A. INTRODUCTION

This chapter assesses the potential impacts of the proposed project with respect to terrestrial and aquatic natural resources.[1] The purpose of this chapter is to:

- Describe the regulatory programs that protect natural resources;
- Describe existing geology and soils, groundwater, floodplain and wetland resources;
- Describe existing water and sediment quality within the study area;
- Describe existing terrestrial and aquatic biota, and threatened or endangered species and species of special concern;
- Assess future conditions for each of these natural resources features through the 2016 and 2036 analysis years;
- Assess the potential effects of the proposed project on water and sediment quality within the study area, as described in the reasonable worst-case development scenario (RWCDS) for the 2016 and 2036 analysis years;
- Assess the potential effects of the proposed project, as described in the RWCDS, on the aquatic and terrestrial biota within the study area for the 2016 and 2036 analysis years; and
- Present measures, as necessary, that mitigate and/or reduce any identified potential significant adverse effects to water quality and natural resources.

The project site is within the East Park area of Fresh Kills Park (see Figure 10-1). Much of the project site is a highly engineered complex of man-made infrastructure and artificial landscapes (see Figure 10-2). The disturbance to natural ecosystems caused by 50-plus years of municipal solid waste landfilling has been significant in this area. However, natural areas do include wetland and maturing woodlands. The creeks form the western boundary of the site; they are Richmond Creek to the south and Main Creek, to the north and west. In addition, the project site context within Fresh Kills Park and its proximity to the Staten Island Greenbelt and William T. Davis Wildlife Refuge suggests that that fauna and flora present in these natural areas would also have the opportunity to frequent or colonize the project site over time. These adjacent areas also create significant opportunities for open space linkages. For these reasons, the creeks and wetlands of Fresh Kills have been designated a Significant Coastal Fish and Wildlife Habitat by New York State Department of State ([NYSDOS] 2007).

[1] Natural resources are defined as "Plant and animal species and any area capable of providing habitat for plant and animal species or capable of functioning to support ecological systems and maintain the city's environmental balance" (*New York City Environmental Quality Review (CEQR) Manual*, City of New York, 2001).

Provided below is an assessment of the potential impacts of the proposed project with respect to natural resources. It begins with the methodologies employed in the investigation, the resulting context for the site (i.e., existing regulatory jurisdiction) and the assessment of impacts, and provides the baseline (existing) conditions, the future without the proposed project (2016 and 2036), and the future with the proposed project (2016 and 2036).

B. METHODOLOGY

This section presents the methodologies used to describe natural resources of the project area under existing and future conditions, and to assess potential impacts to these resources from the proposed project.

For the purposes of this analysis, two study areas were defined (see Figure 10-3). The primary study area encompasses East Park and the proposed road corridors. The secondary study area encompasses the large parcels surrounding the project site and is the area of potential secondary (or indirect) impacts. The secondary study area includes habitats located adjacent to the Fresh Kills Park project site (up to a distance of ½ mile from the primary study area boundary) and adjacent areas that include park lands and other open space or natural areas such as (but not limited to) South Shore Golf Course, Arden Heights Woods Park, LaTourette Park, Willowbrook Park, and the existing William T. Davis Wildlife Refuge to the north. Potential impacts to threatened or endangered species were evaluated for a distance of approximately ½ mile from the Fresh Kills Park project site. The study area for water quality and aquatic resources included the overall aquatic resources within the Arthur Kill, and the water quality and aquatic resources within Fresh Kills, Richmond Creek, and Main Creek, up to and including the headwaters within the William T. Davis Wildlife Refuge.

The analysis of potential impacts on natural resources from the proposed project considered the potential effects of the park elements for the two proposed analysis years, 2016 and 2036 (see Chapter 1, "Project Description).

EXISTING CONDITIONS (METHODOLOGY)

Existing conditions for geology, soils, groundwater, floodplains, wetlands, water quality, aquatic biota, and terrestrial biota within the study area were summarized from the information sources described below.

- Investigations performed by SCS Engineers and summarized in *Preliminary Fresh Kills Landfill Conceptual Design Report, Subtask 3.2, Mapping and Assessment of Natural Areas* (April 1990).
- Investigations performed by Applied Ecological Services, Inc. (AES) and summarized in selected chapters of Field Operations' *Fresh Kills End Use Master Plan*, including 2.1.7 Soil Boring Analysis and Soils Plan, Soils and Ecological Condition of Waste Deposit Areas at Fresh Kills Landfill (AES 2007) and 2.1.8 Ecological Survey, Ecological Conditions of Natural Areas at Fresh Kills Landfill (AES 2003).
- Investigations performed by AES and summarized in the Draft Vegetative Assessment of North Park Area Including North Mound and Off-Mound (AES 2007).
- Freshwater wetlands investigation and delineation performed by Geosyntec Consultants in September 2007 for the North and East parks, and December 2007 along the West Shore Expressway service ramp corridor for the purposes of determining any potential wetland

impacts from the proposed construction of the northbound service road. Delineations were performed in these areas based on the United States Army Corps of Engineers (USACE) three-parameter approach methodology.

- The Fresh Kills Park Stormwater Management Plan prepared by Geosyntec (February and March 2008) and supplemental water quality modeling studies.
- Data collected by AKRF during May and October 2007 field observations, which were conducted to characterize existing terrestrial and aquatic resources within the primary and secondary study areas. Information obtained during these recent field observations included geographic location of habitats in the primary and secondary study areas, weather conditions, wetland/upland classification, vegetative composition, herbaceous and canopy cover, plot size, number and size of trees observed, hydrology, wildlife observed, level of disturbance, unvegetated surface area, surrounding/adjacent land use, and other applicable parameters.
- Existing information identified in the literature and obtained from governmental and non-governmental agencies such as: New York City Department of Environmental Protection (NYCDEP); the 1993 New York City Department of Sanitation (DSNY) Final Surface Water and Sediment Report prepared as part of the Fresh Kills Leachate Mitigation System Project in compliance with the Consent Order (IT Corporation 1993), 1996 Fresh Kills Landfill Draft Environmental Impact Statement (DEIS) prepared by DSNY, results of field observations performed in May 2006 as part of the Owl Hollow Environmental Assessment Statement EAS prepared by the New York City Department of Parks and Recreation (DPR) (2007), results of surface water, sediment, and benthic invertebrate sampling conducted by DSNY as part of the Fresh Kills Environmental Monitoring Plan (Shaw 2005 and 2007), New York City Audubon Society; NY State Ornithological Association (NYSOA) annual January waterfowl count, New York State Department of Environmental Conservation (DEC) Bird Conservation Area Program, the Breeding Bird Atlas Project, and Coastal Fish and Wildlife Habitat Rating Forms, New York State Amphibian and Reptile Atlas Project, and tidal wetlands and freshwater wetlands maps; United States Environmental Protection Agency (USEPA); New York/New Jersey Harbor Estuary Program (HEP); USEPA Regional Environmental Monitoring and Assessment Program (R-EMAP); US Fish and Wildlife Service (USFWS) Waterfowl Surveys and National Wetland Inventory (NWI) maps, Federal Emergency Management Agency (FEMA); and Interstate Environmental Commission (IEC) and USACE studies conducted as part of the New York and New Jersey Harbor Navigation Project and the Hudson-Raritan Estuary Environmental Restoration Feasibility Study (Arthur Kill/Kill Van Kull Study Area).
- Responses to requests for information on rare, threatened or endangered species, or critical habitats in the vicinity of the project area were submitted to the USFWS—New York Field Office, National Marine Fisheries Service (NMFS), and New York Natural Heritage Program (NYNHP).

FUTURE WITHOUT THE PROPOSED PROJECT (METHODOLOGY)

The methodology for developing conditions in the future without the proposed project considered the potential effects from in-water and upland activities that may occur within and outside the study area independently of the proposed project. The assessment considered ongoing and proposed projects in the vicinity of the Fresh Kills Park project site such as:

- Ongoing Fresh Kills closure construction, maintenance, and monitoring operations;

- Water quality and sediment quality improvements expected to occur as a result of regional programs and the completed closure construction of Landfill Sections 6/7 and 1/9;
- Landscape enhancement or restoration activities associated with HEP, or Hudson-Raritan Estuary Ecosystem Restoration Project (HRE); and
- Proposed projects or plans expected to be completed by the two analysis years including the development of the proposed Fresh Kills Park.

The assessment also considered the results of the hydrodynamic modeling study conducted for the proposed project.

ASSESSMENT OF IMPACTS FROM THE PROPOSED PROJECT (METHODOLOGY)

Potential impacts to natural resources from the construction and operation of the East Park Roads were assessed using the following approach:

- Existing water and sediment quality within the study area;
- Hydrodynamic characteristics of the surface waters within the study area;
- Results of the water quality modeling prepared for the proposed project (March 2009);
- Impacts to aquatic resources from the discharge of stormwater during construction of the upland components of the proposed project or due to permanent loss of habitat for benthic macroinvertebrates and fish from construction of in-water components such as road viaducts/culverts;
- Impacts to geology and soils, groundwater, floodplains, and terrestrial natural resources associated with land clearing, grading and other upland activities associated with construction as well as permanent loss or modification of habitat associated with park roads;
- Impacts to fish and benthic macroinvertebrate habitat as a result of shading from new over water structures such as bridges, walkways, boat docks and overlooks;
- Wetland restoration and mitigation measures; and
- Long-term impacts to wildlife, increased human activity such as road traffic and lighting (for example).

REGULATORY CONTEXT

Activities proposed in tidal and freshwater wetlands and in-water activities, and activities within the New York State Coastal Zone require compliance with relevant federal and state laws and regulations, a summary of which is provided below.

FEDERAL LAWS AND REGULATIONS

Clean Water Act (33 USC §§ 1251 to 1387)

The objective of the Clean Water Act (CWA), also known as the Federal Water Pollution Control Act, is to enhance and maintain the chemical, physical, and biological integrity of U.S. waters. It regulates point sources of water pollution such as discharges of municipal sewage and industrial wastewater, the discharge of dredged or fill material into navigable waters and other waters of the United States, and non-point source pollution such as runoff from streets, agricultural fields, and construction sites.

Under Section 401 of the Act, any applicant for a federal permit or license for an activity that may result in a discharge to navigable waters must provide a certificate to the relevant federal agency stating that the discharge would comply with Sections 301, 302, 303, 306, 307, and 316 (b) of the CWA. Applicants for discharges to navigable waters in New York must obtain a Water Quality Certificate from DEC.

Section 404 of the Act requires authorization from the Secretary of the Army, acting through USACE for the permanent or temporary discharge of dredged or fill material into navigable waters and other waters of the United States. The term “waters of the United States,” as defined in 33 Code of Federal Regulations (CFR) 328.3, includes streams, rivers, wetlands, mudflats, and sandflats that meet the specified requirements. Activities authorized under Section 404 must also comply with Section 401 of the Act.

Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act of 1899 requires authorization from the Secretary of the Army, acting through USACE, for the construction of any structure in or over any navigable waters of the United States, the excavation from or deposition of material into these waters, or the introduction of any obstruction or alteration into these waters. Any structures placed in navigable waters such as pilings, piers, or bridge abutments up to the mean high water line would be regulated pursuant to this Act.

Coastal Zone Management Act of 1972 (16 USC §§ 1451 to 1465)

The Coastal Zone Management Act of 1972 established a voluntary participation program to encourage coastal states to develop programs to manage development within the state’s designated coastal areas to reduce conflicts between coastal development and protection of resources within the coastal area. Federal permits issued in New York State must be accompanied by a Coastal Zone Consistency Determination that evaluates consistency with New York State’s federally approved coastal zone management program.

Magnuson-Stevens Act (16 USC §§ 1801 to 1883)

Section 305(b)(2)-(4) of the Magnuson-Stevens Act outlines the process for NMFS and the Regional Fishery Management Councils (in this case, the Mid-Atlantic Fishery Management Council) to comment on activities proposed by federal agencies that may adversely impact areas designated as EFH. EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 USC §1802(10)).

Adverse impacts, as defined in 50 CFR 600.910(A), include any impacts that reduce the quality and/or quantity of EFH. Examples include:

- Direct impacts, such as physical disruption or the release of contaminants;
- Indirect impacts, such as the loss of prey or reduction in the fecundity (number of offspring produced) of a managed species; and
- Site-specific or landscape-wide impacts that may include individual, cumulative or synergistic consequences of a Federal action.

Endangered Species Act of 1973 (16 USC §§ 1531 to 1544)

The Endangered Species Act of 1973 recognizes that endangered species of wildlife and plants are of aesthetic, ecological, educational, historical, recreational, and scientific value to the nation and its people. The Act provides for the protection of these species, and the critical habitats on which they depend for survival.

Fish and Wildlife Coordination Act (PL 85-624; 16 USC 661-667d)

The Fish and Wildlife Coordination Act entrusts the Secretary of the Interior with providing assistance to, and cooperating with, federal, state and public or private agencies and organizations, to ensure that wildlife conservation receives equal consideration with other water-resource development programs. These programs can include the control (such as a diversion), modification (such as channel deepening), or impoundment (through the construction of a dam) of a body of water.

Executive Order 11988 (Flood Plain Management)

Executive Order 11988 requires that agencies provide leadership and take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to enhance and preserve the natural and beneficial values served by floodplains.

Executive Order 11990 (Protection of Wetlands)

This Executive Order directs federal agencies to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance wetland quality. New activities in wetlands, either undertaken or supported by a federal agency, are to be avoided unless there is no practicable alternative and all practical measures have been taken to minimize the potential impacts to the wetlands.

STATE LAWS AND REGULATIONS

Protection of Waters, Article 15, Title 5, New York State Environmental Conservation Law (ECL), Implementing Regulations 6 NYCRR Part 608.

DEC is responsible for administering Protection of Waters regulations to prevent undesirable activities within surface waters (rivers, streams, lakes, and ponds). The Protection of Waters permit program regulates five different categories of activities: disturbance of stream beds or banks of a protected stream or other watercourse; construction, reconstruction or repair of dams and other impoundment structures; construction, reconstruction or expansion of docking and mooring facilities; excavation or placement of fill in navigable waters and their adjacent and contiguous wetlands; and Water Quality Certification for placing fill or other activities that result in a discharge to waters of the United States in accordance with Section 401 of the CWA.

State Pollutant Discharge Elimination System (SPDES) (N.Y. Environmental Conservation Law [ECL] Article 3, Title 3; Article 15; Article 17, Titles 3, 5, 7, and 8; Article 21; Article 70, Title 1; Article 71, Title 19; Implementing Regulations 6 NYCRR Articles 2 and 3)

Title 8 of Article 17, ECL, Water Pollution Control, authorized the creation of the State Pollutant Discharge Elimination System (SPDES) to regulate discharges to the state's waters. Activities requiring a SPDES permit include: point source discharges of wastewater into surface or ground waters of the State, including the intake and discharge of water for cooling purposes; constructing or operating a disposal system (sewage treatment plant); discharge of stormwater; and construction activities that disturb one acre or more.

Waterfront Revitalization of Coastal Areas and Inland Waterways Act (Sections 910-921, Executive Law, Implementing Regulations 6 NYCRR Part 600 et seq.)

Under the Waterfront Revitalization of Coastal Areas and Inland Waterways Act, NYSDOS is responsible for administering the Coastal Management Program (CMP). The Act also authorizes the State to encourage local governments to adopt Waterfront Revitalization Programs (WRP) that incorporate the state's policies. New York City has a WRP administered by the Department of City Planning.

Tidal Wetlands Act, Article 25, ECL, Implementing Regulations 6 NYCRR Part 661.

Tidal wetlands regulations apply anywhere tidal inundation occurs on a daily, monthly, or intermittent basis. In New York State, tidal wetlands occur along the salt-water shore, bays, inlets, canals, and estuaries of Long Island, New York City and Westchester County, and the tidal waters of the Hudson River up to the salt line. DEC administers the tidal wetlands regulatory program and the mapping of the state's tidal wetlands. A permit is required for most activities that would alter wetlands or the adjacent areas (up to 300 feet inland from wetland boundary or up to 150 feet inland within New York City).

Freshwater Wetlands Act, Article 24, ECL, Implementing Regulations 6 NYCRR Part 662

The Freshwater Wetlands Act requires DEC to map freshwater wetlands protected by the Act (12.4 acres or greater in size containing wetland vegetation characteristic of freshwater wetlands as specified in the Act). Around each mapped wetland is a protected 100-foot adjacent area that serves as a buffer. In accordance with the Act, the DEC ranks wetlands in one of four classes that range from Class 1, which represents the greatest benefits and is the most restrictive, to Class IV. The permit requirements are more stringent for a Class I wetland than for a Class IV wetland. Certain activities (e.g., normal agricultural activities, fishing, hunting, hiking, swimming, camping or picnicking, routine maintenance of structures and lawns, and selective cutting of trees and harvesting fuel wood) are exempt from regulation. Activities that could have negative impact on wetlands are regulated and require a permit if conducted in a protected wetland or its adjacent area. There are no mapped State freshwater wetlands on the project site but they do exist in the surrounding area.

Floodplain Management Criteria for State Projects (6 NYCRR 502)

Under 6 NYCRR 502, all state agencies are required to ensure that the use of state lands, and the siting, construction, administration and disposition of state-owned and state-financed projects involving any change to improved or unimproved real estate, are conducted in ways that would minimize flood hazards and losses. Projects are required to consider alternative sites on which the project could be located outside the 100-year floodplain. Projects to be located within the floodplain are required to be designed and constructed to minimize flood damage, and to include adequate drainage to reduce exposure to flood hazards. All public utilities and facilities associated with a project are also required to be located and constructed to minimize or eliminate flood damage. The regulations specify that for nonresidential structures, the lowest floor should be elevated or flood-proofed to not less than one foot above the base flood level, so that below this elevation the structure, together with associated utility and sanitary facilities, is watertight, with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. No project may be undertaken unless the cumulative effect of the proposed project and existing developments would not cause material flood damage to the existing developments.

Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern (ECL, Sections 11-0535[1]-[2], 11-0536[2], [4], Implementing Regulations 6 NYCRR Part 182)

These regulations prohibit the taking, import, transport, possession or selling of any endangered or threatened species of fish or wildlife, or any hide, or other part of these species, as listed in 6 NYCRR §182.6.

C. EXISTING CONDITIONS

GEOLOGY AND SOILS

The project site, located within both the Newark Basin and Atlantic Coastal Plain, is an area that has been substantially shaped by both geologic processes and human use (Isachsen et al. 2000). The underlying bedrock at the project site is complex, and consists of sedimentary material from the Ordovician (i.e., serpentinite and Manhattan Schist), Triassic (i.e., Stockton and Lockatong Formation bedrock) and Jurassic (i.e., Palisades diabase) periods (Rogers et al. 1990, DSNY 1996). The surficial geology in the project area includes silt deposited during the Cretaceous period, and glacial sand, till, and lake deposits from the Pleistocene epoch (DSNY 1996, Isachsen et al. 2000). The waterways that run through the project site were formed during glacial retreat in the Pleistocene and Holocene epochs as sea levels rose, and salt marshes subsequently formed along western Staten Island (DSNY 1996), where some of the oldest marshes in the Hudson River Estuary have been identified (Peteet et al. 2007).

Before landfill operations began, the project site was characterized by tidal and freshwater marshes, clay pits, farmlands, and upland areas (DSNY 1996, Borough of Richmond Topographical Survey Map 1911). As a result, surficial soils underneath the landfill sections, or mounds, would be classified as disturbed peat, clay, and sand deposited during the Pleistocene and Holocene epochs over older glacial and Cretaceous deposits (DSNY 1996). Soils under the landfill mounds have been compressed over time due to the weight of refuse and fill deposited on the site, which may have created a partial barrier that inhibits some direct leaching of contaminants into groundwater (DSNY 1996). Soils around the perimeter of the landfill mounds include peats and other hydric soils in tidal, freshwater, and forested wetlands in locations not directly affected by landfilling operations.

GROUNDWATER

Groundwater beneath the project site and within the secondary study area has been shown to contain various organic and inorganic contaminants. The most likely sources include leachate originating from the Fresh Kills Landfill, the adjacent Brookfield Landfill, and other residential and commercial sources (ATSDR 2000). Sampling conducted within the Fresh Kills Landfill from 1991 to 1993 indicated that groundwater contaminants at Landfill Section 1/9 were present in concentrations exceeding DEC groundwater standards (DSNY 1996). Elevated levels of ammonia and other leachate indicators (i.e., total dissolved solids (TDS), total organic carbon (TOC), biological/chemical oxygen demand (BOD/COD), etc.), and volatile organic compounds (VOCs) associated with petrochemicals were present in near surface groundwater in Landfill Section 1/9 refuse and fill (DSNY 1996). In groundwater associated with lower glacial and Cretaceous deposits, saltwater intrusion and direct leachate flow into these horizons were suspected; levels of ammonia tended to be less than in shallower groundwater, possibly influenced by saltwater intrusion (DSNY 1996). Other leachate indicators (i.e., TDS, chlorine, and sulfate) and metals (i.e., iron, magnesium, manganese, and boron) were higher in groundwater found within more recent glacial deposits than in lower Cretaceous deposits (DSNY 1996). VOCs and semivolatile organic compounds (SVOCs) were low or nonexistent. At Landfill Section 6/7, similar patterns were observed in near surface groundwater, with the exception of VOCs in violation of DEC standards at one location in the southeastern area of the mound (DSNY 1996).

