wildlife habitat.

Open space areas are found in three parks; Canarsie Beach Park that borders the eastern portion of Paerdegat Basin and includes Canarsie Pier that extends into Jamaica Bay; McGuire Park on the western portion of Paerdegat Basin and north of the Belt Parkway; Bergen Beach that is south of the Belt Parkway and includes Jamaica Bay shoreline; and undeveloped City-owned land lining Paerdegat basin from McGuire Park and Canarsie Beach Park to the head of the basin.

Paerdegat Basin is fairly representative of the tidal basins that discharge to Jamaica Bay. These tidal basins have been altered as a result of urbanization and their freshwater flow now consists primarily of discharge from one or more Combined Sewer Outfalls (CSOs). Paerdegat Basin receives discharge from a large CSO at the head of the basin and discharges into Jamaica Bay. Jamaica Bay is an example of an important habitat area found within New York City. NYSDEC has designated Jamaica Bay as a Critical Environmental Area (the only one in the City). New York State Department of State (NYSDOS) has designated Jamaica Bay as a Significant Coastal Fish and Wildlife Habitat. Additionally, much of the open space within and bordering the bay is within the Gateway National Recreational Area administered by the National Park Service. Jamaica Bay receives discharge from numerous CSOs and stormwater discharges, through basins similar to Paerdegat, such as Fresh Creek, Bergen Basin, Thurston Basin, Shell-bank Basin, and Hawtree Basin. The following sections describe the natural resources found within Paerdegat Basin, and Jamaica Bay.

Paerdegat Basin

Paerdegat Basin receives flow from the Paerdegat Basin CSO facility, run by NYCDEP, located at the head of the basin at the intersection of Ralph and Flatlands Avenues. Other developments on about 7 acres of City-owned property at the head of the basin on the northwest side, include a plant nursery, storage area for landscaping equipment, a lumber yard, a boat storage area, and a marina (AKRF 1993). A New York City Department of Transportation (NYCDOT) facility, located on the northeast portion of the basin head, is used for vehicle repair and storage. Much of the rest of the basin frontage on both sides (approximately 90 acres), bounded by Paerdegat Avenue North on the east and Bergen Avenue on the west, is undeveloped. The remaining land uses include 3 or 4 marinas and an athletic club.

At one time, Paerdegat Basin was a freshwater-fed stream, known as Paerdegat Creek (or Bedford Creek). The basin as it exists now was constructed from the creek by dredging the creek bed in 1932, following the goals of the Jamaica Bay Improvement Plan of 1910, and placing the dredged material in wetlands adjacent to the channel. Paerdegat Basin is approximately 6,600 feet long (1.25 miles) and 450 feet wide. Water depth ranges from 1 to 16 feet. The elongated shape and lack of freshwater inputs other than from the CSO limits tidal flushing, and contributes to the poor water quality of the basin. It is classified as a Class I waters by NYSDEC—secondary contact recreation such as fishing and boating is the highest and best use under this classification. The basin is used for recreational boating and kayaking, but pollution levels currently restrict the development of any fisheries. Untreated stormwater and sanitary sewage overflows from the three CSOs discharge to the basin during almost all storm events, resulting in coliform bacteria counts and dissolved oxygen concentrations (DO) that do not meet Class I standards. The limited flushing of the basin has also resulted in a build up of settled CSO materials at the head of the basin that lower dissolved oxygen to near zero and cause odors through hydrogen sulfide production (AKRF, 1993).

At the time of the 1993 AKRF study, no fish and few benthic species were recorded as occurring at the head of the basin near the CSO outfalls, most likely due to the depressed DO levels and high amount of accumulated sediments. Fish and benthos were collected near the mouth where water quality is improved and probably more reflective of Jamaica Bay. A 1986 fish survey of the basin

identified only five species of fish (10 individuals total), Atlantic silverside, sundial (*Lophosetta maculata*), seahorse (*Hippocampus hudsonius*), summer flounder, and black seabass. A later survey collected only black sea bass and summer flounder, documented killifish along the shoreline, and collected blue crab near the mouth of the basin (AKRF, 1993). Benthic invertebrates known to occur within the basin are mostly those known to be pollution tolerant—they are dominated by polychaete worms, followed by mollusks and amphipods, with few organisms found within a mile of the CSOs. Table 3.D-14 lists benthic invertebrates that have been collected from the mud/sand flats and the channel within the basin.

Table 3.D-14
Benthic Invertebrates Known to Occur within Paerdegat Basin

Scientific Name	Scientific Name
Hemichordata	**Oligochaeta**
Saccoglossus kowalewskii	*Peloscolex gabriellae*
Nemertea	*Peloscolex benedini*
Cerabratulus lacteus	**Copepoda**
Lineus ruber	*Alteutha depressa*
Nematoda	**Cirripedia**
Unidentified species	*Balanus improvisus*
Mollusca	**Ostracoda**
Bittium altermatum	*Unidentified species*
Littorina littoria	**Isopoda**
Littorina saxatilis	*Edotea triloba*
Nassarius obsoletus	*Jaera marina*
Urosalpinx cinerea	**Amphipoda**
Mercenaria mercenaria	*Psammonyx nobilis*
Modiolus demissus	*Ampelisica abdita*
Mytilus edulis	*Unciola irrorata*
Mya arenaria	*Corophium acherusicum*
Tellina sp.	*Corophium insidiosum*
Polychaeta	*Caprella linearis*
Tharyx acutus	*Hyale plumosa*
Drilonereis longa	*Hyalella azteca*
Fabricia sabella	*Gammarus sp.*
Glycera americana	*Melita nitida*
Glycera dibranchiata	**Decapoda**
Eteone heteropoda	*Neopanopeus sani*
Heteromastus filiformis	*Eurypanopeus depressus*
Nereis arenaceodonta	**Insecta**
Nereis succinea	*Anurida maritima*
Phyllodoce maculata	*Chironomidae*
Polydora ligni	
Scolecolepides viridis	
Spio sp.	
Streblospio benedicti	
Pectinaria gouldi	
Travisia carnea	
Arabella iricolor	

Source: AKRF (1993).

Table 3.D-15 presents phytoplankton collected in Paerdegat Basin during dry weather sampling in August and October 1986. Diatoms were the dominant group out of the 31 species identified. Algal densities were higher in August than October.

Table 3.D-15
Phytoplankton Collected in Paerdegat Basin in August and October 1986

Scientific Name	Scientific Name
Diatoms	**Chrysophytes**
Ceratulina bergonii	*Olisthodiscus luteus*
Chaetoceros danicus	**Cryptophytes**
Chaetoceros simplex	*Chroomonas amphioxia*
Chaetoceros sp.	*Chroomonas minuta*
Cylindrotheca closterium	*Hemiselmis sp.*
Hemiaulus membranaceus	**Prasinophytes**
Leptocylindrus minimus	*Pyraminonas sp.*
Minutocellus polymorphus	**Euglenophytes**
Rhizosolenia delicatula	*Eutreptia sp.*
Skeletonema costatum	**Haptophyceae**
Skeletonema menzilii	*Phaeocystis sp.*
Thalassiosira pseudonana	**Cyanobacteria**
Thalassiosira sp.	*Synechococcus sp.*
Dinoflagellates	**Miscellaneous**
Gyrodinium qureolum	Unidentified flagellates
Gyrodinium esturiale	
Heterocapsa triquetra	
Katodinium rotundatum	
Peridinium sp.	
Prorocentrum minimum	
Prorocentrum redfieldii	

Source: AKRF (1993).

On the basis of the July 2000 site visit, the vegetation community within the basin consisted of a narrow band of tidal emergent wetlands (approximately 40 to 60 feet wide) dominated by *Spartina alterniflora* in a 20 to 30 foot-wide low marsh that grades into *Phragmites* (see Appendix 3.D-3, Pictures 12, 13, and 14). All of the basin's shoreline and the waters of the basin have been mapped as tidal wetlands by NYSDEC (Figure 3.D-2). The wetland classification is primarily as littoral zone (i.e., shore zone of tidal water, between high- and low-water marks), with some areas of bars and mud flats toward the mouth. The upland areas, formed by greater amounts of dredge material and other fill such as demolition debris, and old piles of asphalt (observed in the northeast portion of the basin), are dominated by species typical of disturbed areas with poor soil found within New York City: mugwort (*Artemisia vulgaris*), sumac, *Phragmites*, cottonwood, honey locust (*Gleditsia triacanthos*), and tree-of-heaven (*Ailanthus altissima*). Other vegetation documented for Paerdegat Basin includes red mulberry (*Morus rubra*), black cherry (*Prunus serotina*), plane tree maple (*Acer pseudoplatanus*), weeping willow (*Salix babylonica*), common ragweed (*Ambrosia artemisiifolia*), and Queen Ann's lace (*Daucus carota*) (AKRF, 1993). Closer to the mouth, the band of *Spartina* gets wider, particularly on the western side by Joseph Thomas McGuire Park, where there is also a wide mudflat. NYSDEC has mapped the southwestern area as tidal wetlands consisting of coastal shoals, bars, and mudflats. In the middle of the basin, next to the marinas, the shoreline is bulkheaded and there are no tidal wetlands.

Wildlife observed during the July 2000 site visit included: common crow, mockingbird, catbird, red-winged blackbird, common tern, herring gull, laughing gull, great blue heron, great egret, and a warbler. Other waterfowl documented as occurring within the basin include snowy egret and sandpipers (AKRF, 1993). Algae and sea lettuce were observed growing on the bulkhead near the marina along with ribbed mussel (*Geukensia demissa*) and barnacles. The NYNHP has no record of rare, threatened, or endangered plant or animal species for the Paerdegat Basin area (NYNHP, 2000a and 2000b).

Landscaped Parks Next to Paedergat Basin

Canarsie Beach Park and McGuire Park are the two public parks on either side of Paerdegat Basin, near the mouth and next to the Belt Parkway (see Figure 3.B-3 in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning"). Canarsie Beach Park (see Appendix 3.D-3, Pictures 15 and 16) is a 132-acre park with a playground located on the east side of the basin, between Seaview Avenue and the Belt Parkway. It has basketball courts, approximately eight baseball diamonds, and a large grassy field. While the playing fields and grassy field do not provide much habitat value, the band of scrubby, mixed deciduous, woodland observed during the July site visit, provides some edge habitat, between the grassy field, the Belt Parkway, and a leaf composting facility. Vegetation included staghorn sumac, mimosa, locust, black cherry, tree-of-heaven, multiflora rose, red maple, and ragweed. The only wildlife observed was a red-winged blackbird. This woodland should provide habitat for other birds common to urban areas that were observed in other locations such as mourning dove, sparrows, starlings, crows, mocking bird, American robin, and pigeon, as well as mammals such as meadow vole, squirrel, cottontail rabbit, Norway rat, and raccoon.

McGuire Park consists of 77 acres on the west side of the basin, north of the Belt Parkway. Approximately 15 acres of the park are devoted to active recreational uses such as playgrounds, base-ball diamonds, tennis, volleyball, and basketball courts. Between the active recreational areas and the Belt Parkway is mixed deciduous woodland similar to that observed at Canarsie Beach Park. The NYSDEC tidal wetlands boundaries (Figure 3.D-2) indicate an area of littoral zone along the shoreline area of the park.

Canarsie Pier, part of the National Park Service Gateway National Recreational Area, is immediately south of Canarsie Beach Park and the Belt Parkway, along Jamaica Bay. Canarsie Pier has rest rooms, tables and benches for board games and eating, the pier for fishing, a restaurant and a large parking area. While the pier provides little in the way of wildlife habitat there is access to the beach and shoreline (see Appendix 3.D-3, Picture 17). The *Spartina alterniflora* wetland fringe next to the pier varies in width but is generally between 50 and 60 feet wide. Figure 3.D-2 presents the approximate NYSDEC tidal wetland boundaries for the shoreline areas next to the pier, and indicates both littoral zone and bars and mud flats. Other vegetation observed above the tidal wetland included *Phragmites*, groundsel, multiflora rose, staghorn sumac, eastern cottonwood, and eastern red cedar. Only pigeons and swallows were observed during the site visit, but the area should provide foraging habitat for some of the shorebird and wading birds described in the next section (Bergen Beach/Jamaica Bay), as well as raccoon, and possibly Norway rat.

Bergen Beach/Jamaica Bay

Bergen Beach (Appendix 3.D-3, Pictures 18 through 21) is part of the Gateway National Recreational Area administered by the National Park Service. Located south of the Belt Parkway and McGuire Park, (see Figure 3.B-2 of Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning") this park is undeveloped with the exception of the Jamaica Bay Riding Academy located at its southern end, at the mouth of Paerdegat Basin, and the bridal trails associated with this activity. Bergen Beach provides waterfront access to Jamaica Bay.

NYSDEC has designated Jamaica Bay as a Critical Environmental Area (the only one in New York City). NYSDOS has designated Jamaica Bay as a Significant Coastal Fish and Wildlife Habitat. Additionally, the NYNHP has documented the presence of rare, threatened, and endangered animals and plants in and surrounding Jamaica Bay. Rare, threatened, or endangered animal species known to occur in Jamaica Bay include: common tern, least tern, roseate tern, short-eared owl, piping plover, northern harrier, Forster's tern, and black skimmer. Rare threatened or endangered plant species of the Jamaica Bay area include: Schweinitz's flatsedge (Bergen Beach), red pigweed, woodland bluegrass, Roland's sea-blithe, seabeach amaranth (oceanside beaches), dune sandspur, seabeach knotweed, fringed boneset, yellow flatsedge, and retrorse flatsedge.

Jamaica Bay is part of the Gateway National Recreational Area administered by the National Park Service. Gateway National Recreational Area was established by Congress in 1972 and includes Floyd Bennett Field, Jamaica Bay Wildlife Refuge, Breezy Point (i.e., the westernmost portion of the Rockway Peninsula), a portion of Staten Island, and Sandy Hook. The Jamaica Bay Wildlife Refuge was originally acquired by New York City in 1938 and designated a wildlife refuge in 1948. The refuge's 9,155 acres of islands, open water, dunes, and salt marsh were incorporated into the Gateway National Recreational Area in 1974 (NRG, 1995a). Jamaica Bay includes some 16,000 acres of water, wetlands, and lowlands that function as an ecological system. It is a semi-enclosed coastal embayment, containing salt marsh islands in a tidal lagoon. Prior to development activities undertaken by the City to develop Jamaica Bay as a seaport early in the 20th century, the bay had an estimated 26,000 acres of wetlands. Approximately 13,000 unaltered acres of wetlands are now present within Jamaica Bay, 4,000 acres of which consist of inner bay marsh that can only be accessed by boat (NYCDEP, 1995).

Salinity in Jamaica Bay is highest at the mouth and gradually decreases further into the bay. Tidal flushing is limited to the relatively narrow Rockaway Inlet, which causes the residence of the bay's water to be about 30 days (Riepe and Tanacredi undated). Water near the mouth is well mixed, but the deeper waters at the eastern portion of the bay can be stratified because of sluggish circulation (Peterson and Dam, 1986). Although surface waters are well oxygenated, deeper waters have been found to be hypoxic in the inner bay during the summer (Peterson and Dam, 1986). The depth of the bay ranges from less than 3 meters (9.8 feet) to a maximum of 10 meters (32.8 feet) (Peterson and Dam, 1986), with an average depth of 3.7 meters (12 feet) at mean low water (Riepe and Tanacredi, undated).

Water quality has been severely impaired (low dissolved oxygen, toxics, eutrophication, pathogens, floatables, etc.) as a result of land use changes (commercial and industrial development, and landfills); filling and dredging activities; and sewage treatment plant, stormwater and CSO discharges. Although several tidal creeks once provided freshwater inputs to Jamaica Bay, including Paerdegat Creek discussed in the previous section, freshwater input to the bay now comes from groundwater discharge, stormwater runoff, CSO discharge (stormwater and sewage), and discharge from the four sewage treatment plants located along the bay (Franz and Tanacredi 1992).

Approximately 36,700 acres of Brooklyn and Queens drain to Jamaica Bay through about 41 combined sewer overflows, numerous storm sewers, and groundwater seepage from the Brooklyn/Queens aquifer. Secondary pollution sources that also contribute to water quality and habitat degradation include landfill leachate from the four landfills located around the bay, runoff from John F. Kennedy Airport, discharges from marinas and boats, leakage from petroleum tank farms, and illegal dumping.