A leachate treatment containment, collection, and treatment system was constructed at Fresh Kills Landfill in 1997, significantly reducing leachate contributions to groundwater and surface waters. The leachate treatment plant has a treatment capacity of up to 1 million gallons of per day. Regular groundwater monitoring at the Fresh Kills site in 2002-2004 indicated low concentrations of VOCs and SVOCs, elevated concentrations of metals, and no polychlorinated biphenyls (PCBs) or pesticides. The results of the 2006 Fresh Kills Groundwater Quality Monitoring program found that groundwater samples collected from the shallow/refuse monitoring zone at the landfill continue to have concentrations or values of leachate indicator parameters (i.e., ammonia, color, total dissolved solids, chloride and turbidity, and concentrations of inorganic parameters boron, iron, magnesium, manganese, and sodium) above the standards (TOGS Ambient Water Quality Standards and Guidance Values). A limited number of organic parameters were detected at concentrations above the groundwater protection standards, with benzene and chorobenzene the most common. Within the intermediate depth and deep (bedrock) monitoring zones at the landfill, concentrations or values of leachate indicator parameters (i.e., bromide, chloride, total dissolved solids and turbidity, and inorganic parameters boron, iron, manganese, magnesium and sodium) consistently exceed the standards. However, geochemical evaluation of the groundwater from these monitoring zones indicate that elevated concentrations of these parameters may be a result of seawater mixing, or related to the geologic formation mineralogy. Five organic parameters in the intermediate depth-monitoring zone were detected at concentrations above groundwater standards during the 2006 monitoring period. Within the deep monitoring zone, the organic parameters toluene, 2-butanone, 2-methylphenol continued to be detected above the groundwater protection standards in each of the four landfill sections. Phenol, xylene, bis(2-ethylhexyl)phthalate and pentachlorophenol exceeded the groundwater protection standards in one or two deep wells. The results of the 2006 Groundwater Monitoring Program found that concentrations or values of leachate indicator and inorganic parameters continue to be above standard levels, as they have been since the cumulative sampling period began in 1991. Analysis of groundwater data collected during the cumulative period (1991 through 2006) and after the installation of the leachate control systems (1998 through 2006) indicated that the majority of statistically significant trends for the parameters evaluated are decreasing concentrations, particularly with respect to leachate indicator and inorganic parameters (Shaw 2007a).

Groundwater on Staten Island has not been used for potable water since 1970. Potable water on Staten Island is provided by New York City's public water supply, which comprises a system of upstate reservoirs.

FLOODPLAINS

Figure 10-4 presents the 100-year floodplain (area with a 1 percent chance of flooding each year) and 500-year floodplain (area with a 0.2 percent chance of flooding each year) boundaries within the project site. As a result of landfilling activities which has raised the topography, much of the project site is outside the 100-year floodplain. Within the project site, the shorelines and tidal wetlands around East Park are within the 100-year and 500-year floodplains.

WETLANDS

PROJECT SITE

DEC has mapped tidal wetlands within the project site—the primary study area (see Figure 10-5). Mapped intertidal and high marsh tidal[1] wetlands occur along the shorelines of the Arthur Kill (west of Landfill Section 1/9), Main Creek and Richmond Creek (north, south, and west of Landfill Section 6/7), and Isle of Meadows; and within two large tidal wetland areas located north of Landfill Section 6/7 along Main Creek associated with the William T. Davis Wildlife Refuge, and south of Landfill Section 6/7 along Richmond Creek near the south eastern corner of the primary study area. A small area designated as high marsh, intertidal marsh and coastal shoals, bars and mudflats is located at the southwestern corner of the primary study area along the Arthur Kill. A detailed description of wetland landscapes occurring at the Fresh Kills site is provided in the "Terrestrial Resources" section of this chapter.

Richmond Creek and Main Creek adjoining the project site are designated as DEC littoral zone tidal wetlands by DEC (see Figure 10-4). However, DEC regulations state that actual water depths determine whether or not an area is a littoral zone (shallow waters six feet or less in depth at mean low water that are not included in other DEC tidal wetland categories).

There are no mapped and regulated DEC freshwater wetlands at the project site. However, activities in and around these wetlands would be regulated under Article 15, "Protection of Waters" on a case by case basis.

The USFWS NWI (see Figure 10-6) classifies wetlands at the project site. Similar to the tidal wetland areas designated by DEC, the NWI indicates estuarine intertidal emergent wetlands along the shorelines of Main Creek and Richmond Creek (E2EM1P) and large areas of estuarine intertidal emergent wetlands associated with the William T. Davis Wildlife Refuge in the northern reach of Main Creek, and at the southeast corner of the study area along Richmond Creek. Additional NWI wetlands (estuarine intertidal unconsolidated shore that are regularly flooded) are mapped along the eastern edge of Landfill Section 6/7 (estuarine intertidal emergent and unconsolidated shore (E2EM5P and E2EM1P, and E2USN)). The southern portion of this emergent estuarine wetland area corresponds to an area of DEC designated high marsh and intertidal marsh, and does appear to have a tidal connection to Richmond Creek 9AKRF field surveys, October 2007). The DEC tidal wetlands maps, however, do not identify the remaining portions of this complex of open water and wetland vegetation that extends north between Landfill Section 6/7 and Richmond Avenue as tidal wetlands.

The northern portion of this wetland system comprises two interconnected stormwater management basins that receive stormwater runoff from Landfill Section 6/7, and ultimately discharge to the area indicated on the NWI as estuarine emergent wetland that is located at the

[1] 6 NYCRR Part 661 defines intertidal marsh as "the vegetated tidal wetland zone, designated IM on an inventory map, lying generally between average high and low tidal elevation. The predominant vegetation in this zone is low marsh cordgrass, *Spartina alterniflora*." 6 NYCRR Part 661 defines high marsh as "The normal uppermost tidal wetland zone, designated HM on an inventory map, usually dominated by salt meadow grass, *Spartina patens*; and spike grass, *Distichlis spicata*. This zone is periodically flooded by spring and storm tides and is often vegetated by low vigor, *Spartina alterniflora* and Seaside lavender, *Limonium carolinianum*. Upper limits of this zone often include black grass, *Juncus gerardi*; chairmaker's rush, *Scirpus* sp; marsh elder, *Iva frutescens*; and groundsel bush, *Baccharis halimifolia*.

northeast side of Landfill Section 6/7. This area generally contains vegetation characteristic of a freshwater emergent/forested wetland and ultimately drains north to a tributary of Springville Creek through a culvert. Based on field observations, stormwater runoff from Richmond Avenue also drains into this area through existing storm drain pipes. With the existence of these stormwater basins the open water areas may be regulated under Article 15, "Protection of Waters," by DEC.

Stormwater basins, and freshwater wetlands were also identified using the USACE three-parameter methodology, along the eastern border of East Park paralleling Richmond Avenue. These areas have been associated with the stormwater infrastructure system for the Fresh Kills Landfill and are a necessary component of the landfills operations and post closure management. Over time, while still functioning as critical stormwater drainage for the landfill, the hydrology, soils, and flora changed, taking on some characteristics associated with freshwater wetlands. As such, the regulatory context over these areas is not clear. These wetlands are not been mapped as tidal or freshwater wetlands by the DEC, and are not associated with any classified waterbodies regulated under Article 15, Water Resources Law, of the Environmental Conservation Law. However, these stormwater basins and freshwater wetlands do include much of the NWI-mapped estuarine wetlands presented in Figure 10-6. To the north and south of the freshwater wetlands identified as associated with Basins A, B1 and B2, are DEC mapped tidal wetlands (Hartzel 2007). The freshwater wetlands identified in association with Basins A, B1 and B2 along the eastern border of East Park are a combination of emergent and forested wetlands. Characteristic plants associated with these wetlands include sweet gum (*Liquidambar styraciflua)*, bayberry (*Morella pensylvanica)*, groundselbush (*Baccharis halimifolia)*, marsh-elder (*Iva frutescens*), *Phragmites*, broad leaf cat-tail (*Typha latifolia*), jewel weed (*Impatiens capensis)*, and various sedges (*Carex* spp.) (AKRF 2007).

SECONDARY STUDY AREA

Within the secondary study area, DEC tidal wetlands have been mapped in the William T. Davis Wildlife Refuge (north of the project site), in the area northwest of the project site associated with Neck Creek, and at the southeastern corner of the project site along Richmond Creek within LaTourette Park and at the edge of Brookfield Landfill. DEC freshwater wetlands have been mapped within Arden Heights Woods Park south of the project site, within LaTourette Park, within the William T. Davis Wildlife Refuge to the north of the project site, within Willowbrook Park northeast of the project site, and in association with Neck Creek to the northwest of the project site.

Similar to DEC mapped freshwater wetlands, the NWI indicates areas of freshwater wetlands—palustrine forested broad-leaved deciduous seasonally flooded/saturated (PFO1E) and palustrine scrub-shrub broad-leaved deciduous seasonally flooded/saturated (PSS1E), and palustrine emergent wetlands (PEM1E) within Arden Heights Woods Park, palustrine forested and emergent wetlands within Willowbrook Park, and palustrine forested wetlands north of the tidal wetlands of William T. Davis Wildlife Refuge.

The former Brookfield Landfill, while presently undergoing remediation due to illegal disposal of hazardous materials at the landfill, contains plant communities that could provide information for enhancement efforts at Fresh Kills (Lynch 2007).

AQUATIC RESOURCES

BACKGROUND CONDITIONS

The surface water resources within the vicinity of the project site include the Arthur Kill, Great Fresh Kill, Little Fresh Kill, Fresh Kill, Main Creek and Richmond Creek. The Arthur Kill is part of the Newark/Raritan Bay tidal complex, which has two principal freshwater inputs (the Raritan River and the Passaic River), and two tidal inputs, Arthur Kill and Kill van Kull. The Arthur Kill is a tidal strait that connects Newark Bay to Raritan Bay (Kaluarachchi et al 2003, Pence et al 2005). It is approximately 13 miles long, between 800 and 2,800 feet-wide, and has a total surface area of approximately 4.4 square miles. A 500-foot-wide federal navigation channel, maintained at a depth of 35 feet mean low water level (MLW), runs the entire length of the Kill (USACE 1999a).

Tidal dynamics in the Arthur Kill are extremely complex, as they are driven by astronomical and meteorological tidal forces from multiple inlets, seasonally variable freshwater input, and anthropogenic effects. Long term volume and salt flux generally is directed southward toward Raritan Bay, with the peak water flux being more than 400 cubic meters per second (14,125 cubic feet per second). This flux appears to be driven by the tidal elevation gradients between New York Bay and Raritan Bay that result from the tides in these water bodies being temporally out of phase, and not by water density differences attributable to salinity gradients (Kaluarachchi et al 2003).

The Arthur Kill has been heavily impacted by anthropogenic activity, and much of the Arthur Kill's shoreline is developed with cargo shipping terminals, petroleum refineries, tank farms, electrical generating stations, chemical manufacturers, landfills, and other industrial uses. Despite the extensively developed nature of these land uses, the Arthur Kill shoreline still contains substantial acreages of tidal salt marshes. Oil spills routinely impact the Arthur Kill, including a 500,000-gallon spill in 1990, and a recent 31,000-gallon spill (Chevron 2006). Several salt marsh enhancement projects lead by DPR – Natural Resources Group and other organizations have been conducted subsequent to some of these previous spills.

Results of water quality studies (dye study and water quality study) conducted by DEC in the Fresh Kills system in 1989 (DEC 1991 and IT Corporation 1993) indicated that the Fresh Kills system reaches equilibrium within 5 tidal cycles, indicating a high degree of mixing and that the tidal exchanges with the Arthur Kill flush the system relatively quickly.

PROJECT SITE

The project site contains constructed stormwater management ponds, basins, and swales that feed into both Main Creek (via Springville Creek) to the north and west and Richmond Creek to the south. Two stormwater management ponds are located in the central portion of the project site (Basins C1 and C2), near the confluence of Main Creek and Richmond Creek (see Figure 10-7), and currently receive stormwater runoff from Landfill Section 6/7. Both stormwater management ponds have vegetated riprap banks (shrubs and herbaceous plants) and stormwater inlet and outlet structures. Standing water was present at the time of the May and October 2007 field observations. Sampling for fish and benthic invertebrates within these areas was conducted during the October 2007 field investigation. The sampling results are summarized in the *Benthic Invertebrates* and *Fish* sections of this chapter.

Four other large open water areas are located along the eastern edge of the project site, between Landfill Section 6/7 and Richmond Avenue. These areas correspond to the areas misidentified as estuarine emergent wetlands by NWI (see Figure 10-6) and the freshwater wetlands identified using the USACE three-parameter approach during the Geosyntec study, as discussed in the previous section. These wetlands have not been mapped as tidal or freshwater wetlands by the DEC, and are not associated with any classified waterbodies regulated under Article 15, Water Resources Law, of the Environmental Conservation Law. They include the wetland basin with some tidal connection to Richmond Creek; two interconnected stormwater management basins (Basins B1 and B2) that receive runoff from Landfill Section 6/7; and an open water area that drains to a tributary of Springville Creek through a culvert. This upper basin does not directly receive stormwater runoff from Landfill Section 6/7, but does receive surface water from Basin B1 and stormwater runoff from Richmond Avenue. At the time of the 2007 field observations, these areas had emergent and forested wetlands along the edges but did not appear to be tidally influenced. There was no apparent connection between Basin B2 and Richmond Creek. During the October 2007 field investigation, fish and benthic invertebrate sampling was performed in the two stormwater management basins and freshwater wetlands east of Landfill Section 6/7. The results of this sampling effort are summarized in the *Benthic Invertebrates* and *Fish* sections of this chapter.

WATER QUALITY

BACKGROUND CONDITIONS

Title 6 of the NYCRR Part 703 includes surface water standards for each Use Classification of New York surface waters. For example, the New York classified use for the Arthur Kill and the lower portion of Fresh Kills requires that the water be suitable for fish survival (Use Class SD). This classification is reserved for water bodies that cannot meet the requirements for primary and secondary human contact and fish propagation. The DEC saline surface water quality standards for Use Class SD is that DO must never be less than 3 milligrams per liter (mg/L). No standards for coliform have been established for Use Classification SD waters.

The New York Classified use for Richmond Creek, Main Creek and the upper portion of Fresh Kills requires that the water be suitable for fish propagation and survival, and for primary and secondary contact recreation (Use Class SC). Water quality standards for fecal and total coliform, DO, and pH for Use Class SC waters are as follows. (There are no New York State standards for chlorophyll *a* or water clarity.)

- Fecal coliform—Monthly geometric mean less than or equal to 2,000 colonies/100mL.
- Total coliform—Monthly median less than 2,400 colonies/100 milliliters (mL).
- DO—Never less than 5 mg/L.

The City of New York has monitored New York Harbor water quality for over 90 years through the Harbor Survey. NYCDEP evaluates surface water quality of four designated regions: Inner Harbor Area, Upper East River-Western Long Island Sound, Lower New York Bay-Raritan Bay, and Jamaica Bay (NYCDEP 2006). The Harbor Survey station closest to the project site is Station K4 (Fresh Kills). Additionally, the DSNY has conducted water and sediment quality monitoring within the Arthur Kill and Fresh Kills estuary (i.e., Little Fresh Kill, Great Fresh Kill, Fresh Kills, Richmond Creek, and Main Creek) from 1991 to the present. This sampling is currently being conducted in accordance with the Environmental Monitoring Plan (EMP) developed as part of the Post-Closure Monitoring and Maintenance Operations Manual prepared for the landfill.

Temperature and salinity influence several physical and biological processes within the Harbor, Raritan Bay, and the Arthur Kill. Temperature has an effect on the spatial and seasonal distribution of aquatic species and affects oxygen solubility, respiration, and other temperature-dependent water column and sediment biological and chemical processes. Salinity fluctuates in response to tides and freshwater discharges. Salinity and temperature largely determine water density and can affect vertical stratification of the water column. Salinity is also an important habitat variable as a number of aquatic species have a limited salinity tolerance.

Average temperatures taken in the Arthur Kill typically range from about 3°C (37.4°F) in winter months to nearly 30°C (86°F) in summer. For the period of 2002 through 2003, the maximum temperature observed at NYCDEP Harbor Survey station closest to the project site (Station K4, Fresh Kills) was 28.57°C (83.7°F) in the second half of August, 2002.

Salinity measurements taken in the Arthur Kill near the project site between 2002 and 2003 generally ranged from about 14.3 to 28.0 parts per thousand (ppt), with bottom water salinity generally slightly greater than surface water salinity. Periodic high freshwater flows in extremely wet years can occasionally create mesohaline conditions (salinity between 5 and 18 ppt) for relatively short periods.

The results of recent Harbor Surveys (NYCDEP 2001, 2002, 2003, 2004, 2005, 2006) show that the water quality of New York Harbor has improved significantly since the 1970s as a result of measures undertaken by the City. These measures include eliminating 99 percent of raw dry-weather sewage discharges, reducing illegal discharges, increasing the capture of wet-weather related "floatables," and reducing the toxic metals loadings from industrial sources by 95 percent (NYCDEP 2002). The 1999 and 2000 IEC 305(b) reports also indicate that the year-round disinfection requirement for discharges to waters within its district (including New York Harbor) has contributed significantly to water quality improvements since the requirement went into effect in 1986 (IEC 2000, 2001).

Recent survey data from Harbor Survey Station K4, Fresh Kills, near the project site, indicate that the water quality in this part of the lower Arthur Kill conforms to NYCRR water quality standards for Use Classification SD. The following section provides a summary of the water quality conditions in the sampling region (Arthur Kill) of the Harbor Survey that includes the project site. Table 10-1 presents a summary of water quality measurements at the Fresh Kills station (K4) for 2006.

Table 10-1
2006 NYCDEP Water Quality Data for the Fresh Kills (K4) Sampling Station

	Surface Waters			Bottom Waters		
Parameter	**Low**	**High**	**Mean**	**Low**	**High**	**Mean**
Total Fecal Coliform (per 100 mL)	2	475	125	NR	NR	NR
Dissolved Oxygen (mg/L)	3.8	10.4	6.6	3.6	10.9	6.1
Secchi Transparency (ft)	2.5	6.0	4.1	NA	NA	NA
Chlorophyll a (µg/L)	1.0	31.7	7.7	NM	NM	NM

Notes: NA = Not applicable, NM = Not measured, NR = Not reported.
Sources: NYCDEP 2006 (2006 New York Harbor Water Quality Report).

The presence of coliform bacteria in surface waters indicates potential health impacts from human or animal waste, and elevated levels of coliform can result in the closing of bathing beaches and shellfish beds. The waters of the Inner Harbor Area, which includes the Arthur Kill, complied with fecal coliform standards for the water body they are located in for all sampling locations. Temporary increases in fecal coliform concentrations may occur during wet weather due to increased runoff containing fecal coliform loadings following a rain event. Overall, fecal coliform concentrations in this area have declined, significantly improving water quality from the early 1970s, when levels were well above 2,000 colonies/100 mL; however, there has been a gradual increase over the last few years (NYCDEP 2006). Levels are well below the Bathing Standard for the region, but increasing. In general, the improvement in water quality with respect to fecal coliform has allowed for the opening of Inner Harbor waters for most recreational activities (NYCDEP 2004).

DO in the water column is necessary for respiration by all aerobic forms of life, including fish and invertebrates such as crabs, clams, and zooplankton. The bacterial breakdown of high organic loads from various sources can deplete DO and persistently low DO can degrade habitat and cause a variety of sublethal or, in extreme cases, lethal effects. Consequently, DO is one of the most universal indicators of overall water quality in aquatic systems. DO concentrations in the Inner Harbor Area have increased over the past 30 years from an average that was below 3 mg/L in 1970 to approximately 5.2 mg/L in 2006 (NYCDEP 2006), above the 3.0 mg/L standard for Use Class SD waters. DO concentrations recorded during DSNY annual late summer sampling at low tide from 2001 through 2004 within the Fresh Kills, Main Creek and Richmond Creek, which are Use Class SC, have generally been at or above the 5 mg/L standard for Use Class SC waters (Shaw 2005), but were generally below the 5 mg/L standard during the 2006 annual late summer sampling (Shaw 2007b).

High levels of nutrients can lead to excessive plant growth (a sign of eutrophication) and depletion of DO. Concentrations of the plant pigment chlorophyll *a* in water can be used to estimate productivity and the abundance of phytoplankton. Chlorophyll *a* concentration greater than 20 micrograms per liter (µg/L) are considered suggestive of eutrophic conditions. The Inner Harbor area had average 2006 summer chlorophyll *a* values below the 20µg/L level for all sampling stations (NYCDEP 2006). Although chlorophyll concentrations at the Harbor Survey Station K4 near the project site (see Table 10-3) have generally been below the level suggestive of a eutrophic system, chlorophyll concentrations may occasionally be higher that 20µg/L, such as the 31.7 µg/L concentration reported in April 2006.