NYSDEC has classified Jamaica Bay and the tributaries Gerritsen, Mill, and Shellbank, as Use Class SB (primary contact/bathing) for open waters. The north shore tributaries and the Head of the Bay have been classified as Class I (secondary contact/fishing). Uses that are currently impaired by poor water quality include shellfishing, bathing, fish consumption, wildlife habitat, and aesthetics. In 1999, 22 percent of the water samples collected in Jamaica Bay by the National Park Service exceeded the total coliform criteria (2,400 colonies/100 mL) and 40 percent of these samples exceeded the fecal coliform criteria (2,400 colonies/100 mL). Approximately 25 percent of the samples collected at Canarsie Pier, within the Representative Area, exceeded the total coliform criteria in 1999, and 35 percent exceeded the fecal coliform criteria (Ringenary, 1999). At Canarsie Pier, DO levels ranged from a low of 3.32 mg/L in the surface sample in August, and 2.75 mg/L in the bottom sample in July, to a high of 11.07 mg/L at the surface in early July and 8.15 mg/L in the bottom in early July. The range of pH values at Canarsie Pier was 7.19 to 8.06 for 1999 (Ringenary, 1999). Water, sediment and habitat quality vary within the bay depending upon proximity to contaminated discharges, hydrologic conditions that affect dispersion contaminants, and other local conditions that may affect decomposition of contaminants. Despite this, Jamaica Bay provides important habitat for spawning and nursery ground for fish, as well as habitat for benthic invertebrates and numerous species of birds (NYCDEP, 1995). Health advisories have been issued for the consumption of striped bass, bluefish, and American eels caught in Jamaica Bay.

Vegetation communities within Jamaica Bay include salt marshes, grassland, coastal shrub communities, and beach areas. Figure 3.D-2 presented the approximate locations of NYSDEC tidal wetlands within this Representative Area. The tidal wetlands include both littoral zone, and bars and mud flats. Although not indicated by NYSDEC mapped wetlands, there were areas of intertidal marsh along the Bergen Beach area, particularly in the small inlet area observed in the aerial photograph. The tidal marshes are dominated by smooth (saltmarsh) cord grass (*Spartina alterniflora*) along with salt hay (saltmeadow cordgrass) (*Spartina patens*), and glasswort. The center of the bay contains extensive areas of low-lying saltmarsh, intertidal flats, and uplands important for colonial nesting waterbirds. At low tide, approximately 350 acres of mudflats and 925 acres of *Spartina alterniflora* marsh and 526 acres of high marsh dominated by *Spartina patens* are exposed. The intertidal areas are rich in benthic invertebrates, discussed below, and sea lettuce (*Ulva lactuca*) (USFWS, 1997). Grasslands occur at JFK Airport, Floyd Bennett Field, and some upland areas in the center part of the bay. Grassland species include little bluestem (*Schizachyrium scoparium*), switchgrass (*Panicum virgatum*), and seaside goldenrod (*Solidago sempivirens*) (USFWS, 1997). The grasslands at JFK Airport support several State-listed rare plants and are used for feeding by grassland birds, including upland sandpiper and grasshopper sparrow (USFWS, 1997). Coastal shrub communities comprise beach heather, bittersweet (*Celastrus orbiculatus*), beach plum (*Prunus maritima*), bayberry (*Myrica pensylvanica*), sumac (*Rhus spp*.) and rose. Upland woodlands comprise oaks, hackberry (*Celtis occidentalis*), willow (*Salix spp*), dwarf sumac, gray birch, quaking aspen, black cherry (*Prunus serotina*), and tree-of-heaven (*Ailianthus altisima*). Beach/dune communities consisting of beachgrass (*Ammophila breviligulata*) occur at Breezy Point/Fort Tilden, Plumb beach, Bayswater Park, and in

Arverne (NYCDEP 1995, USFWS 1997). The endangered seabeach amaranth, discussed previously, occurs within Jamaica Bay associated with the beach/dune community.

More than 325 species of birds have been observed in the refuge over the last 25 years. Table 3.D-16 presents a list of birds observed at the Jamaica Bay Wildlife Refuge. The bay provides resting, feeding and breeding habitat to numerous waterfowl, as well as several species listed by NYSDEC as threatened or endangered such as piping plover, and common, least, and roseate terns as discussed in a previous section. Because the Bay lies within the Atlantic Flyway, the important migration corridor on the east coast of North America for many species of birds, numerous species stop here during spring and fall migration (NYCDEP, 1995). Thousands of waterfowl use the Bay in the winter, and numerous wading birds and migrating shore-birds feed on the bay's mudflats during the fall and spring migrations. The grasslands surrounding the bay provide habitat to upland sandpiper, short-eared owl, barn owl, grasshopper sparrow, northern harrier, eastern meadowlark, horned lark, savannah sparrow, American kestrel, red tailed hawk, Cooper's hawk, and rough-legged hawks, bitterns, woodcocks, rails, gallinules, laughing gulls, ring-necked pheasant, and bobwhite quail (NYCDEP, 1995). Wading birds commonly observed in the summer feeding in the shallows and mudflats include great blue, little blue, and tricolored herons, and great and snowy egrets. (NRG, 1995a). The endangered piping plover and roseate terns, and threatened least tern and black skimmers, discussed previously, occur within Jamaica Bay (Muzio and Rubel, 1993). Breezy Point, at the western tip of the Rockaway marine barrier beach, supports some of the highest concentrations of beach-nesting birds in the New York Bight coastal region. It has one of the largest piping plover nesting sights, one of the largest concentrations of least terns, and one of the largest black skimmer colonies. It also has the largest common tern colony on the south shore of Long Island (USFWS, 1997).

The composition of the phytoplankton community of Jamaica Bay changes with season. Large diatoms dominate the spring blooms, and small diatoms and flagellates (less than 20 µm) dominate summer blooms. Fall blooms are a mixture of size groups. Adult and juvenile copepods are the dominant zooplankton throughout the bay and their abundance follows that of the phytoplankton. The copepods *Acartia hudsonica* and *A. tonsa* have been found to dominate during most of the year, with *Eurytemora affinis* being dominant during the spring bloom but disappearing thereafter. *Oithona similis* and *Parvocalanus crassiorostris* are most abundant in the fall near the mouth of the bay. Polychaete larvae appear in September but peak in April and May after the copepod bloom (Peterson and Dam, 1986).

Approximately 129 benthic invertebrate species have been recorded for the Bay. The benthic community for a given area will depend on water and sediment quality found there. Bottom sediments in the eastern and northern portion of the bay are muddy fine-sands with an organic content greater than 1 percent, and are highly reducing. Sediments in the southern and western bay are fine to medium sands (Franz and Tanacredi, 1992). In a study conducted in 1981 and 1982, Franz and Harris (1988) collected 121 benthic taxa from 27 stations. Approximately 43 percent of the individuals collected were polychaetes, with mollusks and crustaceans making up about 25 and 26 percent, respectively. Five species accounted for 74 percent of the individuals collected in each sampling period except July when these species accounted for 87 percent—*Ampelisca abdita* (a tube-building amphipod that is an important food for many fish), *Streblospio benedicti*, *Corophium tuberculatum*, *Uniciola dissimilis*, and *Mediomastus ambiseta*. *Ampelisca abdita* was the most common species found in the gut of winter flounder in Jamaica Bay (Borowski and Aitken-Ander, 1991), and may provide the trophic basis of the winter flounder population (Franz and Harris, 1988). In the 180 winter

Table 3.D-16
Common Names of Birds Known to Occur in the Jamaica Bay Wildlife Refuge

Common Name	Common Name
Red-throated loon	Turkey vulture
Common loon	Osprey
Pied-billed grebe	Bald eagle
Horned grebe	Northern harrier
Red-necked grebe	Sharp-shinned hawk
Eared grebe	Cooper's hawk
Great cormorant	Goshawk
Double-crested cormorant	Red-shouldered hawk
American bittern	Broad-winged hawk
Least bittern	Red-tailed hawk
Great blue heron	Rough-legged hawk
Great egret	American kestrel
Snowy egret	Merlin
Little Blue heron	Peregrine falcon
Tricolored heron	Gryfalcon
Cattle egret	Ring-necked pheasant
Green heron	Northern bobwhite
Black-crowned night heron	Yellow-crowned rail
Yellow-crowned night heron (Nycticorax violacea)	Black rail
Glossy Ibis	Clapper rail
Tundra swan	King rail
Mute swan	Virginia rail
Snow goose	Sora
Brant	Common moorhen
Canada goose	American coot
Wood duck	Black-bellied plover
Green-winged teal	Lesser golden plover
Black duck	Semipalmated plover
Mallard	Piping plover
Pintail	Killdeer
Blue-winged teal	American oystercatcher
Northern shoveler	Black-necked stilt
Gadwall	American avocet
Eurasion wigeon	Greater yellowlegs
American wigeon	Lesser yellowlegs
Canvasback duck	Solitary sandpiper
Redhead duck	Willet
Ring-necked duck	Spotted sandipiper
Greater scaup	Upland sandpiper
Lesser scaup	Whimbrel
Common eider	Hudsonian godwit
King eider	Marbled godwit
Oldsquaw	Ruddy turnstone
Black scoter	Red knot

Table 3.D-16 (continued)
Common Names of Birds Known to Occur in the Jamaica Bay Wildlife Refuge

Common Name	Common Name
Surf scoter	Sanderling
White-winged scoter	Semipalmated sandpiper
Common goldeneye	Western sandpiper
Bufflehead	Least sandpiper
Hooded merganser	White-rumped sandpiper
Common merganser	Baird's sandpiper
Red-breasted merganser	Pectoral sandpiper
Ruddy duck	Dunlin
Curlew	Acadian flycatcher
Stilt	Alde flycatcher
Buff-breasted sandpiper	Willow flycatcher
Ruff	Leas flycatcher
Short-billed dowitcher	Eastern phoebe
Long-billed dowitcher	Great crested flycatcher
Common Snipe	Western kingbird
American Woodcock	Eastern kingbird
Wilson's phalarope	Horned lark
Northern phalarope	Purple martin
Red phalarope	Tree swallow
Laughing gull	Rough-winged swallow
Little gull	Bank swallow
Black-headed gull	Cliff swallow
Bonaparte's gull	Barn swallow
Ring-billed gull	Blue jay
Herring gull	American crow
Iceland gull	Fish crow
Lesser Black-backed gull	Black-capped chickadee
Glaucous gull	Red-breasted nuthatch
Greater Black-backed gull	White-breasted nuthatch
Gull-billed tern	Brown creeper
Caspian tern	Carolina wren
Royal tern	House wren
Roseate tern	Winter wren
Common tern	Sedge wren (*Cistothorus platensis*)
Forster's tern	Marsh wren
Least tern	Golden-crowned kinglet
Black tern	Ruby-crowned kinglet
Black skimmer	Blue-gray gnatcatcher
Rock dove	Eastern bluebird
Mourning dove	Veery
Black-billed cuckoo	Gray-cheeked thrush
Yellow-billed cuckoo	Swainson's thrush
Barn owl	Hermit thrush
Snowy owl	Wood thrush

Table 3.D-16 (continued)
Common Names of Birds Known to Occur in the Jamaica Bay Wildlife Refuge

Common Name	Common Name
Long-eared owl	American robin
Short-eared owl	Gray catbird
Saw-whet owl	Northern mockingbird
Common nighthawk	Brown thrasher
Whip-poor-will	American pipit
Chimney Swift	Cedar waxwing
Ruby-throated hummingbird	Northern shrike
Belted Kingfisher	Loggerhead shrike
Red-headed woodpecker	Starling
Red-bellied woodpecker	White-eyed vireo
Yellow-bellied sapsucker	Solitary vireo
Downy woodpecker	Yellow-throated vireo
Hairy woodpecker	Warbling vireo
Common flicker	Philadelphia vireo
Olive-sided flycatcher	Red-eyed vireo
Eastern wood pewee	
Yellow-bellied flycatcher	
Blue-winged warbler	Grasshopper sparrow
Golden-winged warbler	Henslow's sparrow
Tennessee warbler	Sharp-tailed sparrow
Orange-crowned warbler	Seaside sparrow
Nashville warbler	Fox sparrow
Parula warbler	Swamp sparrow
Yellow warbler	White-throated sparrow
Chestnut-sided warbler	White-crowned sparrow
Magnolia warbler	Dark-eyed junco
Cape May warbler	Lapland longspur
Black-throated Blue warbler	Snow bunting
Yellow-rumped warbler	Bobolink
Black-throated Green warbler	Red-winged blackbird
Blackburnian warbler	Eastern meadowlark
Yellow-throated warbler	Yellow-headed blackbird (*Xanthocephalus xanthocephalus*)
Pine warbler	Rusty blackbird
Prairie warbler	Boat-tailed grackle
Palm warbler	Common grackle
Bay-breasted warbler	Brown-headed cowbird
Blackpoll warbler	Orchard oriole
Cerulean warbler	Northern oriole
Black and white warbler	Pine grosbeak
American redstart	Purple finch
Prothonotary warbler	House finch
Worm-eating warbler	Red crossbill
Ovenbird	White-winged crossbill
Northern waterthrush	Common redpoll

Table 3.D-16 (continued)
Common Names of Birds Known to Occur in the Jamaica Bay Wildlife Refuge

Common Name	Common Name
Louisiana thrush	Pine siskin
Kentucky warbler	American goldfinch
Connecticut warbler	Evening grosbeak
Mourning warbler	Song sparrow
Common yellowthroat	House sparrow
Hooded warbler	
Wilson's warbler	
Canada warbler	
Yellow-breasted chat	
Summer tanager	
Scarlet tanager	
Western tanager (*Piranga ludoviciana*)	
Northern cardinal	
Rose-breasted grosbeak	
Blue grosbeak	
Indigo bunting	
Dickcissel	
Rufous-sided towhee	
Tree sparrow	
Chipping sparrow	
Clay-colored sparrow	
Field sparrow	
Vesper sparrow	
Lark sparrow	
Savannah sparrow	

Source: Davis (Undated).

flounder collected from the bay by Franz and Tanacredi (1992), *Ampelisca abdita* accounted for 88 percent of all of the prey found in the stomachs. Table 3.D-17 presents the dominant invertebrates collected by Franz and Hams (1988). From this list of dominant invertebrates, the following species are crustaceans: the amphipod (*Unicola dissimilis*), the mud crab (*Neopanope texana*), the gammaridean amphipod (*Ampelisca abdita*), the amphipod (*Elasmopus laevis*), beach flea (*Corophium tuberculatum*), the mysid shrimp (*Heteromysis Formosa)*, the amphipod (*Paraphoxus spinosus*), and the amphipod (*Lysianopsis alba)*. While historically an important shellfish nursery on the Atlantic Coast, Jamaica Bay has been closed to shellfishing since 1921 because of shellfish contamination by human pathogens. Without fishing pressures, the shellfish population in the bay has increased, and bivalves are an important food source to shorebirds, waterfowl, and wading birds (NYCDEP, 1995). The Atlantic ribbed mussel (*Geukensia demissa*) is abundant in the *Spartina alterniflora* marshes found rimming the bay (Franz and Tanacredi, 1993). Other invertebrates found in the tidal wetland-mudflat area include mud snail (*Ilyanassa obsoleta*), the northern quahog (*Mercenaria mercenaria*), and the Atlantic surf clam (*Spisula solidissima*) (USFWS, 1997).

Table 3.D-17
Dominant invertebrates collected in Jamaica Bay by Franz and Harris (1988)

Scientific Name
Crepidula fromicata
Crepidula plana
Crepidula convexa
Tellina agilis
Mercenaria mercenaria
Ilyanassa obsolete
Mulina lateralis
Macoma lenta
Unicola dissimilis
Neopanope texana
Ampelisca abdita
Elasmopus laevis
Corophium tuberculatum
Heteromysis formosa
Paraphoxus spinosus
Lysianopsis alba
Glycera capitata
Streblospio benedicti
Tharyx acutus
Mediomastus ambiseta
Sabelaria vulgaris
Asabellides oculata
Pectinaria gouldii
Nereis succinea
Polydora ligni
Capitella capitata
Eteone lacteal
Oligochaeta spp.
Eunida sanguinea

Table 3.D-18 lists finfish that have been collected in Jamaica Bay. A total of 81 species have been recorded using otter trawl, gill nets, and beach seines (Scaglione et al., 1991). Because Jamaica Bay is not fed by any major freshwater flows, freshwater species have not been documented in the Bay (Scaglione et al., 1991).