Secchi transparency is a measure of the clarity of surface waters. Transparency greater than 5 feet (1.5 meters) is indicative of clear water. Decreased clarity can be caused by high suspended solid concentrations or blooms of plankton. Secchi transparencies less than 3 feet (0.9 meters) are generally indicative of poor water quality conditions. Average Secchi readings in the Inner Harbor area have remained relatively consistent since measurement of this parameter began in 1986, ranging between about 3.5 and 5.5 feet (NYCDEP 2004). In 2006, the average Secchi transparency for the Inner Harbor area was 4.6 feet (NYCDEP 2006). In 2006, secchi depths reported for the Harbor Survey station closest to the project site (see Table 10-3) ranged from 2.5 to 6 feet, suggesting that at times, transparency at this station was suggestive of poor water quality conditions.

The DEC routinely monitors potentially harmful levels of contaminants in fish and wildlife in the freshwater and marine waters of New York. The New York State Department of Health (NYSDOH) issues advisories on eating sportfish and wildlife on the basis of these testing results. The general health advisory for sportfish obtained from New York's fresh waters and the marine waters at the mouth of the Hudson River, including the Arthur Kill, is that a person should eat no more than one half pound of fish per week, or six blue crabs (*Callinectes sapidus*) per week. Specific restrictions have been issued on the consumption of certain species of fish from the Arthur Kill, Kill van Kull and Newark Bay due to concentrations of dioxin and PCBs. Fish not recommended for consumption include American eel (*Anguilla rostrata)*, gizzard shad (*Dorosoma cepedianum*), striped bass

(*Morone saxatilis)* and white perch (*Morone Americana*). Fish recommended for consumption no more than one meal per month include Atlantic needlefish (*Strongylura marina*), bluefish (*Pomatomus saltatrix)*, and rainbow smelt (*Osmersus mordax*) (NYSDOH 2007).

DSNY WATER QUALITY SAMPLING

Since 1991, DSNY has been conducting water and sediment quality monitoring within the Arthur Kill and Fresh Kills estuary (i.e., Little Fresh Kill, Great Fresh Kill, Fresh Kills, Richmond Creek, and Main Creek). Sampling conducted after 1998 represents the conditions present within the water bodies in and near the landfill after the leachate control system was installed at all four landfill sections to control future percolation to local groundwater. Water and sediment samples are analyzed for chemical parameters considered indicative of leachate contamination from the Fresh Kills Landfill complex, as identified through the process described in the 1996 Fresh Kill Landfill DEIS (DSNY 1996). These parameters included general water chemistry parameters (i.e., alkalinity, ammonia, BOD, COD, color, DO, total Kjeldahl nitrogen (TKN), and turbidity), and metals (i.e., arsenic, barium, copper, lead, manganese, nickel, and zinc).

Results of sampling conducted between 1991 and 1995 indicated that during all seasons, parameters suggestive of leachate contamination were higher in Main Creek and Richmond Creek, decreasing gradually in Fresh Kills toward the Arthur Kill. This was most pronounced at low tide (DSNY 1996). Results of sampling conducted within the Arthur Kill, Fresh Kills, Main Creek and Richmond Creek after 1998 show a similar pattern for most of the leachate contaminants. However, on the basis of the results from the 2006 Environmental Monitoring Program, some of these parameters have exhibited a significant downward trend after 1998. Surface water TKN, color, manganese, ammonia, zinc, lead, alkalinity, copper and nickel exhibit significant decreasing trends and significantly lower values or averages for the period after 1998 compared to the period prior to the completion of the leachate collection system.

Only two VOCs were detected in the samples collected in the 2004 surface water quality monitoring program within the Landfill creeks. Toluene was detected at a very low concentration in only one Main Creek sample. Acetone, though detected frequently, was highest in the freshwater portion of Main Creek. Only three to five organic parameters have been detected between 1998 and 2004 (Shaw 2005). On the basis of an evaluation of the surface water data collected through 2004, and as permitted by the Environmental Monitoring Program for Fresh Kills Landfill, the analysis of organic parameters in surface water was discontinued after 2004.

SEDIMENT QUALITY

BACKGROUND CONDITIONS

Typical of any urban watershed, New York Harbor Estuary sediments, including the Arthur Kill and the other surface waters within the Fresh Kills Park project site, are contaminated due to a history of industrial uses in the area. Contaminants found throughout the New York Harbor Estuary included pesticides such as chlordane and DDT, metals such as mercury and copper, and various polycyclic aromatic hydrocarbons. Adams et al. (1998) found the mean sediment contaminant concentration for 50 of 59 chemicals measured to be statistically higher in the Harbor Estuary than other coastal areas on the East Coast. Within the New York Harbor Estuary, Adams et al. (1998) ranked Newark Bay as the most degraded area on the basis of sediment chemistry, toxicity, and benthic community, followed by the Upper Harbor, Jamaica Bay, Lower Harbor, Western Long Island Sound and the New York Bight Apex. Biological effects, identified based upon the benthic invertebrate community, were found to be associated with the chemical contamination. While the sediments of the New York Harbor Estuary are contaminated, the levels of most sediment contaminants (e.g., dioxin, DDT, and mercury) have decreased on average by an order of magnitude over the past 30 years (Steinberg et al. 2002). Between 1993 and 1998 the percentage of sediment sampling locations with benthic macroinvertebrate communities considered impacted, or of degraded quality, decreased throughout the New York/New Jersey Harbor Estuary. Within the Upper Harbor, the percentage of benthic communities considered impacted decreased significantly from 75 percent in 1993 to 48 percent in 1998 (Steinberg et al. 2004).

Arthur Kill sediment has been found to have very high concentrations of PCB, dioxin, and DDT (primarily DDD). Arthur Kill PCBs are richer in the heavier homologues than those from other areas. The chemicals contributing to total dioxin concentrations in the Arthur Kill suggest sources beyond those from the Newark Bay-Passaic River-Hackensack River watershed (Litten & Fowler 1999, Litten 2003). Sediment quality data reported in the USEPA National Sediment Database for the Arthur Kill near Goethals Bridge and near the Arthur Kill/Kill van Kull confluence had concentrations of polycyclic aromatic hydrocarbons (PAHs), metals (lead, mercury, zinc), PCBs, and total DDT that may affect benthic organisms (Maxus 1991, National Oceanic and Atmospheric Administration (NOAA) 1991, USEPA 1993). Results of sediment sampling conducted as part of the Environmental Monitoring Program in 2006 detected concentrations of contaminants not indicative of leachate—alpha-chlordane, gama-chlordane, DDT, DDD and DDE, and the PAHS benzo(a)anthracene, benzo(b)fluoranthene, chrysene, fluoranthene, and pyrene—above their criteria in sediment samples collected from within Fresh Kills, Main, and Richmond creeks, and from the Arthur Kill. (Shaw 2007b).

DSNY SEDIMENT MONITORING

As stated above, DSNY has conducted sediment quality monitoring within the Arthur Kill and Fresh Kills estuary (i.e., Little Fresh Kill, Great Fresh Kill, Fresh Kills, Richmond Creek, and Main Creek) since 1991 to assess the effects of leachate discharge, characterize the sediment quality, to monitor the effects of landfill operation, and as part of the Long-Term Monitoring Plan. Sediment samples were collected from subtidal areas and analyzed for the same parameters indicative of leachate contamination that were discussed previously under "Water Quality."

For sediment samples collected in 1992, TKN sediment concentrations were found to be significantly higher at the Fresh Kills and Main Creek stations than in the Arthur Kill. Barium, nickel and zinc concentrations in sediment were found to be higher in Fresh Kills, Main, and Richmond Creeks than in the Arthur Kill. Sulfide concentrations within sediments of the Fresh Kills system creeks were similar to those for Arthur Kill sediments. Sediment levels of COD, phenols, TOC, aluminum, arsenic, chromium, cobalt, copper, iron, lead, manganese, vanadium and total cyanide were similar in the Fresh Kills estuary and the Arthur Kill (DSNY 1996).

The presence of leachate in sediments may be indicated by elevated levels of alkalinity, ammonia, TKN, barium, sulfide, and zinc in samples in the vicinity of the Fresh Kills Landfill in Fresh Kills, Main Creek, and Richmond Creek. Results of sampling conducted within the Arthur Kill, Fresh Kills, Main Creek and Richmond Creek after 1998 show a similar pattern for most of the leachate contaminants. On the basis of the results from the 2006 Environmental Monitoring Program, some of these parameters are exhibiting a significant downward trend after 1998. Ammonia, alkalinity, and TKN exhibit significant decreasing trends in some locations, which were mirrored in samples collected from shallow groundwater wells (Shaw 2007b). These improvements in sediment quality may be indicative of decreasing leachate impacts on the Landfill creeks.

AQUATIC BIOTA

PHYTOPLANKTON

Phytoplankton are generally microscopic plants whose movements within the waters of the Harbor Estuary are controlled by tides and currents. Phytoplankton, submerged aquatic vegetation (SAV), and benthic macroalgae (multi-cellular algae that attach to surfaces) are the primary producers of energy in the ocean food chain. They require sunlight as their primary energy source, and their productivity, biomass, and depth distribution will be limited by light penetration. Diatoms (unicellular members of the largest group of algae in the golden algae phylum) dominate the phytoplankton community in the Harbor Estuary in late winter to early spring, when they are succeeded by smaller forms (Malone 1977, Lively et al. 1983). Brosnan and O'Shea (1995) identified 29 taxa in a 1993 survey of the New York Harbor. Common phytoplankton species that occur in the Harbor Estuary are as presented below.

- Diatoms (Bacillariophyta)—*Asterionella japonica, Chaetoceros debilis, Eucampia zoodiacus, Nitzchia bilobata, Rhizosolenia delicatula, Schroderella delicatula, Skeletonema costatum, Thalassionema nitzchoides, Thalassiosira decipiens, and Thalassiosira nordenskioldii.*
- Dinoflagellates (a group of microscopic algae characterized by two flagella, whip-like projections) (Pyrrophyta)—*Peridinium globulum, Peridinium trochoideum, Prorocentrum micans, and Prococentrum refieldii*.
- Green algae (Chlorophyta)—*Chlorella* sp., and *Nannochloris atomus*.
- Blue-Green algae (Cyanophyta)—*Agmenellum* sp., and *Anacystis* sp. (Brosnan and O'Shea 1995, Cosper undated).

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 (*Anchoa mitchilli)* and early life stages of commercially and recreationally important fish species such as striped bass and white perch. Zooplankton 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 Harbor 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, Hazen and Sawyer 1983). Copepods, rotifers, and barnacle larva (Cirripedia) are common microzooplankton (smallest zooplankton) (USACE & U.S. Department of Transportation (USDOT) 1984). Common larger macrozooplankton (retained on nets with mesh openings of 505 µm) are mysid shrimp (*Neomysis americana*), cumaceans, and amphipods (USACE & USDOT 1984).