The bay provides spawning and nursery habitat to many species, the most common of which include scup, bluefish, Atlantic silverside, winter flounder, windowpane, blackfish, weakfish, and mummichog (NYCDEP, 1995). Anadromous fish found within Jamaica Bay include striped bass, American shad, alewife, and river herring (Scaglione et al., 1991). An estuarine fish (one that spends its entire life cycle in the estuary) found in the bay is white perch. Winter flounder, other flounder species, sculpin, menhaden, and searobin are marine species that feed in the bay, and some may use it for breeding or nursery areas. Most species of fish captured in Jamaica Bay are juveniles—they are using the bay as a nursery before sexual maturity and starting their seasonal migrations (Scaglione 1991). Most of the winter flounder collected by Franz and Tanacredi (1992) in Jamaica Bay were less than four years old and were considered to be juveniles. Some adult winter flounder may be trawled

Table 3.D-18
Finfish Known to Occur in Jamaica Bay

Common Name	Scientific Name
Sand tiger	*Odontaspis taurus*
Smooth dogfish	*Mustelis canis*
Spiny dogfish	*Squalus acanthias*
Little skate	*Raja erinacea*
Clearnose skate	*Raja eglanteria*
Cownose ray	*Rhinoptera bonasus*
Atlantic sturgeon	*Acipenser oxyrhynchus*
American eel	*Anguilla rostrata*
Conger eel	*Conger oceanicus*
Blueback herring	*Alosa aestivalis*
Alewife	*Alosa pseudoharengus*
American shad	*Alosa sapidissima*
Atlantic menhaden (bunker)	*Brevoortia tyrannus*
Atlantic herring	*Clupea harengus*
Bay anchovy	*Anchoa mitchilli*
Inshore lizardfish	*Synodus foetens*
Oyster toadfish	*Opsanus tau*
Atlantic cod	*Gadus morhua*
Atlantic tomcod	*Microgadus tomcod*
Silver hake	*Merluccius bilinearis*
Red hake (squirrel hake)	*Urophycis chuss*
Spotted hake	*Urophycis regia*
White hake	*Urophycis tenuis*
Halfbeak	*Hyporhamphus unifasciatus*
Atlantic needlefish	*Strongylura marina*
Mummichog	*Fundulus heteroclitus*
Banded killifish	*Fundulus diaphanus*
Striped killifish	*Fundulus majalis*
Spotfin killifish	*Fundulus luciae*
Inland silverside	*Menidia beryllina*
Atlantic silverside	*Menidia menidia*
Bluespotted cornetfish	*Fistularia tabacaria*
Fourspine stickleback	*Apeltes quadracus*
Threespine stickleback	*Gasterosteus aculeatus*
Lined seahorse	*Hippocampus erectus*
Northern pipefish	*Syngnathus fuscus*
White perch	*Morone americana*
Striped bass	*Morone saxatilis*
Black sea bass	*Centropristis striata*
Bigeye	*Priacanthus arenatus*
Short bigeye	*Pristigenys alta*
Bluefish	*Pomatomus saltatrix*
Cobi	*Rachycentron canadum*
African pompano (threadfin)	*Alectis ciliaris*
Yellow jack	*Caranx bartholomaei*

Table 3.D-18 (continued)
Finfish Known to Occur in Jamaica Bay

Common Name	Scientific Name
Crevalle jack	*Caranx hippos*
Bigeye scad	*Selar crumenophthalmus*
Lookdown	*Selene vomer*
Scup (porgy)	*Stenotomus chrysops*
Northern kingfish	*Menticirrhus saxatilis*
Spot (lafayette)	*Leiostomus xanthurus*
Weakfish	*Cynoscion regalis*
Spotfin butterflyfish	*Chaetodon ocellatus*
Tautog (blackfish)	*Tautoga onitis*
Cunner (bergall)	*Tautogolabrus adspersus*
Striped mullet	*Mugil cephalus*
White mullet	*Mugil curema*
Northern sennett	*Sphyraena borealis*
Northern stargazer	*Astroscopus guttatus*
Rock gunnel	*Pholis gunnellus*
Ocean pout	*Macrozoarces americanus*
American sand lance	*Amodytes hexapterus*
Naked goby	*Gobiosoma bosci*
Seaboard goby	*Gobiosoma ginsburgi*
Butterfish	*Peprilus triacanthus*
Northern searobin	*Prionotus carolinus*
Striped searobin	*Prionutus evolans*
Grubby (sculpin)	*Myoxocephalus aeneus*
Longhorn sculpin	*M. octodecimspinosus*
Summer flounder (fluke)	*paralichthys dentatus*
Fourspot flounder	*Paralichthys oblongus*
Gulf stream flounder	*Citharichthys arctifrons*
Smallmouth flounder	*Etropus microstomus*
Windowpane	*Scophthalmus aquosus*
Winter flounder	*Pseudopleuronectes amer.*
Hogchoker	*Trinectes maculatus*
Orange filefish	*Aluterus schoepfi*
Planehead filefish	*Monacanthus hispidus*
Smooth trunkfish	*Lactophrys triqueter*
Northern puffer	*Sphoeroides maculatus*
Striped burrfish	*Chilomycterus schoepfi*
Some Common Fish Species of Jamaica Bay	
Scup	*Stenotomus chrysops*
Bluefish	*Pomatomus saltatrix*
Atlantic silverside	*Menidia menidia*
Winter flounder	*Pseudopleuronectes americanus*
Windowpane	*Scophthalmus aquosus*
Blackfish or Tautog	*Tautoga onitis*
Weakfish	*Cynoscion regalis*
Mummichog	*Fundulus heteroclitus*

Source: Reipe et al., (undated).

from the bay in all months, and some winter flounder may return to Jamaica Bay to spawn in late winter and early spring (Franz and Tanacredi, 1992). Surveys conducted in the middle and late 1980s suggest that winter flounder (a commercially and recreationally important fish) comprise the largest percentage of fish within the bay (Scaglione, 1991). The high percentage of the tube-building amphipod *Ampelisca abita* found in winter flounder stomachs suggest that this fish forages primarily in the *Ampelisca*-dominated, muddy fine-sand community (Franz and Tanacredi, 1992). Atlantic silverside is the dominant forage fish using the shoreline areas, along with striped killifish and mummichog. Other forage fish include Atlantic menhaden, and bay anchovy. Juvenile bluefish were found to be entering the bay to feed.

Jamaica Bay provides woodland, grassland, and freshwater marsh habitats for the mammals, amphibians, and reptiles listed in Table 3.D-19. The reptile and amphibian community found within the Jamaica Bay area are impoverished compared to the community found on Long Island, primarily due to urbanization and loss of contiguous habitat areas (Cook, 1989). Some of the individuals belonging to species found within the Jamaica Bay Wildlife Refuge are the result of transplantation efforts undertaken by the Gateway National Recreational Area (Cook and Pinnock, 1989). Gateway National Recreational Area has developed a program to restore or recreate, to the extent possible, the reptile and amphibian community native to the habitats now present within the refuge (Cook, 1989). Diamondback terrapin nest and forage in the saltmarshes and mudflats of the bay. They prefer to nest in sandy areas with sparse to moderate vegetation. Some common nesting areas include Ruler's Bar Hassock, Dubos Point, Floyd Bennett Field, and Broad Channel. Loggerhead sea turtles have occasionally been reported for Jamaica Bay (USFWS, 1997).

The small mammals found within the Jamaica Bay area listed in Table 3.D-19 provide a food source to hawks, owls, and some snakes using this area. They include opossum, black-tailed jackrabbit (*Lepus californicus*)—believed to have escaped from JFK Airport cargo, eastern cottontail rabbit, eastern chipmunk, gray squirrel, white-footed mouse, meadow vole, muskrat, and house mouse. Little brown myotis bat, silver-haired bat, red bat, and hoary bat also occur within the bay (USFWS, 1997). In addition to the mammals listed in Table 3.D-19, bottlenose dolphin (*Tursiops truncatyus*), the harbor seal (*Phoca vitulina*), and sperm whale (*Physeter catodon*) have occasionally been reported within Jamaica Bay. Some of these sightings have been strandings (Muzio and Rubel, 1993).

Many of the butterflies listed earlier in Table 3.D-8 occur within the Jamaica Bay area. Gateway National Recreational Area has been enhancing habitat for butterflies and moths since the 1980s, zoning several areas for butterflies and wildflowers, and following a mowing schedule that promotes grass and wildflower production (Riepe and Tanacredi, 1988). Fifty-four species of butterflies and skippers have been recorded within Jamaica Bay, including regular use by rare species such as checkered white, white m hairstreak, Appalachian azure, tawny emperor, and salt marsh skipper (USFWS, 1997). As discussed earlier, the number of moth species occurring within New York City is greater than the number of species of butterfly. The species that occur in Jamaica Bay were listed in Table 3.D-9.

Table 3.D-19
Amphibians, Reptiles, and Mammals Observed Within the Jamaica Bay Region

Common Name	Scientific Name
Amphibians	
Spotted salamander	*Ambystoma maculatum*
Redback salamander	*Plethodon cinereus*
Fowler's toad	*Bufo woodhousei fowleri*
Spring peeper	*Hyla c. crucifer*
Grey treefrog	*Hyla versicolor*
Green frog	*Rana clamitans melanota*
Spadefoot toad	*Scaphiopus h. holbrooki*
Reptiles	
Atlantic loggerhead turtle	*Caretta c. caretta*
Snapping turtle	*Chelydra s. serpentina*
Box turtle	*Terrapene c. carolina*
Painted turtle	*Chrysemys p. picta*
Red-eared slider	*Chrysemys scripta e'egans*
Diamondback terrapin	*Malaclemys t. terrapin*
Brown snake	*Storereia d. dekayi*
Garter snake	*Thamnophis s. sirtalis*
Hognose snake	*Heteredon platyrhinos*
Smooth green snake	*Opheodrys v. vernalis*
Black racer	*Coluber c. constrictor*
Milk snake	*Lampropeltis t. triangulum*
Mammals	
Opossum	*Didelphis virginiana*
Little brown myotis	*Myotis lucifugus*
Silver-haired bat	*Lasionycteris noctivagans*
Red bat	*Lasiurus borealis*
Hoary bat	*Lasiurus cinereus*
Eastern cottontail	*Sylvilagus floridanus*
Black-tailed jackrabbit	*Lepus californicus*
Grey squirrel	*Sciurus carolinensis*
Muskrat	*Ondatra zibethicus*
Meadow vole	*Microtus pennsylvanicus*
White-footed mouse	*Peromyscus leucopus*
Norway rat	*Rattus norvegicus*
House mouse	*Mus musculus*
Raccoon	*Procyon lotor*
Mink	*Mustela vision*
Eastern chipmunk	*Tamias striatus*
Masked shrew	*Sorex cinereus*

Source: Cook and Pinnock (1989).

Vegetation observed in the Bergen Beach (Appendix 3.D-3, Pictures 18 through 21) area in the upland scrub/shrub area, located above the beach area and intersected by the bridle paths, during the July 2000 site visit included bayberry, black cherry, winged sumac, phlox, beach grass, gray birch, Russian olive, and tree-of-heaven. USACOE, 1997, also documented multiflora rose (Rosa multiflora), poison ivy, Japanese honeysuckle, and cottonwood in this area. The tidal wetland/mudflat area was dominated by *Spartina alterniflora* at the lower elevations. The *Spartina* wetland graded into a *Phragmites* dominated high marsh. Small shallow tidal pools occurred within the Spartina/mudflat area. Wildlife observed within the upland scrub/shrub area included barn swallows, mockingbird, and red-winged blackbird. Wildlife observed in the tidal marsh/mudflat area included: ribbed mussel, barnacle, snails, blue claw crab, fiddler crab, hermit crab, horseshoe crab (shell), razor clam (shell), great black-backed gull, herring gull, black-crowned night heron, great egret, American oyster catcher, black skimmer, glossy ibis, Canada goose, snowy egret, and marsh wren.

Fish that would be expected to occur along the Bergen beach shoreline include silversides, killifish, and mummichog.

Edgemere/Far Rockaway

The Edgemere/Far Rockaway Representative Area is located on the Rockaway peninsula, at the southeastern portion of Jamaica Bay. A portion of the Representative Area protrudes into Jamaica Bay and another portion of the Representative Area includes a portion of Rockaway Beach. Chapter 3B. "Land Use, Community Facilities, Public Policy and Zoning," provides a description of existing land use, that includes high- and low-density residential, a hospital, commercial, vacant land, and open space (see Figure 3.B-3). The three primary open space areas include the former Edgemere Landfill, Rockaway Community Park, and Rockaway Beach. In addition, there is a narrow band of tidal wetlands located within Conch Basin, Norton Basin, and Sommerville Basin, as well as at the toe of the Edgemere Landfill (see the approximate NYSDEC tidal wetlands boundaries presented in Figure 3.D-3).

The approximately 178-acre Edgemere landfill was opened in 1938 and is the oldest landfill in New York City. In addition to municipal solid waste, this landfill received petroleum products and chemical waste (Storozynski 1989) before it was closed in the 1990s. During the July 2000 site visit, a narrow band (20 to 30 feet wide) of low tidal marsh dominated by *Spartina alterniflora* was observed lining Conch Basin (Appendix 3.D-3, Pictures 22 and 23). The road leading to the landfill, a marina, and residential development that extended almost up to the water's edge limited the tidal marsh. Wildlife observed within Conch Basin included fiddler crab, cormorants, herring gull, laughing gull, and red-winged blackbird. Other species likely to use this area occasionally for feeding include egrets and herons, as well as other gulls, terns, and skimmers, similar to those observed for the Bergen Beach site. Fish expected to occur in the small coves within this Representative Area include silversides, mummichog, killifish, juvenile bluefish, sea trout, and spot. Other invertebrates expected to occur in the mudflats and tidal wetland area include mud crabs, blue crabs, and mud snails.

A grassland vegetation community covers the closed Edgemere Landfill. Immediately south of this area and near the gate is a ruderal (i.e., natural vegetative cover has been disturbed by man)/scrub-shrub community with eastern cottonwood, *Phragmites*, Queen Anne's lace, staghorn sumac, poison ivy, and fleabane. Rockaway Community Park comprises the southern portion of the open space south of the landfill. It has tennis courts, basketball courts, baseball diamonds surrounded by grass and scattered trees and offers little in the way of wildlife habitat. Adjacent to the park is vacant land dominated by mugwort and *Phragmites*, and scattered trees such as sumac, black locust, and tree-of-

heaven. As is the case for Conch Basin, Sommerville Basin is developed almost up to the water's edge with residential and commercial uses and a marina. There is a narrow fringe wetland dominated by *Spartina alterniflora* in the low marsh areas and *Phragmites* in the upper marsh areas (Appendix 3.D-3, Pictures 24, 25, and 26). USACOE (1997) describes the presence of vacant lots adjacent to Sommerville Basin covered with mugwort, foxtail, evening primrose, and *Phragmites*. Cormorants and gulls were observed in Sommerville Basin during the July 2000 site visit. This basin should provide feeding habitat for other shorebirds and wading birds common in Jamaica Bay

The beach vegetation community of Arverne, is similar to that described earlier in this chapter for New York City (see *Beaches, Dunes, and Bluffs*). The NYNHP lists several species of special concern in the Rockaway area, including the State-threatened dune sandspur, the State- and Federally-listed endangered seabeach amaranth, the State- and Federally-listed endangered piping plover, and the threatened least tern. Other species that would use this area include common shorebirds such as sandpipers, a variety of gulls, common tern, great-black-backed gull, herring gull, willet, and American oystercatcher. Aquatic animals expected to use the shoreline adjacent to the beaches in this area include silversides and jellyfish. Fish species that occur in the nearshore zone include: spotted hake (*Urophycis regina*), windowpane flounder (*Scophthalmus aquosus*), longfin squid, little skate (*Raja erinacea*), fourspot flounder (*Paralichthys oblongus*), lady crab (*Ovalipes ocellatus)*, butterfish, winter flounder, rock crab (*Cancer irroratus*), American lobster (*Homarus americanus*), smooth dogfish (*Mustelus canis)*, and northern searobin (*Prionotus carolinus*) (USFWS, 1997). Invertebrates expected to use some portion of the beach-dune area include: sand crabs, ghost crabs, and bivalves such as gem clams.

Hunts Point/Soundview

As described in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning," the Hunts Point/Soundview Representative Area includes two neighborhoods, Hunts Point and Soundview, that are split by the Bronx River (see Figure 3.B-4). Hunts Point is a mixture of residential, commercial, and industrial uses, with the south and east portions of Hunts Point devoted almost entirely to industrial uses with scattered vacant lots. These land uses offer little in the way of habitat and natural resources. The Soundview neighborhood is primarily residential with accessory service uses and the 156-acre Soundview Park. The remainder of the description of this Representative Area will focus on Soundview Park since it contains the majority of the wildlife habitat and natural resources for this Representative Area.

Much of Soundview Park has been developed on top of landfill (NYCDPR, 1994). The northern half of Soundview Park (Appendix 3.D-3, Pictures 27 and 28) is devoted to grass lawn with scattered willow oak and black locust shade trees of playgrounds, ballfields, basketball courts, and street hockey playing areas. During the July 2000 site visit, wildlife observed in this portion of the park included starling, sparrows, pigeon, and robin. South of the play area, and bordering the Bronx River is a complex of successional mixed deciduous woodland (trees between 30 and 50 feet tall) mixed with ruderal vegetation. The woodland areas occur on either side of the path leading from the play area toward the river and then as a narrow border between the residential area and the ruderal or old-field habitat. Trees within the woodland area include those common to disturbed areas within the City: tree-of-heaven, cottonwood, and some maples. A downy woodpecker was observed in these woods. Most of the southern portion of the park, however, consists of ruderal old field vegetation growing on fill material. Large pieces of construction debris were observed protruding from the soil. Dominant plant species in the ruderal areas included mugwort, milkweeds, knapweed, ragweed, ladies thumb, daisy fleabane, black-eyed Susan, path rush, thistle, Japanese knotweed, common

mullein, rabbits foot clover, mustard, *Phragmites*, asters, and staghorn sumac with some scattered cottonwoods and tree-of-heaven (Appendix 3.D-3, Pictures 29 through 31). Wildlife observed in the ruderal/old field area included: red-winged blackbird, catbird, yellowthroat, song sparrow, goldfinch, ring-neck pheasant, ground hog, mouse or meadow vole, numerous butterflies, grasshoppers, leafhoppers, bees, and land snails. A walking trail runs along the riverfront.

The shoreline on both sides of the Bronx River consists of large riprap with sporadic goldenrod, curly dock, and dodder growing between the rocks. Next to the riprap is an approximately 20-foot-wide band of shrub/scrub vegetation comprising mugwort, staghorn sumac, and milkweed. Wildlife observed in or immediately next to the river included cliff swallow, sparrow, great blue heron, cormorant, sandpiper, and mallard.

At the very southern tip of Soundview Park (Appendix 3.D-3, Picture 32) is a small cove with a narrow fringe (approximately 20 feet wide) of *Spartina alterniflora* marsh next to the boat piers. The *Spartina* wetland then grades into an area covered with groundsel bush. Plover and cormorant were observed in this area. Figure 3.D-4 presents the approximate NYSDEC tidal wetland boundaries for this Representative Area. While the Bronx River and where it discharges to the East River are mapped as littoral zone, this cove area, and a smaller one to the south are mapped as bars and mudflats. The results of the site visit indicate a small area of intertidal wetland as well.

In addition to the wildlife observed during the site visit, other wildlife typical of urban areas and edge and ruderal habitats would be expected to use Soundview Park. These species could include: house mouse, cottontail rabbit, gray squirrel, Norway rat, raccoon, mockingbird, sparrows, flycatchers, mourning dove, common grackle, brown-headed cowbird, purple finch and house finch. The NYNHP has no records of rare, threatened or endangered plants or animals within this portion of the Bronx.Fish expected to occur the Bronx River off Soundview Park include: tautog, menhaden, sculpin, rough and Atlantic silversides, mummichogs and striped killfish, bay anchovy, weakfish, spot, sculpin, summer and winter flounder, Atlantic needlefish, creval jacks, inshore lizardfish, naked goby, northern pipefish, northern puffer, striped searobin, and fourspine stickleback. Seasonal migrants that might occur occasionally in the Bronx River include American shad, alewife, blueback herring, striped bass, white perch, tomcod, and rainbow smelt. Invertebrates likely to occur here include**:** green crabs (*Carcinus meanas*), blue crabs *(Callinectes sapidus*), lady crabs (*Eurypanopeus*)**,** mud crabs (*Panopeus*)**,** fiddler crabs (*Uca*), amphipods, shrimp (*Palaemonetes* and *Crangon septimspinosa*)), soft-shelled clams in the soft sediments, barnacles and blue mussels on the rocks, mud snails (*Nassarius obsoleta*), polychaetes, and tubificids (Oligochaetes) in the shallow areas, and jellyfish.

Jerome Park/Van Cortlandt Park South

This Representative Area is located within the Bronx. As described in Chapter 3.B "Land Use, Community Facilities, Public Policy, and Zoning," land uses include the Jerome Park Reservoir that occupies the center of this Representative Area, institutional uses immediately to the east of the reservoir (Bronx Science High School, Lehman College, Dewitt Clinton High School), several playgrounds and ballfields that provide little wildlife habitat, and the southern portion of Van Cortlandt Park (Mosholu Golf Course, driving range, playground areas, parade ground, and Van Cortlandt Mansion and Museum). Between these areas are residential areas that include large apartment houses, row houses, and single family homes (see Figure 3.B-5).

Jerome Park Reservoir

The 92-acre Jerome Park Reservoir consists of two concrete-bottom basins formed of vertical stone-masonry walls and earth embankment (NYCDEP, 1999a), separated by a dividing wall (Appendix 3.D-3, Picture 33). One of these basins was drawn down at the time of the July 2000 site visit. The NYSDEC classifies Jerome Park Reservoir as Class AA water. Class AA waters are best suited for drinking water supply, primary contact recreation (swimming), secondary contact recreation (boating), fishing, and fish propagation. The reservoir is surrounded by two sets of perimeter fences that prevent access to the public. Vegetation surrounding the reservoir consists of a narrow strip of grass and other herbaceous plants with occasional trees. Table 3.D-20 lists the vegetation documented around the reservoir by NYCDEP (1999).

Table 3.D-20
Vegetation Surrounding Jerome Park Reservoir Documented by NYCDEP (1999)

Common Name	Scientific Name
Trees, Shrubs, and Saplings	
Tree-of-heaven	*Alianthus altissima*
Sugar maple	*Acer saccharum*
Honey locust	*Gleditsia triacanthos*
Tuliptree	*Liriodendron tulipifera*
Crabapple	*Malus sp.*
White mulberry	*Morus alba*
Eastern sycamore	*Plantanus occidentalis*
Black cherry	*Prunus serotina*
Chokecherry	*Prunus virginiana*
Pin oak	*Quercus palustris*
Northern red oak	*Quercus rubra*
Staghorn sumac	*Rhus typhina*
Black locust	*Roninea pseudoacacia*
Black willow	*Salix nigra*
Seedlings/Herbaceous	
Knotweed	*Polygonum sp.*
Knapweed	*Centaurea sp.*
Quack grass	*Agropyrun repens*
Common ragweed	*Ambrosia artemisiifolia*
Mustard	*Cruciferae*
Crab grass	*Digitaria sanguinalis*
Fleabane	*Erigeron sp.*
Holly	*Ilex sp.*
English plantain	*Plantago lanceolata*
Bluegrass	*Poa pratensis*
Potentilla	*Potentilla simplex*
Yellow foxtail	*Setaria glauca*
Goldenrod	*Solidago sp.*
Common dandelion	*Taraxacum officinale*
Red clover	*Trifolium pratense*
Common mullein	*Verbascum thapsus*
Vines	
Bittersweet	*Celastrus orbiculatus*
Virginia creeper	*Parthenocissus quinquefolia*
Poison ivy	*Toxicodendron radicans*
Grape	*Vitis sp.*

Other than the reservoir itself there is little habitat for wildlife. Birds observed around the water during the July 2000 site visit include swallows, American robin, a few mallards, and sparrows. Table 3.D-21 lists other bird documented as occurring around the reservoir by NYCDEP (1999), or expected to occur there. Mammals expected to occur in the vicinity of the reservoir include: Norway rat, gray squirrel, small rodents and rabbits. Because the reservoir is chlorinated it does not provide suitable habitat for invertebrates and fish, and does not provide a food source for waterfowl (NYCDEP 1999a).

Table 3.D-21
Bird Species or Observed or Expected to Occur at
Jerome Park Reservoir by NYCDEP in 1998 (NYCDEP 1999a)

Common Name	Scientific Name
Double-crested cormorant	*Phalacrocorax auritus*
Canada goose	*Branta canadensis*
Mute swan	*Cygnus olor*
American black duck	*Anas rubripes*
Mallard	*Anas platyrhynchos*
Hooded merganser	*Lophodytes cucullatus*
Ruddy duck	*Oxyura jamaicensis*
Hooded merganser	*Lophodytes cucullatus*
Ring-billed gull	*Larus delawarensis*
Herring gull	*Larus argentatus*
Great black-backed gull	*Larus marinus*
Rock dove	*Columba livia*
Mourning dove	*Zenaida macroura*
Blue jay	*Cyanocitta cristata*
American crow	*Corvus brachyrhynchos*
Tree swallow	*Tachycineta bicolor*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bank swallow	*Riparia riparia*
Barn swallow	*Hirundo rustica*
Cliff swallow	*Petrochelidon pyrrhonota*

Van Cortlandt Park South

Van Cortlandt Park comprises approximately 1,146 acres at the northwest Bronx (see Figure 3.B-6 in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning"). It is the third largest of New York City's green spaces and over half of the park is wooded, primarily in the northern end (NYCDPR 1994). The southern portion of the park, and the portion located within this Representative Area, is mostly active recreational facilities such as the 85-acre Mosholu Golf Course, ball fields, playgrounds, and open lawn. Several plant species of special concern have been recorded for Van Cortlandt Park, at least one of which, the State-listed endangered Jacob's-ladder is known to occur within the Allen Shandler Recreation Area as described below. The other plant species of concern documented for the park include the State-listed threatened Bicknell's sedge, State-listed threatened golden-seal, the unprotected hairy field beardgrass, and State-listed threatened wingstem (NYNHP, 2000b).

The portion of the park included in the Representative Area that is west of the Major Deegan Expressway contains part of Van Cortlandt Lake (Appendix 3.D-3, Picture 34). Van Cortlandt Lake

was formed from the damming of Tibbetts Brook in the 1690s and is the largest lake in the Bronx. The 1.5-mile long John Muir Nature Trail runs to the west of the lake. The western portion of the park also contains the Van Cortlandt Mansion (built in 1748 and the oldest building in the Bronx, Appendix 3.D-3, Picture 35), which is surrounded by a landscaped garden, the grass covered 66-acre parade ground (Appendix 3.D-3, Picture 36), swimming pool, playground, and a grove of 30 mature pin oak and Norway maple trees (Memorial Grove). Shade trees observed around the mansion during the July 2000 site visit included pin oak, poplar, Norway maple, and pines. Wildlife observed around the mansion and parade ground included black squirrel, brown-headed cowbird, starling, and American robin.

Van Cortlandt Lake is wooded on the western shoreline. Tree species noted during the site visit included black locust (*Robinia pseudoacacia*), Norway maple (*Acer platanoides*), American elm (*Ulmus americana*), shagbark hickory (*Carya ovata*), red oak (*Quercus rubra*), tulip tree (*Liriodendron tulipifera*), gray birch (*Betula populifolia*), green ash (*Fraxinuns pennsylvanica*), black cherry (*Prunus serotina*), and sassafras (*Sassafras albidum*). Shrubs included northern arrowwood (*Viburnum dentatum*), green briar (*Smilax sp.*), sweet pepperbush (*Clethra alnifolia*), elderberry (*Sambucus canadensis*), and witch hazel (*Hamamelis virginiana*). Herbaceous species included false nettle, jewelweed (*Impatiens capensis*), poison ivy (*Toxicodendron radicans*), New York fern, skunk cabbage (*Symplocarpus foetidus*), deer tongue grass (*Panicum clandestinum*), Virginia creeper (*Parthenocissus quinquefolia*), garlic mustard (Cruciferae), and pokeweed (*Phytolacca rigida*). Other woodland species documented for the park near the lake include silver maple (*Acer saccharinum*), black willow (*Salix nigra*), speckled alder (*Alnus rugosa*), spicebush (*Lindera benzoin*), and sensitive fern (*Onoclea sensibilis)* (BayState Environmental Consultants, 1985b). The eastern shore of the lake is grass lined and also contains patches of broad-leaved cattail (*Typha latifolia*) and *Phragmites* in the water. Duckweed (*Lemna spp*) and pond lily (*Nymphaea spp*) were observed in the pond on the western shoreline. The NYSDEC freshwater wetland boundary presented in Figure 3.D-5 maps the lake as freshwater wetlands within this portion of the park. Other emergent plants documented for the lake include arrow arum (*Peltandra virginica*), arrowhead (*Sagittaria latifolia*), and tussock sedge (*Carex stricta*) (BayState Environmental Consultants, 1985b). Wildlife observations in this portion of the park during the July 2000 site visit included Canada goose, great egret, American robin, catbird, tufted titmouse, gray squirrel, and mute swan.

The lake is highly eutrophic (BayState Environmental Consultants, 1985a), with dominant phytoplankton groups documented for the lake consisting of green algae (*Eudorina elagans, Vovox globator*), blue green algae (*Microcycstis aeruginosa, Anabaena, Aphanacapsa*), diatoms and small flagellates. Fish recorded for the lake include green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), pumpkinseed (*Lepomis gibbosus*), crappies (*Pomoxis sp.*), carp (*Cyprinus carpio*), largemouth bass (*Micropterus salmoides*), yellow perch (*Perca flavescens*), shiners (*Notropis sp.*), goldfish (*Carassius auratus*), and brown bullhead (*Ictalurus nebulosus).* Oligochaetes and midge larvae dominate the benthic macroinvertebrates documented in the lake, with occasional gastropod (snail) or pelecypod (clam). Zooplankton collected from the lake include rotifers, cladocerans, and copepods (BayState Environmental Consultants, 1985b).

Common waterfowl observed by other investigators in association with the lake include: American black duck, wood duck, northern shoveler, American wigeon, mallard, Canada goose, black-crowned night-heron and green heron. Common songbirds documented for the area near the lake include red-winged blackbird, yellow warbler, Baltimore oriole, eastern kingbird, robin, black-capped chickadee, tufted titmouse, nuthatch, sparrow, and woodpeckers. Pheasants, a great horned owl, and American bittern have also been recorded as occurring within the park boundaries. Mammals recorded within

the park include squirrels, chipmunk, muskrat, and cottontail rabbit (BayState Environmental Consultants, 1985b).

The lake receives drainage through a series of impoundments (Henry Hudson Lagoons) constructed along Tibbetts Brook within the park in the mid-1930s during construction of the Henry Hudson Parkway. The outflow from the lake enters the New York City combined sewer system (BayState Environmental Consultants, 1985b). Other sources of inflow into the lake include direct precipitation, surface runoff (including drainage from the southern portion of the Major Deegan Expressway, the Mosholu Parkway Extension, and part of Van Cortlandt Golf Course through three direct pipe outfalls and one indirect outlet into a tributary stream), groundwater seepage, and three spring-fed tributaries modified by the highway storm drainage system. In 1985 oil slicks occurred frequently on the lake following any appreciable rain event. Sixty-two percent of the 2,293 acre watershed for the lake is in Yonkers and 38 percent is within Van Cortlandt Park. Although the lake was 38 acres in 1877, the surface area was only 15 acres in 1985 due to sedimentation, resulting in an emergent and forested wetland system in the northern half of the historical lake basin. The maximum depth of the lake is now approximately 5 feet (NRG, 1990b). The lake and the associated wetland system north to the City border have been classified as a Class I State Protected Wetland (Class I is the most valuable) by NYSDEC. As of 1985, the water quality of Van Cortlandt Lake was designated as Class B.

A walking trail developed within the bed of the old rail line extends south through a narrow mixed deciduous woodland, next to the lake and the mansion. South of the lake and along this trail is a small emergent wetland on the west side of the trail that is dominated by *Phragmites* (Appendix 3.D-3, Picture 37). Red-winged blackbirds were observed in this wetland during the site visit.

The Mosholu Golf Course located at the southeast corner of Van Cortlandt Park and the northeast portion of this Representative Area was built in 1914. This 74-acre Mosholu Golf Course has a 9-hole course on about 59 acres, with a 13-acre driving range, and about 2 acres of parking area and access road (NYCDEP, 1999a). There are strips of woodland within the golf course (NRG, 1990). These woodlands consist of London plane tree (*Platanus acerifolia*), Austrian pine, sassafras, black cherry, pin oak (*Quercus palustris*), and American elm. Forested areas at the perimeter of the course, and particularly just to the north within the Representative Area consist of black cherry, white oak (*Quercus alba*) and pin oak. Wet areas within these woodlands have pin oak, red maple, black willow (*Salix nigra*), and sweetgum (*Liquidambar styraciflua*). NYCDEP (1999) reported a 0.3-acre wetland located within a depression at the northern border of the Mosholu Golf Course.

To the north of the Mosholu Golf Course within the Representative Area is the 70-acre Allen Shandler Recreation Area of Van Cortlandt Park. It includes picnic areas, a parking lot, two ballfields, and a field. Approximately 63 acres of the recreation area is wooded. Dominant species recorded for this area include: black cherry, black locust, bittersweet, rose, and five-leaved aralia. Older woodlands in this area contain black, red, white, and pin oak, with white ash, red maple, and arrowwood in wet areas (NRG, 1990b). According to NYCDEP (1999), there are 5 acres of forested wetland within the Allen Shandler Recreation Area that are not designated on NYSDEC maps (Figure 3.D-5). These wetlands are located at the south east portion of the recreation area, near the Mosholu Golf Course. This forested wetland contains red maple, green ash, pin oak, sweet gum, highbush blueberry (*Vaccinium corombosum*), sweet pepperbush (*Clethra alnifolia*), arrowwood (*Viburnum dentatum*), and skunk cabbage (*Symplocarpus foetidus*) (NYCDEP, 1999a). A smaller 1.8-acre wetland was also identified within one of the ballfields in the recreation area. The State-listed endangered plant, Jacob's ladder, a woodland species, is recorded as occurring within the Allen Shandler Recreation Area. The population found within the recreation area was the largest of the

three populations of this species found within the State in 1998 (NYCDEP, 1999a). Other species observed in the more mature woodlands during the July 2000 site visit included tulip tree, black walnut (*Juglans nigra*), box elder (*Acer negundo*), spice bush, jewelweed, shagbark hickory (*Carya ovata)*, and witchhazel (*Hamamelis virginiana*). Table 3.D-22 lists vegetation observed within the recreation area by the NYCDEP in 1998 (NYCDEP, 1999a).