BENTHIC INVERTEBRATES

Benthic macroinvertebrates live within or on sediment and associated structures, and in estuarine systems, and include molluscs, crustaceans, marine worms, and amphipods. Benthic communities are regulated by both substrate type and the quality of surface water and sediment, as tolerance to pollution varies among species. Both diversity and abundance of species tolerant or susceptible to pollution are used as relative indices of benthic community health. Benthic macroinvertebrates support higher level consumers such as fish and birds, and thus play an important role in estuarine food webs in terms of nutrient cycling (Steinberg et al. 2004). Species identified in the NY-NJ Harbor include cnidarians (i.e., anemones), annelids (i.e., oligochaete and polychaete worms), mollusks (i.e., bivalves such as clams and mussels), and arthropods (i.e., shrimps, crabs, isopods) (EA 1988, EA Engineering Science & Technology 1990, NJDEP 1984, Princeton Aqua Science 1985a & 1985b, LMS 1980 & 1984).

Table 10-2 is a list of estuarine benthic macroinvertebrates identified within Fresh Kills (DSNY 1996, Shaw 2005 and 2007). Baseline benthic community studies were conducted within the project site in 1991-1994, and post-corrective benthic community studies have been conducted from 1998 to 2006 (DSNY 1996, Shaw 2005 and 2007). Pollution-tolerant suspension and deposit feeding worms dominate the benthic community in the tidal creeks located within the project site (Richmond Creek, Main Creek and Fresh Kills) and indicate stressed conditions, although more pollution sensitive amphipods and mollusks (*Macoma balthica*) were noted in 2004 and 2006. Shaw (2007) noted that burrowing anemones of the family Edwardsiidae were more abundant in the 2006 samples than in previous years, and that these organisms may be considered to be indicative of improved habitat quality. Additionally, the 2006 sampling efforts collected a single Eastern oyster (*Crassotrea virginica*) in Main Creek. This is the first instance of a living individual of this species being collected during the 13 years of benthic macroinvertebrate monitoring at Fresh Kills. Some species differences may be due to sampling effort and classification of benthos. For instance, saltmarsh snails (*Melampus spp.)* and shrimp were noted on the 1991 species list, but not in 2004, although they most certainly were present; conversely, cnidarians and insects were noted in 2004 and not in 1991. Benthic macroinvertebrate communities in estuarine systems were not assessed as part of the 2007 AKRF field observations. However, benthic macroinvertebrates present in stormwater basins and other open water areas, and creeks with uncertain connections to estuarine systems, were sampled during the fall AKRF survey, and are discussed at the end of this section.

The benthic community structure within the Fresh Kills creeks and the Arthur Kill has shown variability among sampling locations and the various years of the monitoring program and consistent upward or downward trends are not evident. However, some statistically significant improvement in benthic community descriptors have been identified. On the basis of the results from the 2006 Environmental Monitoring Program, some of these parameters are exhibiting a significant downward trend after 1998.

In 1991, the project site supported a species-poor estuarine community (i.e., low species diversity and richness) dominated by pollution-tolerant suspension and deposit-feeding detritivores, considered to be typical of benthic communities in other areas of the Arthur Kill and its tributaries. Sediment and the associated benthic community within the general Arthur Kill region has been adversely impacted by activities (i.e., discharges) from the surrounding highly urbanized area, to a greater degree than the surrounding waters (e.g., Raritan Bay). Benthic invertebrate samples were collected from the subtidal and low intertidal zones at stations in Richmond Creek, Main Creek, and Marshes Creek (a reference area in the Rahway River). Species distributions in the three creeks were similar. *Streblospio benedicti* was the most abundant polychaete worm, within the subtidal zone of all three creeks. Low intertidal zones were dominated by either *S. benedicti* or oligochaete worms. *Eteone heteropoda*, a polychaete worm within low intertidal or subtidal zones, was not as abundant as *S. benedicti*. In the upper tidal zone, oligochaetes were generally the most abundant benthic organism. Intertidal zone also contained low densities of molluscs (i.e., snails and bivalves), amphipods (*Gammarus* spp), and very low densities of the pollution-sensitive isopod (*Cyathura polita*).

Table 10-2
Estuarine Benthic Invertebrate Community Data for Fresh Kills: 1991, 2004, and 2006

Scientific Name	Common Name	Tidal Zone	Year observed
PHYLUM CNIDARIA			
Class: Actiniaria			
Anemones		Subtidal	2004
Family: Edwardsiidae		Intertidal and Subtidal	2006
Edwardsia elegans		Intertidal	2006
Family: Haliplanellidae			
Haliplanella lineate		Subtidal	2006
PHYLUM NEMERTINA			
Class: Nemertea			
Proboscis worms Nemertean worms		Subtidal	1991
Celebratulus sp.		Subtidal	2004
Carinoma tremaphoros		Subtidal	2006
Family: Lineidae		Intertidal and Subtidal	2006
PHYLUM ASCHELMINTHES			
Class: Nematoda			
Aschelminthian worms Roundworms		All	1991
PHYLUM MOLLUSCA			
Class: Bivalvia			
Macoma balthica		Intertidal and Subtidal	2006
Crassostrea virginica		Subtidal	2006
Class: Gastropoda			
Hydrobia minuta	Swamp hydrobia	High & low marsh	1991
Melampus bidentatus	Saltmarsh snail	High & low marsh	1991 2006
Nassarius obsoletus	Mud snail	Intertidal	2006
Nassarius trivittatus	New England dog whelk	Subtidal	2006
Melampus bidentatus	Marsh snail	Intertidal	2006
Class: Pelecypoda			
Modiolus demissus	Ribbed mussel	Intertidal	1991
Tellina agilis	Dwarf tellin	Intertidal	1991
Macoma balthica	Baltic macoma clam	Subtidal	Both
PHYLUM ANNELIDA			
Class: Polychaeta			
Mobile Polychaetes			
Family Phyllodocidae		Intertidal and Subtidal	2006
Eteone heteropoda	Paddle worms	Intertidal and Subtidal	1991, 2004, and 2006
*Nereis succinea**	Clam worm	All	1991 and 2006
Nereis virens	Clam worm	All	1991
Nereis accuminata	Clam worm	All	2004
Notomastus latericeus	Clam worm	All	2004
Scolecolepides viridis	Clam worm	All	2004 and 2006
Sedentary Polychaetes			
Orbiniidae	Orbiniid worms	Intertidal and Subtidal	1991
*Streblospio benedicti**	Mud worm	Intertidal and Subtidal	1991, 2004, and 2006
*Polydora ligni**	Mud worm	Intertidal and Subtidal	1991, 2004, and 2006
Hypaniola grayi	Ampharetid worm	Intertidal and Subtidal	Both
Amphicteis floridus	Ampharetid worm	Intertidal and Subtidal	2006
Scolopolos fragilis		Intertidal and Subtidal	2004 and 2006
Family Capitellidae			
Heteromastus filiformis	Capitellid worm	Intertidal and Subtidal	2006
Capitella capitata	Gallery worm	Intertidal and Subtidal	2006
Class: Oligochaeta *			
Family: Tubificidae		Intertidal and Subtidal	1991, 2004, and 2006
Family: Enchytraeidae		Intertidal and Subtidal	1991, 2004, and 2006

Table 10-2 (cont'd)
Estuarine Benthic Invertebrate Community for Project Site, 1991, 2004, and 2006

Scientific Name	Common Name	Tidal Zone	Year observed
PHYLUM SIPUNCULA			
Family: Sipunculidae		Intertidal and Subtidal	2004
PHYLUM ARTHROPODA			
Class: Crustacea			
Order: Insecta			
Tabanidae			2004
Chironomus sp.			2004
Order: Cumacea		Intertidal and Subtidal	2006
Leucon americanus	Cumacean shrimp		1991
Order: Isopoda		Subtidal	2006
Cyathura polita	Slender isopod	High/low intertidal	1991, 2004, and 2006
Edotea triloba		Subtidal	2006
Order: Amphipoda			
Gammarus mucronatus	Scud	Intertidal	1991
Gammarus spp.	Scud	Intertidal	Both
Order: Decapoda			
*Palaemonetes pugio**	Shore shrimp	Subtidal	1991
Rhithropanopeus harrisii	White-fingered mud crab	Intertidal and Subtidal	1991, 2004, and 2006
Uca pugnax	Mud fiddler crab	Intertidal	1991
Crangon septemspinosa	Sevenspine bay shrimp	Subtidal	2006
Subclass Cirripedia (barnacles)			
Balanus eburneus	Acorn barnacle	Subtidal	2006

Note: *** =** pollution tolerant species
Source: DSNY (1996), Shaw (2005 and 2007).

Monitoring conducted in 2004 indicated similar benthic macroinvertebrate community structure in Main and Richmond creeks that were dominated by polychaete and oligochaete worms (Shaw 2005, Table 10-4). While some changes in species diversity were observed, statistically significant trends in population shifts did not seem to indicate a wide improvement in environmental conditions within the project site.

There is some indication that benthic invertebrate distributions are changing as sediment quality improves (Adams et al. 1998). In 1993 and 1998, the EPA conducted the Regional Environmental Monitoring and Assessment Program (R-EMAP) in the NY-NJ Harbor area to examine benthic community structure and sediment contamination. In 1993, substantial proportion of sampling sites near the Arthur Kill (Newark and Raritan Bays) were considered degraded, although improvements in both sediment quality and benthic species diversity were observed (Adams and Benyi 2003). Interestingly, the percent of pollution-tolerant species significantly declined, but pollution-sensitive species did not show an increasing trend (Adams and Benyi 2003).

A description of aquatic conditions in the stormwater management basins is provided below under "Project Site Summary."

FISH

BACKGROUND CONDITIONS

The Arthur Kill is located at the confluence of several major river and estuarine systems, all of which discharge to the New York Bight of the Atlantic Ocean. This convergence has resulted in a mix of habitats in the Arthur Kill that can 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). Some species may use it only on a seasonal basis as a migratory route between the Hudson River and Raritan Bay. Table 10-3 lists fish species with the potential to occur within the Arthur Kill and adjacent waters. Examples of resident species include naked goby (*Gobiosoma bosc),* winter flounder (*Pseudopleuronectes americanus),* and estuarine species such as mummichog (*Fundulus heteroclitus),* Atlantic silverside (*Menidia menidia),* striped killifish (*Fundulus majalis),* and grubby sculpin (*Myxocephalus aeneus*) (USFWS 1997).