Table 3.D-22
Dominant Vegetation Known to Occur At The Allen Shandler Recreation Area Based Upon NYCDEP 1998 Survey (NYCDEP, 1999a)

Common Name	Scientific Name
Trees	
Red maple	*Acer rubrum*
Pin oak	*Quercus palustris*
Sycamore	*Palatanus x hybrida*
American elm	*Ulmus americana*
White pine	*Pinus strobes*
Black locust	*Robinia pseudoacacia*
Tree-of-heaven	*Alianthus altissima*
Black cherry	*Prunus serotina*
Sugar maple	*Acer saccharum*
Green ash	*Fraxinus pennsylvanica*
Sweet gum	*Liquidambar styraciflua*
Red oak	*Quercus rubra*
White oak	*Quercus alba*
Tulip tree	*Liriodendron tulipifera*
Vines	
Asiatic bittersweet	*Celastrus orbiculatus*
Poison ivy	*Toxicodendron radicans*
Shrubs	
Multiflora rose	*Rosa multiflora*
Japanese honeysuckle	*Lonicera japonica*
Spicebush	*Lindera benzoin*
Herbs	
Wild garlic	*Allium sp.*
Ragweed	*Ambrosia artemisiifolia*
Poison ivy	*Toxicodendron radicans*
Ground ivy	*Glechoma hederacea*
Lady's thumb	*Polygonum persicaria*
Mugwort	*Artemisia vulgaris*
Japanese knotweed	*Polygonum cuspidatum*
Dandelion	*Traxacum officinale*
Jumpseed	*Tovara Virginia*
Jewelweed	*Impatiens capensis*

Wildlife observed in the woodlands surrounding the playing field and parking lot during the July site visit include: woodthrush, American robin, catbird, downy woodpecker, gray squirrel, goldfinch, catbird, and crow. A small ponded area south of the parking area (Appendix 3.D-3, Picture 38) that appears to be a portion of the wetland area described by NYCDEP (1999) was surrounded by red maple, black cherry, and willow saplings. Table 3.D-23 lists reptiles and amphibians expected to occur within the Allen Shandler Recreation Area and possibly the adjacent Mosholu Golf Course. Table 3.D-24 lists bird species observed or expected to occur (based on historical records) within the Allen Shandler Recreation Area during field studies conducted by NYCDEP in May and June 1998.

Table 3.D-23
Reptiles and Amphibians Expected to Occur in the Vicinity of the Allen Shandler Recreation Area and Mosholu Golf Course

Common Name	Scientific Name
Salamanders/Newts	
Spotted salamander	*Ambystoma maculatum*
Marbled salamander	*Ambystoma opacum*
Red-backed salamander	*Plethodon cinereus*
Frogs/Toads	
American toad	*Bufo americanus*
Chorus frog	*Pseudacris triseriata*
Eastern spadefoot	*Scaphiopus holbrooki*
Woodhouse's toad	*Bufo woodhousei*
Turtles	
Eastern box turtle	*Terrapene carolina*
Lizards	
Five-lined skink	*Emeces fasciatus*
Snakes	
Brown snake	*Storeria dekayi*
Common garter snake	*Thamnophis sirtalis*
Eastern hognose snake	*Heterodon platyrhinos*
Milk snake	*Lampropeltis triangulum*
Racer	*Coluber constrictor*
Rat snake	*Elaphe obsoleta*
Red-bellied snake	*Storeria occipitomaculata*
Ringneck snake	*Diadophis punctatus*
Worm snake	*Carphophis amoenus*

Source: NYCDEP (1999).

Table 3.D-24
Bird Species Observed or Expected to Occur Within the Allen Shandler Recreation Area Based Upon Surveys Conducted by NYCDEP (1999) in May and June 1998

Common Name	Scientific Name	Observed in Allen Shandler Recreation Area	Expected to Occur in Allen Shandler Recreation Area
Double-crested cormorant	*Phalacrocorax auritus*	X	
Green heron	*Butorides virescens (striatus)*		X
Black-crowned nightheron	*Nycticorax nycticorax*		X
Glossy ibis	*Plegadis falcinellus*		X
Canada goose	*Branta canadensis*	X	
Mute swan	*Cygnus olor*		X
Wood duck	*Aix sponsa*		X
Gadwall	*Anas strepera*		X
American black duck	*Anas rubripes*		X
Mallard	*Anas platyrhynchos*	X	
Broad-winged hawk	*Buteo platypterus*		X
Red-tailed hawk	*Buteo jamaicensis*	X	
American kestrel	*Falco sparverius*		X
Ring-necked pheasant	*Phasianus colchicus*	X	
Wild turkey	*Meleagris gallopavo*	X	
Killdeer	*Charadrius vociferus*	X	
Spotted sandpiper	*Actitis macularia*		X
Ring-billed gull	*Larus delawarensis*	X	
Great black-backed gull	*Larus marinus*	X	
Rock dove	*Columba livia*	X	
Mourning dove	*Senaida macroura*	X	
Black-billed cuckoo	*Coccyzus erythropthalmus*		X
Yellow-billed cuckoo	*Coccyzus americanus*		X
Eastern screech-owl	*Otus asio*		X
Common nighthawk	*Chordeiles minor*		X
Chimney swift	*Chaetura pelagica*		X
Belted kingfisher	*Ceryle alcyon*		X
Red-bellied woodpecker	*Melanerpes carolinus*	X	
Downy woodpecker	*Picoides pubescens*	X	
Hairy woodpecker	*Picoides villosus*	X	
Northern flicker	*Colaptes auratus*	X	
Eastern wood-pewee	*Contopus virens*		X
Willow flycatcher	*Empidonax traillii*		X
Eastern phoebe	*Sayornis phoebe*		X
Great crested flycatcher	*Myiarchus crinitus*		X
Eastern kingbird	*Tyrannus tyrannus*	X	
White-eyed vireo	*Vireo solitarius*		X
Blue-headed (solitary) vireo	*Vireo solitarius*		X
Warbling vireo	*Vireo gilvus*		X
Red-eyed vireo	*Vireo olivaceus*	X	
Blue jay	*Cyanocitta cristata*	X	
American crow	*Corvus brachyrhynchos*	X	
Tree swallow	*Tachycineta bicolor*		X
Northern rough-winged swallow	*Stelgidopteryx serripennis*		X
Bank swallow	*Riparia riparia*		X
Barn swallow	*Hirundo rustica*	X	

Table 3.D-24 (continued)
Bird Species Observed or Expected to Occur Within the Allen Shandler Recreation Area Based Upon Surveys Conducted by NYCDEP (1999) in May and June 1998

Common Name	Scientific Name	Observed in Allen Shandler Recreation Area	Expected to Occur in Allen Shandler Recreation Area
Black-capped chickadee	*Poecile (Parus) atricapillus*	X	
Tufted titmouse	*Baeolophus (Parus) bicolor*	X	
White-breasted nuthatch	*Sitta carolinensis*	X	
Brown creeper	*Certhia americana*		X
Carolina wren	*Thryothorus ludovicianus*		X
House wren	*Troglodytes aedon*	X	
Ruby-crowned kinglet	*Regulus calendula*	X	
Veery	*Catharus fuscescens*	X	
Hermit thrush	*Catharus guttatus*		X
Wood thrush	*Catharus mustelinus*	X	
American robin	*Turdus migratorius*	X	
Gray catbird	*Drumetella carolinensis*	X	
Northern mockingbird	*Mimus polyglottus*	X	
Brown thrasher	*Toxostoma rufum*		X
European starling	*Sturnus vulgaris*	X	
Cedar waxwing	*Bombycilla cedrorum*	X	
Blue-winged warbler	*Vermivora pinus*		X
Golden-winged warbler	*Vermivora chrysoptera*		X
Tennessee warbler	*Vermivora peregrina*		X
Nashville warbler	*Vermivora ruficapilla*		X
Northern parula	*Parula americana*	X	
Yellow warbler	*Dendroica petechia*	X	
Chestnut-sided warbler	*Dendroica pensylvanica*		X
Magnolia warbler	*Dendroica magnolia*		X
Cape May warbler	*Denroica tigrina*		X
Black-throated blue warbler	*Dendroica caerulescens*		X
Yellow-rumped (myrtle) warbler	*Dendroica coronata*	X	
Black-throuated green warbler	*Denddroica virens*		X
Blackburnian warbler	*Dendroica fusca*	X	
Pine warbler	*Dendroica pinus*		X
Prairie warbler	*Dendroica discolor*		X
Palm warbler	*Dendroica palmarum*		X
Bay-breasted warbler	*Dendroica castanea*		X
Blackpoll warbler	*Dendroica striata*	X	
Cerulean warbler	*Dendroica cerulea*	X	
Black-and-white warbler	*Mniotilta varia*	X	
American redstart	*Setophaga ruticilla*	X	
Prothonotary warbler	*Protonotaria citrea*		X
Worm-eating warbler	*Helmitheros vermivorus*		X
Ovenbird	*Seiurus aurocapillus*		X
Northern waterthrush	*Seiurus noveboracensis*		X
Louisiana waterthrush	*Seiurus motacilla*		X
Kentucky warbler	*Oporornis formosus*		X
Common yellowthroat	*Geothlypis trichas*	X	
Hooded warbler	*Wilsonia citrina*		X
Canada warbler	*Wilsonia canadensis*		X

Table 3.D-24 (continued)
Bird Species Observed or Expected to Occur Within the Allen Shandler Recreation Area Based Upon Surveys Conducted by NYCDEP (1999) in May and June 1998

Common Name	Scientific Name	Observed in Allen Shandler Recreation Area	Expected to Occur in Allen Shandler Recreation Area
Yellow-breasted chat	*Icteria virens*		X
Scarlet tanager	*Piranga olivacea*		X
Eastern (rufous-sided) towhee	*Pipilo erythrophthalmus*	X	
Chipping sparrow	*Spizella passerina*	X	
Field sparrow	*Spizella pusilla*	X	
Song sparrow	*Melospiza melodia*	X	
White-throated sparrow	*Zonotrichia albicollis*	X	
Northern cardinal	*Cardinalis cardinalis*	X	
Rose-breasted grosbeak	*Pheucticus ludovicianus*	X	
Blue grosbeak	*Guiraca caerulea*	X	
Indigo bunting	*Passerina cyanea*	X	
Red-winged blackbird	*Agelaius phoeniceus*	X	
Common grackle	*Quiscalus quiscula*		X
Brown-headed cowbird	*Molothrus ater*	X	
Orchard oriole	*Icterus spurius*		X
Baltimore oriole	*Icterus galbula*	X	
House finch	*Carpodacus mexicanus*		X
American goldfinch	*Carduelis tristis*	X	
House sparrow	*Passer domesticus*	X	

The Mosholu Golf Course provides a lower quality habitat for mammals than the Allen Shandler Recreation Area due to the frequent mowing and because wooded areas are reduced to small isolated patches. The Allen Shandler Recreation Area, with its larger areas of contiguous woodland, provides higher quality habitat for mammals, some of which may also use the golf course. Table 3.D-25 presents a list of mammals expected to occur in this portion of Van Cortlandt Park based on available habitats, as identified by NYCDEP (1999).

Manhattan's Upper East Side

As presented in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning," this Representative Area covers approximately 90 City blocks, most of which contain high-density residential buildings (see Figure 3.B-6). The only open space areas are a portion of Central Park and Carl Schurz Park along the East River. Carl Schurz Park contains paved walkways, dog runs, riverfront esplanade, playground and basketball courts. These two open space areas are described in greater detail in the following sections.

Central Park

The Upper East Side Representative Area includes approximately half of the 843 acres that comprise Central Park (Figure 3.B-6 in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning"), containing the portion of the park bounded by 96th Street, Fifth Avenue, 72nd Street, and Central Park West. This portion of Central Park contains the Ramble, the Shakespeare Garden, the Great Lawn, the Metropolitan Museum of Art, the Central Park Reservoir and running track, the

Table 3.D-25
Mammals Expected to Occur in the Vicinity of the Allen Shandler Recreation Area Based on NYCDEP (1999)

Common Name	Scientific Name
Marsupialia (Pouched Mammals)	
Virginia oppossum	*Didelphis virginiana*
Insect Eaters: Insectivora (Shrews/Moles)	
Masked shrew	*Sorex cinereus*
Smoky shrew	*Sorex fumeus*
Northern short-tailed shrew	*Blarina brevicauda*
Hairy-tailed mole	*Parascalops breweri*
Eastern mole	*Scalopus aquaticus*
Bats **Family Vespertilionidae (Evening Bats)**	
Lagamorpha	
Eastern cottontail	*Sylvilagus floridanus*
Rodentia (Gnawing Mammals)	
Eastern chipmunk	*Tamias striatus*
Woodchuck	*Marmota monax*
Gray squirrel	*Sciurus carolinensis*
White-footed mouse	*Peromyscus leucopus*
Deer mouse	*Peromyscus maniculatus*
Woodland vole	*Microtus pinetorum*
Meadow vole	*Microtus pennsylvanicus*
House mouse	*Mus musculus*
Norway rat	*Rattus norvegicus*
Procyonidae	
Raccoon	*Procyon lotor*
Mustelidae	
Long-tailed weasel	*Mustela frenata*
Striped skunk	*Mephitis mephitic*
Cervidae	
White-tailed deer	*Odocoileus virginianus*

boathouse and the Lake, Turtle Pond, and other wooded areas within the park. Although there are unvegetated areas within the park occupied by roads, paths and buildings, most of this area is well vegetated, primarily with trees and shrubs, with some grassy areas, the greatest of which is the Great Lawn, as discussed below. The NYNHP has no record of rare, threatened, or endangered species within Central Park.

The 38-acre landscaped Ramble is located between Central Park's Lake and Belvedere Castle. One of the three woodlands within Central Park, it has rocky outcrops, secluded glades and an artificial stream called "the Gill" created when the park was developed through extensive grading, drainage alterations, and planting (Andropogon, 1989). Dominated by Black cherry (*Prunus serotina)*, black locust (*Robinia pseudoacacia)*, American sycamore, London plane tree, American hackberry (*Celtis occidentalis*), sassafras (*Sassafras albidum)*, arrowwood (*Viburnum dentatum*), and multiflora rose (*Rosa multiflora*) that form a system of open woodland thickets and meadows, the Ramble provides the best birding opportunities within the park (NYCDPR, 1994). Approximately 230 species of birds have been recorded in the Ramble, and it is well known for its seasonal warbler migration. More than

20 species of warblers fly through during the spring and fall migration, in April and October, respectively (Central Park Conservancy 2000).

At 22 acres, the Lake, at the southern portion of Central Park that is within the Representative Area, is the largest body of water within the park, excluding the Reservoir. Vegetation observed during the July 2000 site visit (Appendix 3.D-3, Pictures 39 and 40) included a fringe of willows and grass on the water edge, along with catalpa, tree-of-heaven (*Alianthus altissima*), swamp white oak (*Quercus bicolor*), red oak (*Quercus alba*), pin oak (*Quercus palustris*), willow oak (*Quercus phellos*), black walnut, witchhazel, sweet pepperbush (*Clethra alnifolia*), mulberry (*Morus sp.*), locust, black cherry, poison ivy (*Toxicodendron radicans*), American beech (*Fagus grandifolia*), American elm (*Ulmus americana*), red maple (*Acer rubrum*), Norway maple, sycamore (*Plantanus occidentalis*), sweetgum (*Liquidambar styraciflua*), ironwood (*Carpinus caroliniana*), dogwoods, holly (*Ilex sp*), maple-leaved viburnum (*Viburnum acerifolia*), arrowwood, horse chestnut (*Aesculus hippocastanum*), sassafras, ginko (*Ginko biloba*), and birch (*Betula sp*.). Emergent plants forming a small wetland fringe included cattail (*Typha sp.*), *Phragmites*, and lizard's tail (*Saururus cernuus*), with purple coneflower (*Echinacea purpurea*), bergamot (*Monarda sp*.), path rush, New York fern (*Thelypteris noveboracensis*), Japanese knotweed (*Polygonum cuspidatum*), pokeweed (*Phytolacca rigida*), and jewelweed (*Impatiens capensis*) along the shoreline. Wildlife observed around the Lake during the July 2000 site visit included: cardinal, herring gull, sparrows, catbird, mute swan, northern flicker, mallard, mourning dove, house sparrow, and gray squirrel.

Table 3.D-26 presents fish that have been documented within Central Park waterbodies by the Central Park Conservancy (Kim, 2000).

Table 3.D-26
Fish Known to Occur Within Waterbodies of Central Park

Common Name	Scientific Name
Pumpkinseed	*Lepomis gibbosus*
Bluegill	*Lepomis macrochirus*
Golden shiner	*Notemigonus crysoleucas*
Brown bullhead	*Ictalurus nebulosus*
Channel catfish	*Ictalurus punctatus*
European carp	*Cyprinus carpio*
Banded killifish	*Fundulus diaphanus*
Largemouth bass	*Micropterus salmoides*
Yellow perch	*Perca flavescens*
Chain pickerel	*Esox niger*
Rock bass	*Ambloplites rupestris*
Grass carp	*Ctenopharyngodon idellus*

Source: Kim (2000).