Results of sampling conducted in the Arthur Kill, Kill Van Kull, and Newark Bay in the mid-1990s (USCG 1995, and LMS 1996) indicate seasonal and spatial patterns for the most abundant fish species. Fish found to be abundant in the shoal areas included bay anchovy, striped bass, winter flounder, windowpane flounder (*Scopthalmus aquosus),* Atlantic silverside (*Menidia menidia),* summer flounder (*Paralichthys dentatus),* northern pipefish (*Syngnathus fuscus),* white perch, Atlantic herring (*Clupea harengus),* and Atlantic tomcod (*Microgadus tomcod).* Fish that were abundant in the channels included grubby (*Myoxocephalus aenaeus),* scup (*Stenotomus chrysops),* spot (*Leiostomus xanthurus),* cunner (*Tautogolabrus adspersus),* alewife (*Alosa pseudoharengus),* gizzard shad, bay anchovy, rainbow smelt, Atlantic tomcod, spotted hake (*Urophycis regia),* white perch, striped bass, weakfish (*Cynoscion regalis),* summer flounder, and winter flounder. Fish found to be abundant in the deep-water areas included some of the same species found to be abundant in the shoal areas, as well as other species abundant only in the channel areas. Fish were much more abundant from April to October in the shoal areas, but was more consistent in the channel areas. Striped and common killifish/mummichog are also found in abundance in the shoal areas. These species, along with bay anchovy, Atlantic silverside and white perch are important forage species for larger predator fish. Duffy-Anderson et al. (2003) conducted fish sampling in the Arthur Kill on alternate weeks from August to November 1995 to characterize juvenile fish assemblages around man-made structures. Young-of-the-year comprised the majority of the individuals collected. Silver perch and naked goby were the most abundant species collected. Many of the dominant fishes were typically more abundant in structured habitats (wrecks or pile fields) than in the open water sites, and only silver perch was collected in greater numbers in open water.

PROJECT SITE

Main and Richmond Creeks

DSNY conducted a survey of the fish community within Main and Richmond Creeks in May 1995 to supplement the available data regarding fish species in the vicinity of the Fresh Kills Landfill. The fish communities in Main and Richmond Creeks appeared to be typical of communities found in small, estuarine waters. The community composition in these creeks was consistent with results from previous studies and other available information on fish communities in the Arthur Kill. Fish species collected included American eel, blueback herring (*Alosa aestivalis),* Atlantic menhaden (*Brevoortia tyrannus),* bay anchovy, mummichog, three-spine stickleback (*Gasterostreus aculeatus*), Atlantic silversides, hogchoker (*Trinectes maculates),* striped bass, and white perch (DSNY 1996).

A description of the stomwater management basins east of Landfill Section 6/7 is provided below.

Table 10-3
Potential Fish Species in the Arthur Kill/Fresh Kills Complex

Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*
American eel	*Anguilla rostrata*
American sand lance	*Ammodytes americanus*
American shad	*Alosa sapidissima*
Atlantic Croaker	*Micropogonias undulates*
Atlantic herring	*Clupea harengus*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic silverside	*Menidia menidia*
Atlantic tomcod	*Microgadus tomcod*
Bay anchovy	*Anchoa mitchilli*
Black sea bass	*Centropristis striata*
Blueback herring	*Alosa aestivalis*
Bluefish	*Pomatomus saltatrix*
Butterfish	*Peprilus triacanthus*
Crevalle jack	*Caranx hippos*
Cunner	*Tautogolabrus adspersus*
Feather blenny	*Hypsoblennius hentz*
Fourbeard rockling	*Enchelyopys cimbrius*
Grubby	*Myoxocephalus aenaeus*
Hickory shad	*Alosa mediocris*
Hogchoker	*Trinectes maculates*
Inland silverside	*Menidia beryllina*
Inshore lizardfish	*Synodus foetens*
Little skate	*Raja erinacea*
Mummichog	*Fundulus heteroclitus*
Naked Goby	*Gobiosoma bosc*
Northern kingfish	*Menticirrhus saxitilis*
Northern pipefish	*Syngnathus fuscus*
Northern puffer	*Sphoeroides maculates*
Northern searobin	*Prionotus carolinus*
Northern stargazer	*Astroscopus guttatus*
Orangespotted filefish	*Cantherhines pullus*
Oyster toadfish	*Opsanus tau*
Pollock	*Pollachius virens*
Rainbow smelt	*Osmersus mordax*
Red hake	*Urophycis chuss*
Rock gunnel	*Pholis gunnellus*
Scawled cowfish	*Lactophrys quadricornis*
Scup	*Stenotomus chrysops*
Sea horse	*Hippocampus erectus*
Seaboard goby	*Gobiosoma ginsburgi*
Silver hake	*Merluccius bilinearis*
Silver Perch	*Bairdiella chrysoura*
Smallmouth flounder	*Etropus microstomus*
Spanish mackerel	*Scomberomorus maculates*
Speckled worm eel	*Myrophis punctatus*
Spot	*Leiostomus xanthurus*
Spotfin butterflyfish	*Chaetodon ocellatus*
Spotted Hake	*Urophycis regia*
Striped bass	*Morone saxatilis*
Striped burrfish	*Chilomycterus schoepfi*
Striped cusk-eel	*Ophidion marginatum*
Striped killifish	*Fundulus majalis*
Striped mullet	*Mugil cephalus*
Striped searobin	*Prionotus evolans*
Summer flounder	*Paralichthys dentatus*
Tautog	*Tautoga onitis*
Weakfish	*Cynoscion regalis*
White mullet	*Mugil curema*
White perch	*Morone Americana*
Windowpane	*Scopthalmus aquosus*
Winter flounder	*Pseudopleuronectes americanus*

Sources: DSNY (1996), Able and Fahay (1998), Duffy-Anderson et al. (2003), USCG (1995), and LMS (1996).

ESSENTIAL FISH HABITAT

The site is located on the Arthur Kill within a portion of the Raritan Bay River Estuary Essential Fish Habitat (EFH) that is situated in NOAA/NMFS 10' x 10' square with coordinates (North) 40°40.0' N, (East) 74°10.0' W, (South) 40°30.0' N, (West) 74°20.0' W, and which includes estuarine Raritan Bay waters within a portion of Newark Bay and the Arthur Kill. The area of the Arthur Kill containing the Fresh Kills Park project site has been identified as EFH for 16 species of fish. Table 10-4 lists the species and life stages of fish identified as having EFH in the Arthur Kill.

Table 10-4
Essential Fish Habitat Designated Species for Fresh Kills

Species	Eggs	Larvae	Juveniles	Adults
Red hake (*Urophycis chuss*)		X	X	X
Winter flounder (*Pseudopleuronectes americanus*)	X	X	X	X/S
Windowpane (*Scopthalmus aquosus*)	X	X	X	X/S
Atlantic herring (*Clupea harengus*)		X	X	X
Bluefish (*Pomatomus saltatrix*)			X	X
Atlantic butterfish (*Peprilus triacanthus*)		X	X	X
Atlantic mackerel (*Scomber scombrus*)			X	X
Summer flounder (*Paralicthys dentatus*)		X	X	X
Scup (*Stenotomus chrysops*)	X	X	X	X
Black sea bass (*Centropristus striata*)			X	X
King mackerel (*Scomberomorus cavalla*)	X	X	X	X
Spanish mackerel (*Scomberomorus maculatus*)	X	X	X	X
Cobia (*Rachycentron canadum*)	X	X	X	X
Clearnose skate (*Raja eglanteria*)			X	X
Little skate (*Leucoraja erinacea*)			X	X
Winter skate (*Leucoraja ocellata*)			X	X

Note: "S" indicates habitat for spawning adults.
Source: National Marine Fisheries Service. "Summary of Essential Fish Habitat (EFH) Designation" posted on the internet at http://www.nero.noaa.gov/hcd/ny3.html.

HABITATS AND COMMUNITIES

INTRODUCTION

The following sections describe the existing habitats and communities at the project site and within the and secondary study area (see Figure 10-3). Information provided below is based on previous documents regarding the project site, and 2007 field observations by AKRF Inc. Appendix C contains the Natural Resources Field Survey Plan, the reference map identifying the data collection locations, and field data sheets.

Figure 10-7 presents the general land cover classifications identified for the project site. In addition, Figures 10-8 through 10-11 provide photographs of some of the key habitats in East Park.

GENERAL CONDITIONS

The impact of past and present human activities on the landscape in both the project site and secondary study area is readily apparent. Within the project site, the presence of 50-year-old Municipal Solid Waste Landfilling sites with a substantial infrastructure, service roads, a waste transfer station, and other facilities are clear indications of the extent of human use of the site. However, Fresh Kills is also one of the largest contiguous upland areas in New York City where access is restricted, human activities are relatively limited, and where the landscape is incrementally shifting towards the development (both natural and assisted) of complex habitat assemblages. Presently, the vast project site contains numerous upland habitats, including 10- to 50-year-old woodlands and expanses of both native and non-native grasslands. A number of these habitats are considered rare or critical within the city and state, and represent valuable sites for flora and fauna in their present condition.

Additionally, limited nighttime lighting is present within the project site, making the project site one of the darkest sites in the New York City area. Nighttime lighting within the project area is limited to the West Shore Expressway, public streets (such as Arthur Kill Road and Richmond Avenue) that surround the project site, and roadway lights along paved roads, bridges and facility areas within former Fresh Kills Landfill. The majority of existing secondary roads, such as those surrounding or traversing landfill sections, are presently unlit; this likely supports numerous wildlife activities (i.e., breeding, foraging) that would not occur in natural areas of the city that are directly or indirectly illuminated.

VEGETATIVE HABITATS

The discussion below provides a description of the plant communities at Fresh Kills (the entire property), the secondary study area, and for the project site (the proposed road alignments).

Fresh Kills Overview

Plant communities present at Fresh Kills and within the secondary study area are described below using terms introduced by SCS Engineers (1990) and adopted by AES (2003) in their subsequent plant community surveys. Categories differ from habitat classifications described in Edinger et al. (2000), but are used in this report for the sake of continuity with previous plant surveys.

The 1996 DEIS describes the project site's upland communities areas as "a highly disturbed upland plant community dominated by grasses" and categorized as early- and late-successional old field communities and early deciduous forest, with associated tidal wetland habitat classifications following Cowardin et al. (1979). Table 10-5 lists plant species identified in the 1996 DEIS as present within the project site (specifically Landfill Sections 1/9 and 6/7) and in tidal wetlands during field observations, and whether they were observed during the 2007 field observations. Figure 10-7 illustrates the current distribution of land cover categories within the project site.

Spartina-dominated Marsh

Fresh Kills contains approximately 160 acres of relatively undisturbed *Spartina*-dominated salt marsh (SCS Engineers 1990, AES 2003, AKRF 2007). These areas generally are located in the Main Creek area of the site north of Landfill Section 6/7, and along Richmond Creek south of Landfill Section 6/7. One of these tidal estuaries (Richmond Creek) has been identified by the HEP as a priority enhancement site (HEP 2007). These marshes are predominantly low marsh vegetated with *Spartina alterniflora*, with smaller areas of high marsh vegetation (i.e., *Spartina patens, Distichlis spicata).* Groundselbush (*Baccharis halimifolia*) is present throughout the area's salt marsh communities.