Turtle Pond (Appendix 3.D-3, Pictures 41 and 42) is located at the base of Belvedere Castle. It was originally formed when the former Croton Reservoir in Central Park was filled with soil in the 1930'S. The shoreline of the pond was modified and landscaped in 1997 to give it a more irregular shape, and maximize its length. Shoreline plants added at this time include lizard's tail, bulrush (*Scirpus sp.*), turtlehead (*Chelone glabra*), and blueflag iris (*Iris versicolor*) set on concrete shelves at different depths. Turtle Island was added in 1997 to provide sandy spots for turtle nests and foraging sites for birds. The pond provides habitat for turtles, dragonflies, damselflies frogs, wading birds such as herons, as well as waterfowl (Central Park Conservancy, 2000). Wildlife observed in the pond during the July 2000 site visit included: painted turtle (*Chrysemys picta picta*), great egret, cormorant,

mallard, and numerous small fish. At the time of the site visit the pond had a large amount of algae floating on the surface.

To the west of Turtle Pond is the 4-acre Shakespeare Garden. Planted on the steep slope of Vista Rock, the garden provides numerous blooming flowers such as hellebores, columbines, Virginia bluebells, daffodils, violets, tulips, iris, rose, black-eyed Susan, asters poppies, along with holly and Eastern hemlock (Central Park Conservancy, 2000). The garden provides habitat for a variety of insects, including butterflies.

The Great Lawn (Appendix 3.D-3, Picture 43) is located within the Representative Area, just north of Turtle Pond. This 55-acre area was created when the Croton Reservoir was filled with construction rubble in the 1930s, and now contains 8 softball fields, basketball courts and two volleyball courts surrounded by a 1/8 mile track (Central Park Conservancy, 2000). Shade trees and shrubs are scattered throughout this area, particularly at the periphery. These trees and the grassy areas would provide habitat for wildlife that utilize edge habitats in urban environments.

To the northwest of the Great Lawn and south of the Reservoir is the Aurthur Ross Pinetum. Created in 1971, this area contains more than 425 evergreens representing 27 species from around the world. The evergreens provide shelter and nesting habitats for numerous birds and have been known to provide resting areas for migrating long-eared and saw-whet owls in the winter (Central Park Conservancy, 2000).

The 106-acre Reservoir (Appendix 3.D-3, Pictures 44 and 45), completed in 1862, is located at the northern portion of the section of Central Park within the Representative Area. It is no longer used as a drinking water supply and is classified by NYSDEC as Class B surface waters. It is surrounded by a 1.58 mile track. The overflow from the Reservoir provides freshwater to the Pool, Loch, and Harlem Meer in the northern part of Central Park. Birds recorded in and surrounding the Reservoir include gulls, over 20 species of waterfowl, grebes, cormorants, and loons. Sightings are particularly numerous in the winter (Central Park Conservancy, 2000). The Reservoir is surrounded be a chain link fence that stands very close to the stone and cement wall forming the reservoir side. The narrow space between the wall and the fence is occupied by ruderal vegetation such as mugwort (*Artemisia vulgaris*), ragweed (*Ambrosia artemisiifolia*), purple loosestrife (*Lythrum salicaria*), and bouncing bet (*Saponaria officinalis*). Wildlife observed in and around the Reservoir during the July 2000 site visit included, cormorant, lesser black-backed gull, mallard, ring-billed gull, herring gull, and mockingbird.

The large woodland areas and gardens of Central Park provide nesting and foraging habitat for many species of birds, as well as squirrel, and possibly chipmunk, voles, mice, raccoon, cottontail rabbit, and Norway rat. Rats were observed in several areas during the July 2000 site visit. Table 3.D-27 presents a list of birds recorded as breeding within Central Park in 1998 by the New York City Audubon Society (2000). Bird species with the potential to breed within the park include: barn swallow, black-capped chickadee, belted kingfisher, brown-headed cowbird, chimney swift, gadwall, northern mockingbird, ring-necked pheasant, and white-breasted nuthatch. Other species that have been documented for the park include: alder flycatcher, eastern wood pewee, and red-eyed vireo (New York City Audubon Society, 2000). The National Audubon Society Christmas Bird Count (CBC) is an early-winter survey of birds conducted at a site, 15 miles in diameter, on a single day within 2 weeks of December 25 (Butcher 1990). Table 3.D-28 lists the bird species recorded as using Central Park in December (CBC 50 through 59, National Audubon Society, 2000).

Table 3.D-27
List of Birds Known to Breed in Central Park in 1998

Common Name	Scientific Name
American crow	*Corvus brachyrhynchos*
American robin	*Turdus migratorius*
Baltimore oriole	*Icterus galbula*
Blue jay	*Cyanocitta cristata*
Brown thrasher	*Toxostoma rufum*
Cedar waxwing	*Bombycilla cedrorum*
Common grackle	*Quiscalus quiscula*
Common yellowthroat	*Geothlypis trichas*
Downey woodpecker	*Picoides pubescens*
Eastern kingbird	*Tyrannus tyrannus*
European starling	*Sturnus vulgaris*
Fish crow	*Corvus ossifragus*
Great crested flycatcher	*Mylarchus criniths*
Gray catbird	*Dumetella carolinensis*
House finch	*Carpodacus mexicanus*
House sparrow	*Passer domesticus*
House wren	*Troglodytes aedoh*
Mallard	*Anas platyrhynchos*
Mourning dove	*Zenaida macroura*
Mute swan	*Cygnus olor*
Northern cardinal	*Cardinalis cardinalis*
Northern flicker	*Colaptes auratus*
Red-bellied woodpecker	*Centurus carolinus*
Red-tailed hawk	*Buteo jamaiceusis*
Red-winged blackbird	*Agelaius phoehiceus*
Rock dove	*Columba livia*
Rough-winged swallow	*Stelgidopteryx ruficollis*
Song sparrow	*Melospiza melodia*
Tufted titmouse	*Parus bicolor*
Warbling vireo	*Vireo gilvus*
Wood thrush	*Hylociachla mustelina*

Source: New York City Audubon Society (2000).

Carl Shurz Park

Carl Schurz Park (See Figure 3.B-7 in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning") and the adjacent esplanade (the John Finley and Bobby Wagner Walks) (Appendix 3.D-3, Pictures 46 through 49) occupy the riverfront along the East River within the Representative Area. Within Carl Schurz Park, the waterfront consists of a riprapped bank, then wall and paved walkway. This park is landscaped with shade trees, grass, paved paths, playgrounds, two dog runs, and basketball courts. The dominant shade trees are London plane tree, and basswood (*Tilia mericana*). Wildlife observed in the East River off the park during the July 2000 site visit included cormorants, and herring and ring-billed gulls. Within the park, the only wildlife observed was rock doves, starlings, sparrows, squirrels, mice, and Norway rat. Other species expected to use this area include songbirds common to urban areas such as mockingbird, song sparrow, and finch.

Table 3.D-28
National Audubon Society Christmas Bird Count For Central Park

Common Name	Scientific Name
Common loon	*Gavia immer*
Horned grebe	*Podiceps auritus*
Black-crowned night-heron	*Nycticorax nycticorax*
Canada goose	*Branta canadensis*
Green-winged teal	*Anas crecca*
Mallard	*Anas platyrhynchos*
Gadwall	*Anas strepera*
Eurasian wigeon	*Anas penelope*
American wigeon	*Anas americana*
Canvasback	*Aythya valisineria*
Ring-neck duck	*Aythya collaris*
Greater scaup	*Aythya marila*
Lesser scaup	*Aythya affinis*
American scoter	*Melanitta nigra*
White-winged scoter	*Melanitta fusca*
Bufflehead	*Bucephala albeola*
Red-breasted merganser	*Mergus serrator*
Ruddy duck	*Oxyura jamaicensis*
Red-shouldered hawk	*Buteo lineatus*
Red-tailed hawk	*Buteo jamaiceusis*
Peregrine falcon	*Falco peregrinus*
Ring-necked pheasant	*Phasianus colchicus*
Killdeer	*Charadrius vociferus*
Laughing gull	*Larus atricilla*
Black-headed gull	*Larus ridibundus*
Bonaparte's gull	*Larus philadelphia*
Ring-billed gull	*Larus delawarensis*
Herring gull	*Larus argentatus*
Iceland gull	*Larus glaucoides*
Glaucous gull	*Larus hyperboreus*
Great black-backed gull	*Larus marinus*
Rock dove	*Columba livia*
Belted kingfisher	*Megaceryle alcyon*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*
Northern flicker	*Colaptes auratus*
Blue jay	*Cyanocitta cristata*
American crow	*Corvus brachyrhynchos*
Black-capped chickadee	*Parus atricapillus*
Tufted titmouse	*Parus bicolor*
White-breasted nuthatch	*Sitta carolinensis*
Brown creeper	*Certhia familiaris*
Carolina wren	*Thryothorus ludovicianus*
Hermit thrush	*Hylociachla mustelina*
American robin	*Turdus migratorius*
Cedar waxwing	*Bombycilla cedrorum*
American tree sparrow	*Spizella arborea*
Field sparrow	*Spizella pusilla*
Fox sparrow	*Passerella iliaca*
Song sparrow	*Melospiza melodia*

Table 3.D-28 (continued)
National Audubon Society Christmas Bird Count For Central Park

Common Name	Scientific Name
Swamp sparrow	*Melospiza georgiana*
White-throated sparrow	*Zonotrichia albicollis*
Dark-eyed junco	*Junco hyemalis*
Red-winged blackbird	*Agelaius phoehiceus*
Rusty blackbird	*Euphagus carolinus*
Purple grackle	*Quiscalus quiscula*
Brown-headed cowbird	*Molothrus ater*
Purple finch	*Carpodacus purpureus*
Pine siskin	*Carduelis pinus*
American goldfinch	*Carduelis tristis*
House sparrow	*Passer domesticus*
American goldeneye	*Bucephala clangula*
American merganser	*Mergus merganser*
Black duck	*Anas rubripes*
Cardinal	*Cardinalis cardinalis*
Common starling	*Sturnus vulgaris*
Pintail	*Anas acuta*
Kestrel	*Falco sparverius*

Source: National Audubon Society (2000)

Lemon Creek/Wolfe's Pond Park

This Representative Area in southern Staten Island (See Figure 3.B-7 in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning") is characterized by large areas of open space containing substantial natural resources and residential development as described in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning." The open space areas are primarily within two City-owned parks, Lemon Creek Park and Wolfe's Pond Park, and the State-owned wetlands north of Lemon Creek Park that are contiguous with the City-owned wetlands. Both parks provide shoreline access to Raritan Bay and a mixture of active and passive recreation opportunities.

Other open space areas are contained within a summer camp, Camp St. Edwards located on Hylan Boulevard at Woodvale Avenue, and a cemetery located on Sharrott Avenue and Hylan Boulevard. The habitat present at the cemetery and summer camp is open grassy area with scattered shade trees that would provide habitat for species common to edge habitats and human developments such as American robin, mourning dove, mockingbird, sparrows, house finch, starling, and American crow. Mammals possible in these areas include cottontail rabbit, gray squirrel, meadow vole, mouse, and woodchuck. The following sections provide a description of the resources present around Lemon Creek and Wolfe's Pond Park based on previous studies and observations made during the July 2000 site visit. The NYNHP has only one record of any rare, threatened or endangered species within this Representative Area, that of the endangered plant Jacob's ladder within Wolfe's Pond Park (NYNHP, 2000b).

Both sites border Raritan Bay, and Lemon Creek discharges to the Bay. Raritan Bay near the shoreline is relatively shallow with relatively wide intertidal and shallow subtidal areas along the shoreline. The Bay itself is usually less than 20 feet deep (6 meters). Because the water is shallow, the near shore area of Raritan Bay is strongly influenced by terrestrial inputs, rather than the marine influence of the New York Bight. The tidal range of Raritan Bay averages 5.5 feet (1.7 meters). The

estuarine habitats found bordering Raritan Bay provide regionally significant habitat for shellfish, marine, estuarine, and anadromous fish, and for migratory and wintering waterfowl. The wetlands are important as fish nursery areas, foraging areas for shorebirds and waterbirds, and the wetlands and adjacent uplands are also important for nesting and foraging areas for terrapins, migratory and wintering stopover habitat for songbirds and raptors, and also provide habitats for rare plants and communities (USFWS, 1997).

Lemon Creek

The natural resources found in and associated with Lemon Creek are located within the 106-acre Lemon Creek Park administered by the City of New York, and the 32-acre wetland preservation area administered by NYSDEC (NYCDEP, 1998). Lemon Creek is tidally influenced within both NYSDEC and New York City properties—it is the only remaining natural tidal creek/wetland ecosystem found on the south shore of Staten Island (USFWS, 1997). The NYSDEC area (Appendix 3.D-3, Picture 50) includes the tidal and nontidal wetlands north of Hylan Boulevard, which have been identified as significant habitat by NYSDEC. This designation was for the significant urban wildlife habitat, as well as the nesting and feeding area for waterfowl and other birds (Woodward-Clyde 1985 in SRI, 1989) the marsh provides. The City-owned land begins south of Hylan Boulevard between Seguine and Bayview Avenues, continues west along Johnston Terrace, and ends at Sharrott Avenue. It includes the creek, the tidal wetlands on either side of the creek, a narrow strip of mixed oak deciduous woodlands on either side of the marsh, a marina, beach front, and a public fishing pier (Appendix 3.D-3, Pictures 51 through 55). The beach front area (Appendix 3.D-3, Picture 55) extends along Johnston Terrace and ends at Sharrott Avenue. The City leases the marinas to private marina operators. The marina is heavily used, and the beachfront, though not a designated beach, is used for sunbathing and picnicking during the summer (NYCDEP, 1998). The New York State Coastal Management Program has also designated Lemon Creek from its mouth to Woodvale Avenue as Significant Coastal Fish and Wildlife Habitat (SRI, 1989).

A tidal creek, Lemon Creek receives freshwater from the stream running through Bloomingdale Park to the north. Saltmarsh plants found in the tidal marsh include seaside goldenrod and saltmarsh cordgrass. The beach area associated with Lemon Creek is also known as a good area to observe the fall migration of monarch butterflies in October (NRG, 1991b). During the July 2000 site visit, numerous dragonflies and butterflies were observed in the saltmarsh toward the mouth of Lemon Creek, and in NYSDEC wetland.

Approximately 100 acres of freshwater wetlands and 50 acres of tidal wetlands occur within the Lemon Creek system (NYCDEP, 1998), 8 acres of which are located in the NYSDEC wetland preservation area purchased by the State in 1980 (SRI, 1989). The width of the tidal Lemon Creek ranges from 30 to 50 feet. The mouth of Lemon Creek is approximately 5 feet deep at low tide (SRI 1989). The Lemon Creek tidal wetland system includes littoral zone (mean low water to about 6 feet below mean low water found within channel of the creek), intertidal marsh (low marsh of salt marsh cordgrass, *Spartina alterniflora*, that is inundated by marine tidal water twice daily), high marsh (salt meadow grass, *Spartina patens*, spike grass, and black grass with salt marsh elder, groundsel bush, and *Phragmites* in the upper areas, inundated twice monthly by spring tides, and by storm surges over mean high water), and tidal freshwater marsh dominated by grasses, sedges, and rushes with marsh wildflower species) (NYCDEP, 1998) The low marsh areas consist of a narrow band along the sides of the main channel, smaller tidal creeks, and mosquito ditches. The high marsh occurs in areas irregularly flooded by tidal waters. Marsh elder is often found in bands along channel levees and the upper limit of tidal waters where the soils are better drained and aerated (SRI, 1989). Figure 3.D-6,

presents the approximate boundaries of the NYSDEC mapped tidal and freshwater wetlands within the Lemon Creek/Wolfe's Pond Representative Area. Although intertidal marshes are not indicated within the figure, other information and the results of the site visit indicate their presence within the Lemon Creek system.

Table 3.D-29 lists plants that have been documented within the Lemon Creek tidal marsh south of Hylan Boulevard. Based upon the July 2000 site visit, the system consists of saltmarsh vegetation dominated by *Spartina alterniflora*, bordered by a forested wetland and upland woodland fringe. Table 3.D-30 lists plants that have been documented in the Lemon Creek wetland system north of Hylan Boulevard, within the NYSDEC wetlands. This list includes plant species recorded for Bloeser's Pond, which is located within the drainage for this portion of Lemon Creek, to the west of the creek. Bloeser's Pond, is a shallow pond (1 to 2 feet deep), approximately 3 acres in size, surrounded by forested wetland dominated by deciduous species and a thick understory of green briar (NYCDEP, 1998, SRI, 1989). The portion of Lemon Creek north of Hylan Boulevard also appears to be dominated by *Spartina alterniflora* next to the creek but appears to have more forested wetlands surrounding it.

Table 3.D-31 presents a list of amphibians, reptiles, and mammals documented as occuring within the Lemon Creek wetland system. In addition to these species, other organisms that have the potential for occurring in this area are snapping turtle (*Chelydra serpentina*), northern black racer (*Coluber constrictor constrictor*), muskrat (*Ondatra zibethica*), opossum (*Didelphis virginiana*), meadow vole (*Microtus pennsylvanicus*) and other rodents, bats, and red fox (*Vulpes fulva*) (NYCDEP, 1998). Raccoon prints were noted near the creek during the July 2000 site visit.

Mud snails and fiddler crabs have been observed in the Lemon Creek wetlands, as well as bivalves, crustaceans, and polychaete worms (NYCDEP, 1998). Fiddler crabs were observed in the Lemon Creek salt marsh next to the marina during the July 2000 site visit. Blue crab cages were also observed within the creek, along with blue mussel and oyster shells. Benthic invertebrates north of Amboy Road bridge were primarily pollutant-tolerant leeches, worms, snails, and midges, typical of a community located downstream of a sewage treatment plant or one receiving organic wastes (NYCDEP, 1998). Although Lemon Creek is not known to be a major spawning or nursery area for fish, it supports many fish that are now uncommon in this area of Staten Island. Fish expected to use Lemon Creek include mummichog, blueback herring, alewife, bay anchovy, sand lance, and possibly American shad, American eel, silver hake, Atlantic and tidewater silverside, and striped bass (Howells and Brundage, 1977 in SRI, 1989). Fish documented as occurring in one of the tributaries feeding into the portion of the wetland north of Hylan Avenue include catfish, sunfish, gambusia, and yellow perch (SRI, 1989). Over 90 species of fish have been reported within the Raritan Bay/Sandy Hook Complex. The most abundant are estuarine species that would also be expected to use Lemon Creek year round. These include mummichog (*Fundulus heteroclitus*), white perch (*Morone americana*), and hogchoker (*Trinectes macalatus*). Recreational fish found within the bay include weakfish (*Cynoscion regalis*), bluefish (*Pomatomus saltatrix*), winter flounder (*Pleuronectes americanaus*), summer flounder (*Paralichthys dentatus*), striped bass (*Morone saxatilis*), sea bass (*Centropristis striata*), tautog (*Tautoga onitis*), scup (*Stenotomus chrysops*), and spot (*Leiostomas xanthurus*). Commercial fisheries include American shad (*Alosa sapidissima*), American eel (*Anguilla rostrata*), American lobster (*Homarus americanus*), horseshoe crab (*Limulus polyphemus*), and blue crab (*Callinectes sapidus*). Shellfish found within the bay include northern quahog (*Mercenaria mercenaria*), soft clam (*Mya arenaria*), blue mussel (*Mytilus edulis*), and eastern oyster (*Crassostrea virginica*) (USFWS, 1997).

Table 3.D-29
Vegetation Observed Within Lemon Creek Tidal Marsh
South of Hylan Boulevard Based on SRI (1989)

Common Name	Scientific Name
Herbaceous	
Aster	*Aster sp.*
Common mullein	*Verbascum thapsus*
Curled dock	*Rumex crispus*
Fathen saltbush	*Atriplex patula*
Glasswort	*Sarcocornia perennis*
Goldenrod	*Solidago uliginosa*
Grass, upland	*Gramineae*
Japanese knotweed	*Polygonum cuspidatum*
Pokeweed	*Phytolacca rigida*
Common reed	*Phragmites australis*
Salt meadow grass	*Spartina patens*
Sand spurry	*Spergularia marina*
Seaside goldenrod	*Solidago sempervirens*
Smooth cordgrass	*Spartina alterniflora*
Spike grass	*Distichlis spicata*
Yarrow	*Achillea millefolium*
Shrubs	
Arrowwood	*Viburnum dentatum*
Choke cherry	*Prunus virginiana*
Elderberry	*Sambucus canadensis*
Deadly nightshade	*Solanum dulcamara*
Greenbrier	*Smilax rotundifolia*
Japanese honeysuckle	*Lonicera japonica*
Japanese barberry	*Berberis thundbergii*
Marsh elder	*Iva frutescens oraria*
Poison ivy	*Rhus radicans*
Raspberry	*Rubus strigosus*
Red chokeberry	*Aronia arbutifolia*
Sassafras	*Sassafras albidum*
Shining sumac	*Rhus copallina*
Trees	
American beech	*Fagus grandifolia*
American chestnut	*Castanea dentata*
Black cherry	*Prunus serotina*
Black locust	*Robinia pseudoacacia*
Chestnut oak	*Quercus muehlenbergii*
Hickory	*Carya sp.*
Pin oak	*Quercus palustris*
Poplar	*Populus sp.*
Post oak	*Quercus stellata*
Red oak	*Quercus rubrum*
Red maple	*Acer rubrumr*
Sassafras	*Sassafras albidium*
Sugar maple	*Acer saccharum*
Sweetgum	*Liquidambar styraciflua*
Tree-of-heaven	*Ailanthus altissima*
Blackgum	*Nyssa sylvatica*
White oak	*Quercus alba*

Table 3.D-30
Vegetation Documented for the NYSDEC wetlands within the Lemon Creek Wetland System Based Upon SRI (1989)

Common Name	Scientific Name
Trees	
Blackgum	*Nyssa sylvatica*
Pin oak	*Quercus palustris*
Red maple	*Acer rubrum*
Swamp white oak	*Quercus bicolor*
Sweet gum	*Liquidambar styraciflua*
Willows	*Salix spp.*
Shrubs	
Alders	*Alnus sp.*
Arrowwod	*Viburnum dentatum*
Buttonbush	*Cephalanthus occidentalis*
Chokeberry	*Aronia arbutifolia*
Dogwood	*Cornus sp.*
Elderberry	*Sambucus canadensis*
Highbush blueberry	*Vaccinium corymbosum*
Spicebush	*Lindera benzoin*
Swamp azalea	*Rhododendron viscosum*
Emergent Vegetation	
Arrow arum	*Peltandra virginica*
Bulrushes	*Scirpus sp.*
Cattails	*Typha sp.*
Common reed	*Phragmites australis*
Herbs	
Cinnamon fern	*Osmunda cinnamomea*
False hellebore	*Veratrum viride*
Horsetail	*Equisetum fluviatile*
Jewelweed	*Impatiens capensis*
Marsh mallow	*Hibiscus moscheutos*
Marsh St. John's wort	*Triadenum virginicum*
Pipewort	*Eriocaulon septangulare*
Smartweed	*Polygonum sp.*
Wet Meadow	
Reed canary grass	*Phalaris arundinacea*
Rice cut grass	*Leersia oryzoides*
Rushes	*Juncus sp.*
Spike rush	*Eleocharis sp.*
Bog Mat	
Sphagnum moss	*Sphagnum spp.*

Table 3.D-31
List of Amphibians, Reptiles and Mammals Known to Occur Within the Lemon Creek Wetland System According to SRI (1989)

Common Name	Scientific Name
Amphibians	
Bullfrog	*Rana catesbeiana*
Fowler's toad	*Bufo woodhousei fowleri*
Gray tree frog	*Hyla versicolor*
Green frog	*Rana clamitans melanota*
Spring peeper	*Hyla crucifer*
Dusky salamander	*Desmognathus fuscus fuscus*
Reptiles	
Box turtle	*Terrapene carolina*
Painted turtle	*Chrysemys picta picta*
Garter snake	*Thamnophis sirtalis*
Water snake	*Nerodia sipedon sipedon*
Mammals	
Eastern cottontail	*Sylvilagus floridanus*
Gray squirrel	*Sciurus carolinensis*
Raccoon	*Procyon lotor*

Lemon Creek has been classified as Class B for freshwater by the New York State in accordance with 6 New York State Official Compilation of Codes, Rules, and Regulations of the State of New York (NYSCRR) Part 890.6. The goal for Class B is suitability of the waterbody for primary and secondary contact recreation (swimming and boating), and fishing, as well as for fish propagation and survival. NYCDEP found that existing water conditions within the Lemon Creek watershed exceed the New YorkState water quality standards for fecal coliform bacteria (monthly geometric mean based on a minimum of five samples shall not exceed 200 mpn/100mL), and are below the standard for DO (minimum daily average shall not be less than 5.0 mg/L, and shall never be below 4 mg/L) due to illegal sewer connections, failing septic systems, stormwater runoff, and functioning septic systems (NYCDEP, 1998). Lemon Creek has also been classified as Class SC for tidal waters, which requires that DO concentrations never be less than 5 mg/L (NYCDEP, 1998).

The park is noted for the City's only purple martin colony. It is located at the southern portion of the marsh, near Johnson Terrace, and is housed in numerous birdhouses constructed by the local naturalist and historian Howard Cleaves (NYCDPR, 1994; NYCDEP, 1998). These birds feed off the insects from a shallow pond nearby (SRI, 1989) and were observed feeding on insects next to the marina during the July 2000 site visit. Lemon Creek is used as a stop for migratory birds in the spring and fall, as well as during the winter. The location of Raritan Bay within the Atlantic flyway, along with the productive wetlands, flats, and waters of the bay make it an important migratory staging area for waterfowl, with peak migration in October. Migratory waterfowl known to occur in the bay at southern Staten Island include American black duck (*Anas rubripes*), canvasback (*Aythya valisneria*), mallard (*Anas platyrhynchos*), brant (*Branta bernicla*), bufflehead (*Bucephala albeola*), oldsquaw (*Clangula hyemalis*), mergansers, and American wigeon (*Anas americana*). Over-wintering waterfowl include double-crested cormorants (*Phalacrocorax auritus*) and great-crested cormorants (*Phalacrocorax carbo*). Peak migration occurs in the spring for migratory shorebirds and in June and August for neotropical migrants. Shorebirds using the area during migration include sanderling (*Calidris alba*), ruddy turnstone (*Arenaria interpres*), and semipalmated sandpiper (*Calidris pusilla*). Breeding birds that occur along the Bay shoreline include American black duck, mallard, clapper rail

(*Rallus longirostris*), king rail (*Rallus elegans*), green-backed heron (*Butorides striatus*), marsh wren (*Cistothorus palustris*), and willet (*Catoptrophorus semipalmatus*). Songbirds known to nest in the woodlands of southern Staten Island around the Bay include wood thrush (*Hylocichla mustelina*) and numerous vireos, warblers, and flycatchers (USFWS, 1997).

Species known to occur in the marsh include green-backed heron, black-crowned night heron, mallard, clapper rail, belted kingfisher, tree swallow, rough-winged swallow, purple martin, common yellowthroat, red-winged blackbird, common grackle, egrets, gulls, and great blue heron. Species observed in the marsh during the site visit include red-winged black bird, mallard, blue jay, and great egret. Table 3.D-32 presents a list of birds documented by other investigators as occurring within the Lemon Creek wetland system.

Wolfe's Pond Park

Wolf Pond Park was acquired by the City in 1929 (Atkinson, undated). It encompases 317 acres that are bounded by the Staten Island Rapid Transit line to the north, Holten Street to the west, Chisholm Street and Luten Avenue to the east, and Raritan Bay to the south (See Figure 3.B-7 in Chapter 3.B, "Land Use, Community Facilities, Public Policy and Zoning"). Approximately 227 acres of the park are undeveloped. The park is divided into a northern and southern portion by Hylan Boulevard. The portion of the park north of Hylan Boulevard includes the 2.9-acre Acme Pond and undeveloped woodlands. The southern portion of the park includes the 15.3-acre Wolfe's Pond, woodlands surrounding the pond and extending north to Hylan Boulevard, woodland walking trails, athletic facilities (tennis courts, roller hockey rink), parking area, playground, picnic tables and barbecues, a playing field, beach access, and a bathhouse.

At the time of the July 2000 site visit, the playing field was an open grassy area that was maintained through mowing almost up to the beach. This grassy area provides no cover for wildlife but may be used occassionally for foraging by birds such as American robin, and mammals such as the eastern cottontail and woodchuck when human use of the park is low. A very narrow band of shrubs and saplings separated the grass from the beach. The tennis courts, roller hockey rink and playground were located close to the beach at the eastern end of the park, just south of the park entrance. These facilities are intermixed with grass and patches of shade trees and natural herbaceous vegetation and shrubs (Appendix 3.D-3, Picture 56). A small area of standing water was observed in this portion of the park near the tennis courts (Appendix 3.D-3, Picture 57). Shade trees scattered through this active recreational area included green ash, silver maple, Norway maple, mulberry, red maple, and sweet gum. Table 3.D-33 presents a list of plant species that have been documented for the park. Tables 3.D-34 and 35 present a list of animal and bird species that have been documented for the park. Wet areas contained herbaceous species such as water plantain, tickseed sunflower, purple loosestrife, groundsel, and cattail. Drier areas contained tiger lily, pokeweed, Virginia creeper, and other herbaceous plants. This area provides edge type habitat, and should provide some foraging and nesting habitat for species preferring these types of areas. Wildlife observed in this area during the site visit included: great crested flycatcher, mourning dove, common grackle, sparrows, and raccoon (footprints).

Table 3.D-32
Birds Documented as Occurring Within the
Lemon Creek Wetland System Based Upon SRI (1989)

Common Name	Scientific Name
Herons	
Great blue heron	*Ardea herodias*
Green heron	*Butorides striatus*
Waterfowl	
American widgeon	*Anas Americana*
Canada goose	*Branta canadensis*
Herring gull	*Larus argentatus*
Mallard	*Anas platyrhynchos*
Hawks and Eagles	
Sharp shinned hawk	*Accipiter striatus*
Galliforms	
Ring-neck pheasant	*Phasianus colchicus*
Kingfishers	
Belted kingfisher	*Megaceryle alcyon*
Woodpeckers	
Downy woodpecker	*Picoides pubescens*
Flycatchers	
Empidonax flycatcher	*Epidonax sp.*
Great crested flycatcher	*Mylarchus criniths*
Swallows	
Barn swallow	*Hirundo rustica*
Tree swallow	*Iridoprocne bicolor*
Rough-winged swallow	*Stelgidopteryx ruficollis*
Purple martin	*Progne subis*
Crows and Jays	
American crow	*Corvus brachyrhynchos*
Fish crow	*Corvus ossifragus*
Blue jay	*Cyanocitta cristata*
Titmic	
Black-capped chickadee	*Parus atricapillus*
Tufted titmouse	*Parus bicolor*
Mockingbirds and Thrashers	
Brown thrasher	*Toxostoma rufum*
Gray catbird	*Dumetella carolinensis*
Mockingbird	*Mimus polyglottos*
Thrushes	
American robin	*Turdus migratorius*
Warblers	
Palm warbler	*Dendroica palmarum*
Redstart	*Sexophaga ruticilla*
Yellow warbler	*Dendroica petechia*
Common yellow throat	*Geothlypis trichas*
Blackbirds	
Grackle	*Quiscalus quiscula*
Red-winged blackbird	*Agelaius phoehiceus*
Sparrows	
Slate colored junco	*Junco hyemalis*
White-throated sparrow	*Zonotrichia albicollis*
Song sparrow	*Melospiza melodia*

Table 3.D-32 (continued) Birds Documented as Occurring Within the Lemon Creek Wetland System Based Upon SRI (1989)	
Common Name	**Scientific Name**
Eastern Towhee	*Pipilo erythrophthalmus*
Grosbeaks and Finches	
Cardinal	*Cardinalis cardinalis*
Indigo bunting	*Paserina cyanea*

The undeveloped portions of Wolfe's Pond Park includes upland forest dominated by oak, hickory, and American beech, and lowland forest dominated by sweetgum, red maple, black gum, and pin oak. The endangered plant, Jacob's ladder, has been recorded as occurring within the park (NYNHP, 2000b). The park has two glacially formed ponds as well as 13.1 acres of beach, a 5.2-acre intertidal zone, and marsh areas (NRG, 1992; USFWS, 1997). Approximately 61.4 acres of wetland have been identified within the Wolfe's Pond watershed, 44 percent palustrine broad-leaved deciduous forest wetlands, 41 percent palustrine open water, 7 percent palustrine emergent wetlands, 5 percent palustrine scrub/shrub wetlands, and 3 percent riverine (NYCDEP, 1999b). Figure 3.D-6 indicates the approximate locations of the NYSDEC identified freshwater and tidal wetlands for both Wolfe's Pond and Lemon Creek. These wetland areas include the two ponds and their associated wetland areas, as well as pockets of wetlands in depression areas within the woodlands of the northern portion of the park, as described below. As of 1999, the stream feeding into Acme Pond, both ponds, and the stream connecting them exceeded the New York State water quality standards for fecal coliform and DO. The drainage area for Wolfe's Pond is about 589 acres, consisting of developed and undeveloped land uses. Impervious coverage is about 50 percent in the northern part of the watershed that drains to Acme Pond (NYCDEP, 1999b).

At the time of the July 2000 site visit, the beach area included a sand-cobble beach approximately 50 to 60 feet wide, with an approximately 40-foot-wide vegetated dune area from the picnic area south (Appendix 3.D-3, Pictures 58 and 59). Shorebirds commonly observed along the cobble beach area of Wolfe's Pond Park include spotted sandpipers, killdeer, and ruddy turnstones. Killdeer are known to nest in the beach area. Other birds found on the beach include laughing gull, herring gull, the State-listed threatened common tern, and state-listed endangered least tern. Wildlife observed on the beach during the July 2000 site visit included: cormorant, herring gull, laughing gull, and Canada goose. The intertidal zone is vegetated with saltmarsh cordgrass, sea lettuce, and Argardh's red weed. Brant frequently forage along the water's edge in the spring. Invertebrates within the intertidal zone of the beach (between low and high tide marks) include soft shell clam, sand worms, ribbon worms, scuds, white rock barnacles, blue mussells, and young jellyfish, common periwinkles, hermit crabs, mud snails, and blue crabs. Other shellfish found along the shoreline include quahog clam, razor clam, pink slipper, and ribbed mussels (Atkinson undated, NRG 1992). The same natural resources for Raritan Bay discussed for Lemon Creek Park would be found in the shoreline area of Wolfe's Pond Park.

A narrow band of dune vegetation is present between the beach and the developed areas of the park. Beach grass is the most common plant on the seaward side of the dunes, along with sea rocket, saltwort, seaside goldenrod, and evening primrose. On the landward side of the dunes, vegetation consists of dwarf sumac and white poplar, oaks, Japanese knotweed, Asiatic bittersweet, Virginia creeper, and poison ivy (Atkinson, undated).

Table 3.D-33
Plants Found in Wolfe's Pond Park

Common Name	Scientific Name
Intertidal Zone	
Saltmarsh cordgrass	*Spartina alterniflora*
Sea lettuce	*Ulva lactuca*
Argardh's red weed	*Agardhiella tenera*
Beach/Dune	
Salt meadow cordgrass	*Spartina patens*
Beach grass	*Ammophila breviligulata*
Sea rocket	*Cakile edentula*
Saltwort	*Salsola kalf*
Seaside goldenrod	*Solidago sempriverens*
Seaside spurge	*Euphorbia polygonifolia*
Sandbur grass	*Cenchrus longispinus*
Clot bur	*Xanthium chinense*
Evening primrose	*Oenothera biennis*
Dwarf sumac	
White poplar	*Populus alba*
Japanese knotweed	*Polygonum cuspidatum*
Asiatic bittersweet	*Celastrus orbiculatus*
Poison ivy	*Toxicodendron radicans*
Virginia creeper	*Partthenocissus quinquefolia*
Aquatic Vegetation	
Water dock	*Rumex obtusifolius*
White water lily	*Nymphaea odorata*
Water smartweed	*Polygonum amphibiam*
Duckweed	*Lemna sp.*
Arrow arum	*Peltandra virginica*
Upland Woodlands	
White oak	*Quercus alba*
Northern red oak	*Quercus rubrum*
Black oak	*Quercus velutina*
Pin oak	*Quercus palustris*
Black locust	*Robinia pseudoacacia*
Sweet gum	*Liquidambar styraciflua*
Sassafras	*Sassafras albidium*
Gray birch	*Betula populifolia*
Tulip tree	*Liriodendron tulipifera*
Beech	*Fagus grandifolia*
Shagbark hickory	*Carya ovata*
Red maple	*Acer rubrum*
American elm	*Ulmus americana*
Ash	*Fraxinus spp.*
Ironwood	*Carpinus caroliniana*
Maple-leafed viburnum	*Viburnum acerifolia*
Wild sarsaparilla	*Aralia nudicaulis*
Lowbush blueberry	*Vaccinium angustifolium*
Wild cucumber	*Echinocystis lobata*
Canadian mayflower	*Maianthemum canadense*
Virginia creeper	*Partthenocissus quinquefolia*
Mayapple	*Podophyllum peltatum*

Table 3.D-33
Plants Found in Wolfe's Pond Park

Common Name	Scientific Name
Emergent and Scrub/Shrub Wetlands	
Skunk cabbage	*Symplocarpus foetidus*
Buttonbush	*Cephalanthus occidentalis*
Arrow arum	*Peltandra virginica*
Common reed	*Phragmites australis*
Elderberry	*Sambucus canadensis*
Swamp rose mallow	*Hibiscus palustris*
Sedges	*Carex spp.*
Soft rush	*Juncus effuses*
Cattails	*Typha spp.*
Forested Wetlands	
Red maple	*Acer rubrum*
Sweet gum	*Liquidambar styraciflua*
Silver maple	*Acer saccharinum*
Blackgum	*Nyssa sylvatica*
White oak	*Quercus alba*
Pin oak	*Quercus palustris*
Black willow	*Salix nigra*
Arrowwod	*Viburnum dentatum*
Black cherry	*Prunus serotina*
Persimmon	*Diospyros virginiana*
Silky dogwood	*Cornus amomum*
Spicebush	*Lindera benzoin*
Swamp azalea	*Rhododendron viscosum*
Maleberry	*Lyonia ligustrina*
Sweet pepperbush	*Clethra alnifolia*
Highbush blueberry	*Vaccinium corymbosum*
Lowbush blueberry	*Vaccinium angustifolium*
Multiflora rose	*Rosa multiflora*
Jewelweed	*Impatiens capensis*
Jack-in-the-pulpit	*Arisaema triphyllum*
Cinnamon fern	*Osmunda cinnamomea*
Canadian mayflower	*Maianthemum canadense*
Sensitive fern	*Onoclea sensibilis*
Wild cucumber	*Echinocystis lobata*
Meadow rue	*Thalictrum polygamum*
Sedges	*Carex spp.*
Tearthumbs	*Polygonum spp.*
False nettle	*Boehmeria cylindrica*
Royal fern	*Osmunda regalis*
Lowland broomsedge	*Andropogon glomeratus*
Haygrass	
Skunk cabbage	*Symplocarpus foetidus*
Virginia creeper	*Partthenocissus quinquefolia*
Poison Ivy	*Toxicodendron radicans*
Greenbriar	*Smilax sp.*
Mosses	

Source: Atkinson (undated), NRG (1992), ZBA and JHCC (1987), and results of July 2000 site visit.

Table 3.D-34
Animals Kown to Occur Within Wolfe's Pond Park

Common Name	Scientific Name
Mammals	
Gray squirrel	*Sciurus carolinensis*
Woodchuck	*Marmota monax*
Muskrat	*Ondatra zibethica*
Raccoon	*Procyon lotor*
Norway rat	*Rattus norvegicus*
Deer mouse	*Peromyscus maniculatus*
Eastern chipmunk	*Tamias striatus*
Eastern cottontail	*Sylvilagus floridanus*
Amphibians	
Red-backed salamander	*Plethodon cinereus*
American toad	*Bufo americanus*
Spring peeper	*Hyla crucifer*
Reptiles	
Painted turtle	*Chrysemys picta picta*
Snapping turtle	*Chelydra serpentina*
Garter snake	*Thamnophis sirtalis*

Source: Atkinson (undated), NRG (1992), NYCDEP (1999b), ZBA and JHCC (1987), and results of July 2000 site visit.

Table 3.D-33 lists the plants found within the intertidal zone and beach area. Vegetation observed in the dune area at the time of the July 2000 site visit included: a rose, Japanese knotweed, sumac, beach grass, Virginia creeper, Asiatic bittersweet, and goldenrod. Wildlife observed using this area included: red-winged blackbird, numerous butterflies, kingbird, eastern cottontail (pellets), and mockingbird.

The picnic grove on the east side of Wolfe's Pond and north of the beach is planted with London plane tree, pin and willow oaks, and honey locust (Atkinson, undated). Other trees observed in this area during the July 2000 site visit included: hawthorne (*Crataegus sp*.), mulberry (*Morus. sp.*), red and black oak, sweet gum, and black cherry. Ground cover between the trees was grass, chicory, or bare ground. As was the case for the active recreational area, the picnic grove would provide nesting and foraging habitat for species preferring edge habitat and tolerant of human disturbance. Wildlife observed in this area during the site visit included: American robin, gray squirrel, and common crow.

Wolfe's Pond is a freshwater pond located north of the beach. It was originally formed from the natural damming of a tidal inlet, although it is now maintained by a permanent dam constructed when the City acquired the property (ZBA and JHCC, 1987). Overflow from the pond exits at a weir into an open channel that connects to Lemon Creek, just upstream of the point where it enters Raritan Bay (NYCDEP, 1999b). The pond is shallow in depth, has a mucky bottom, and has been documented as having high levels of suspended sediments (ZBA and JHCC, 1987). Most of the pond is open water, with water dock, white water lily, and arrow arum along the pond edge (NRG, 1992). It receives drainage from Acme Pond (after passing under Hylan Boulevard), groundwater discharge, and runoff from the park and surrounding residential neighborhoods. The baseflow for both Wolfe's Pond and Acme Pond is provided by groundwater, and the surface elevations for these ponds are the same elevation as groundwater inflow. The surface water levels for these ponds do not fluctuate significantly by season (NYCDEP, 1999b). The Wolfe's Pond watershed has no sanitary sewers, although the NYCDEP is currently working on constructing a comprehensive drainage system for this area (NYCDEP, 1999b). Table 3.D-36 lists fish known to occur in Wolfe's Pond. Other animals inhabiting the pond include snapping and painted turtles (NRG 1992). Several painted turtles, a muskrat, and numerous damsel and dragon flies were observed in the pond during the July 2000 site visit.

Table 3.D-35
Birds Known to Occur Within Wolfe's Pond Park

Common Name	Scientific Name
Great egret	*Casmerodius albus*
Green heron	*Butorides striatus*
Black-crowned night-heron	*Nycticorax nycticorax*
Great blue heron	*Ardea herodias*
Common tern	*Sterna hirundo*
Least tern	*Sterna albifrous*
Osprey	*Pandion halietus*
Spotted sandpiper	*Actitis macularia*
Killdeer	*Charadrius vociferus*
Ruddy turnstones	*Arenaria interpres*
Herring gull	*Larus argentatus*
Laughing gull	*Larus atricilla*
Lesser scaup	*Aythya affinis*
Hooded merganser	*Lophodytes cucullatus*
Mute swan	*Cygnus olor*
American coot	*Fulica americana*
Mallard	*Anas platyrhynchos*
American widgeon	*Anas americana*
Brant	*Branta bernicla*
American black duck	*Anas arubripes*
Wood duck	*Aix sponsa*
Double-crested cormorant	*Phalacrocorax auritus*
Blue jay	*Cyanocitta cristata*
Common crow	*Corvus brachyrhynchos*
Northern cardinal	*Cardinalis cardinalis*
American robin	*Turdis migratorius*
Rufous-sided towhee	*Pipilo erythrophthalamus*
Brown thrasher	*Toxostoma rufum*
Woodthrush	*Hylociachla mustellina*
Downy woodpecker	*Picoides pubescens*
Red-bellied woodpecker	*Centurus carolinus*
Red-eyed vireos	*Vireo olivaceus*
American redstart	*Setophaga ruticilla*
Common yellowthroat	*Geothyipis trichas*
Black-and-white warbler	*Mniotilta varia*
Black-capped chickadee	*Parus atricapillus*
Tufted titmouse	*Parus bicolor*
Cedar waxwing	*Bombycilla cedrorum*
Scarlet tanager	*Paranga olivacea*
Red-winged blackbird	*Agelaius phoehiceus*
Belted kingfisher	*Megaceryle alcyon*
Gray catbird	*Dumatella carolinensis*
Mockingbird	*Mimis polyglottos*
Brown-headed cowbird	*Molothrus ater*
Mourning dove	*Zenaida macroura*
House wren	*Troglodytes aedoh*
Greatcrested flycatcher	*Mylarchus criniths*
Eastern kingbird	*Tyrannus tyrannus*
Common grackle	*Quiscalus quiscula*
House sparrow	*Passer domesticus*

Table 3.D-35 (continued)
Birds known to occur within Wolfe's Pond Park

Common Name	Scientific Name
Golden-crowned kinglet	*Regulus satrapa*
White-breasted nuthatch	*Sitta carolinensis*

Source: Atkinson (undated), NRG (1991b), NRG (1992), NYCDEP (1999b), ZBA and JHCC (1987), and results of July 2000 site visit.

Table 3.D-36
Fish Known to Occur in Wolfe's Pond

Common Name	Scientific Name
Brown Bullhead catfish	*Ictalurus nebulosus*
Sunfish	*Centrarchidae*
Largemouth bass	*Micropterus salmoides*
Common Carp	*Cyprinus carpio*

Source: ZBA and JHCC (1987).

Observations made during the July 2000 site visit indicated that there is a narrow band of vegetation around the southeastern portion of the pond, until just north of the park office. The remainder of the vegetation surrounding the pond consists of mature maple trees that overhang the pond and shrubs. Patches of bare ground occur in some areas (Appendix 3.D-3, Picture 60). The vegetation bordering the pond includes Asiatic bittersweet, Japanese honeysuckle, poison ivy, sweet pepperbush, highbush blueberry, serviceberry (*Amelanchier sp.*), and winterberry (*Ilex laevigata*). In the spring, common yellowthroats, redstarts, and other warblers are known to forage in these thickets of pond side vegetation (Atkinson, undated). Wetland plants found along the periphery of the pond include arrow arum, swamp rose mallow and buttonbush. Waterfowl using these areas include wood ducks and mallards. Wading birds that have been observed in the pond include black-crowned night heron, and great blue heron. Osprey hunt in the pond in the fall, and lesser scaup and hooded merganser use the pond in the winter (NRG, 1992). Other birds foraging in the pond area include red-winged blackbird and belted kingfisher (Atkinson, undated). Wildlife observed within the pond and adjacent upland areas during the July 2000 site visit included: deer mouse (*Peromyscus maniculatus*), great blue heron, mute swan, mallard with duckling, and cardinal.

An area of emergent/scrub-shrub wetland was observed at the northern portion of the pond where the stream draining Acme Pond enters Wolf Pond. Arrow arum, buttonbush, and swamp rose mallow are the dominant plants that have been documented for this area (NRG, 1992; ZBA and JHCC, 1987). Plants observed in this area at the time of the July 2000 site visit included: elderberry, swamp rose mallow, and arrow arum. This wetland grades into woodland on the steep stream banks (Appendix 3.D-3, Picture 61). The wooded stream valley includes red maples, sweetgum, tulip trees, red oak, white oak, black oak, American beech, catbrier, arrowwood, and spicebush. At the time of the July 2000 site visit, the substrate of the stream consisted of cobbles and silt. The streambed was approximately 15 to 20 feet wide and there was little flow in it. Minnows and small brown bullhead catfish were observed in the deeper areas. The banks were steep but well vegetated. Birds that have been documented in this area include woodthrush, red-eyed vireos, blue jay, and chickadee; cedar waxwing and scarlet tanager have been documented in the spring (Atkinson, undated). Wildlife documented in the woodlands north of the pond during the July 2000 site visit included: blue jay, cardinal, raccoon (footprints), and red-bellied woodpecker. During the site visit, small depression

areas were observed in the woodlands north of the pond (Appendix 3.D-3, Picture 61) that contained jewelweed, false nettle, skunk cabbage, New York fern, and false Solomon's seal surrounded by red maple and sweet gum.

The portion of the park north of Hylan Boulevard is wooded, and contains Acme Pond. The dominant vegetation in the wetter areas are sweetgum, blackgum, red maple, pin oak, cinnamon fern, royal fern, netted chain fern, and sensitive fern. White oak and hickory are the dominant trees in the upland areas. The remains of old sidewalks built during the 1920's cause temporary ponding of water in vernal pools within the woodland. Wildlife known to use this portion of the park includes green heron, garter snakes, chipmunk, eastern gray squirrel, wood thrush, brown thrasher, and American toad. Acme Pond is surrounded by red maple, black willow, greenbrier, multiflora rose, skunk cabbage, tussock sedge, cinnamon fern, as well as *Phragmites* in areas where the pond was disturbed by the construction of culverts and drainage ditches that carry surface runoff (Atkinson, undated). Approximately 2.9 acres of the pond is open water, 3.3 acres is *Phragmites*, and the remaining area is trees with pools of standing water and drainage channels (NRG, 1992). The vegetation surrounding the pond provides shelter for wildlife such as raccoons, muskrats, rufous-sided towhees, brown thrashers, cardinals, and red-backed salamanders. The pond itself supports painted turtles, snapping turtles, largemouth bass, and carp (Atkinson undated, NRG 1992). At the time of the July 2000 site visit, there was very little flow in the stream connecting Acme Pond to Wolfe's Pond in the portion of the site north of Hylan Boulevard (Appendix 3.D-3, Picture 63). Vegetation observed in the woods surrounding Acme Pond during the site visit included green ash, blackgum, red maple, sensitive fern, and arrowwood, with a wide band of tall *Phragmites* (Appendix 3.D-3, Picture 64 and Picture 65). Black-capped chickadees were observed in these woods.

Table 3.D-34 presented a list of animals known to occur within the park, and Table 3.D-35 presented a list of birds known to occur in the park. Gray catbirds, brown thrashers, and rufous-sided towhees are known to breed within the park. Other possible breeders include American redstart, common yellowthroat, and black-and-white warbler (NRG, 1992). The mallard duckling observed during the site visit suggests that mallards are also breeding within the park.

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