Mixed Marsh

Much of the shoreline habitats at Fresh Kills are vegetated with patches of *Spartina alterniflora* and *Phragmites australis*. Areas of *Spartina alterniflora,* approximately 5 to 25 feet in width, exist along the shoreline, generally at the mid and mean high tide elevation levels. Stands of *Phragmites* are associated with *Spartina* fragments or alone, and tend to be located along wetland edges, and transitional areas between wetland and upland areas. Groundselbush is also present within these mixed marsh areas, but less frequently than *Spartina* and *Phragmites*.

Table 10-5
Plant Species Known to Occur at Fresh Kills

Common Name	Scientific Name	Observed in 2007
Grasses/Sedges/Rushes		
Bentgrass	*Agrostis sp.*	
Broom sedge	*Andropogon virginicus*	
Japanese Broom	*Bromus japonicus*	
Sedge	*Carex spp.*	X
Tussock sedge	*Carex stricta*	X*
Blunt broom sedge	*Carex tribuloides*	
Umbrella sedge	*Cyperus strigosus*	X
Crabgrass	*Digitaria filiformis*	
Saltgrass	*Distichlis spicata*	X
Barnyard grass	*Echinochloa crus-galli*	X
Blunt spike rush	*Eleocharis obtusa*	X
Spike rush	*Eleocharis sp.*	X
Fescue	*Festuca sp.*	X
Squirrel-tail grass	*Hordeum jubatum*	X*
Canadian rush	*Juncus canadensis*	
Soft rush	*Juncus effusus*	X
Path rush	*Juncus tenuis*	X*
Panic grass	*Panicum spp.*	X
Philadelphia panic grass	*Panicum philadelphicum*	
Switchgrass	*Panicum virgatum*	X
Reed canary grass	*Phalaris arundinacea*	X
Common reed	*Phragmites australis*	X
Sturdy bulrush	*Schoenoplectus robustus*	
Woolgrass	*Scirpus cyperinus*	X
Foxtail grass	*Setaria sp.*	
Green foxtail	*Setaria viridis*	
Saltwater cordgrass	*Spartina altemiflora*	X
Salt reed grass	*Spartina cynosuroides*	
Salt-meadow grass	*Spartina patens*	X
Broad-leaved cattail	*Typha latifolia*	X
Forbs		
Yarrow	*Achillea millefolium*	X
Purple false foxglove	*Agalinis purpurea*	X
White snakeroot	*Ageratina altissima*	X*
Scented thoroughwort	*Ageratina aromatica*	
Marsh water-hemp	*Amaranthus cannabinus*	
Common ragweed	*Ambrosia artemisiifolia*	X
Indianhemp	*Apocynum cannabinum*	
Biennial wormwood	*Artemisia biennis*	
Common mugwort	*Artemisia vulgaris*	X
Common milkweed	*Asclepias syriaca*	X
Marsh orache	*Atriplex patula*	
Bearded beggarticks	*Bidens aristosa*	
False nettle	*Boehmeria cylindrica*	X*
Patridge pea	*Chamaecrista nictitans*	X
Lambs quarters	*Chenopodium album*	
Mexican tea	*Chenopodium ambrosioides*	
Common chicory	*Cichorium intybus*	X*
Canada thistle	*Cirsium arvense*	
Bull thistle	*Cirsium vulgare*	X

Table 10-5 (cont'd)
Plant Species Known to Occur at Fresh Kills

Common Name	Scientific Name	Observed in 2007
Forbs (cont'd)		
Asiatic dayflower	*Commelina communis*	X
Horseweed	*Conyza canadensis*	
Whorled coreopsis	*Coreopsis verticillata*	X*
Fiveangled dodder	*Cuscuta pentagona*	
Queen Anne's Lace	*Daucus carota*	
Hay-scented fern	*Dennstaedtia punctilobula*	
White thoroughwort	*Eupatorium album*	X*
Hyssop-leaf thoroughwort	*Eupatorium hyssopifolium*	X*
Common boneset	*Eupatorium perfoliatum*	X*
Late-flowering thoroughwort	*Eupatorium serotinum*	
Slender goldenrod	*Euthamia tenuifolia*	X*
Wild sunflower	*Helianthus annuus*	
Jewel weed	*Impatiens capensis*	X*
White morning glory	*Ipomoea lacunosa*	X*
Marsh elder	*Iva frutescens*	
Bugleweed	*Lycopus sp.*	X
White sweet clover	*Melilotus alba*	X
Evening primrose	*Oenothera biennis*	
Sensitive fern	*Onoclea sensibilis*	X
Cinnamon fern	*Osmunda cinnamomea*	X
Pokeweed	*Phytolacca americana*	X
Common plantain	*Plantago major*	X*
Lady's thumb	*Polygonum cespitosum*	X*
Japanese knotweed	*Polygonum cuspidatum*	X
Nodding knotweed	*Polygonum lapathifolium*	
Dotted smartweed	*Polygonum punctatum*	
Pennsylvania knotweed	*Polygonum pensylvanicum*	
Climbing false buckwheat	*Polygonum scandens*	
Knotweed	*Polygonum spp.*	X
Sweet everlasting	*Pseudognaphalium obtusifolium*	
Curly dock	*Rumex crispus*	X
Climbing nightshade	*Solanum dulcamara*	
Common nightshade	*Solanum ptycanthum*	X*
Canada goldenrod	*Solidago canadensis*	X
Grass-leaved goldenrod	*Solidago graminifolia*	X
Sweet goldenrod	*Solidago odora*	
Wrinkled goldenrod	*Solidago nigosa rugosa*	X
Goldenrods	*Solidago sp.*	X
Small white aster	*Symphyotrichum lateriflorum*	X*
Heath aster	*Symphyotrichum pilosus*	X
Marsh aster	*Symphyotrichum subulatus*	X
Skunk cabbage	*Symplocarpus foetidus*	X
Dandelion	*Taraxacum sp.*	
Lesser hop clover	*Trifolium campestre*	X*
Red clover	*Trifolium pratense*	X
Common mullein	*Verbascum thapsus*	
Swamp vervain	*Verbena hastata*	
White vervain	*Verbena urticifolia*	
Tall ironweed	*Vernonia gigantea*	
Cocklebur	*Xanthium strumarium*	

Table 10-5 (cont'd)
Plant Species Known to Occur at Fresh Kills

Common Name	Scientific Name	Observed in 2007
Woody Plants		
Red maple	*Acer rubrum*	X
Silver maple	*Acer saccharinum*	X
Tree-of-heaven	*Ailanthus altissima*	X
Mimosa tree	*Albizia julibrissin*	
Hazel alder	*Alnus serrulata*	
Serviceberry	*Amelanchier sp.*	X
Groundselbush	*Baccharis halimifolia*	X
Gray birch	*Betula populifolia*	X
Gray dogwood	*Cornus .racemosa*	X*
Silky dogwood	*Cornus amomum*	
Persimmon	*Diospyros sp.*	X
White ash	*Fraxinus americana*	X
Green ash	*Fraxinus pennsylvanica*	X
Witch hazel	*Hamamelis virginiana*	X
Eastern red cedar	*Juniperus virginiana*	X*
Spicebush	*Lindera benzoin*	X
Sweet gum	*Liquidambar styraciflua*	X
Tulip tree	*Liriodendron tulipifera*	X
Crabapple	*Malus spp.*	X*
Bayberry	*Morella pensylvanica*	
White mulberry	*Morus alba*	X
Black tupelo	*Nyssa sylvatica*	X
Princess tree	*Paulownia tomentosa*	X*
Chokeberry	*Photinia sp.*	X*
Black chokeberry	*Photinia melanocarpa*	
White pine	*Pinus strobus*	X
Cottonwood	*Populus deltoides*	X
Large-toothed aspen	*Populus grandidentata*	X
Sour cherry	*Prunus cerasus*	
Black cherry	*Prunus serotina*	X
White oak	*Quercus alba*	X
Swamp white oak	*Quercus bicolor*	X
Scarlet oak	*Quercus coccinea*	X*
Pin oak	*Quercus palustris*	X
Willow oak	*Quercus phellos*	X*
Red oak	*Quercus rubra*	X
Winged sumac	*Rhus copallinum*	X
Smooth sumac	*Rhus glabra*	
Staghorn sumac	*Rhus typhina*	X
Black locust	*Robinia pseudoacacia*	X
Multiflora rose	*Rosa multiflora*	X
Blackberry	*Rubus sp.*	X
Blackberry	*Rubus allegheniensis*	X
Pussy willow	*Salix discolor*	
Black willow	*Salix canadensis*	X
Common elderberry	*Sambucus nigra*	X
Sassafras	*Sassafras albidum*	X
Eastern hemlock	*Tsuga canadensis*	X
American elm	*Ulmus americana*	X
Blueberry	*Vaccinium sp.*	X

Table 10-5 (cont'd)
Plant Species Known to Occur at Frseh Kills

Common Name	Scientific Name	Observed in 2007
Woody Plants (cont'd)		
Highbush blueberry	*Vaccinium corymbosum*	X*
Black highbush blueberry	*Vaccinium fuscatum*	X*
Arrow-wood	*Viburnum dentatum*	X
Vines		
Porcelainberry	*Ampelopsis brevipedunculata*	X*
Oriental Bittersweet	*Celastrua orbiculatus*	X
Common bindweed	*Convolvulus arvensis*	
Bush honeysuckle	*Lonicera sp.*	X*
Japanese honeysuckle	*Lonicera japonica*	X
Virginia creeper	*Parthenocissus quinquefolia*	X
Greenbrier	*Smilax rotundifolia*	X
Poison ivy	*Toxicodendron radicans*	X
Fox Grape	*Vitis labrusca*	X*

Notes: The species above were noted in 1996 at Landfill Sections 1/9 and 6/7 at the project site, and verified in 2007 by AKRF.
Sources: DSNY 1996, AKRF field observations, May and October 2007.
X—plant species observed during the May 2007 field investigation
X*—plant species observed during the October 2007 field investigation

There is evidence that the marsh community species composition has changed in some areas of the project site over time, possibly due to changes in site activity associated with the closure of the landfill. For instance, a 32-acre scraped shoreline community vegetated with *S. alterniflora*, *S. patens*, *D. spicata*, and *Phragmites* was described along Landfill Sections 1/9 and 3/4 in 1990 (SCS Engineers 1990). These areas are now predominantly vegetated with *Spartina alterniflora* immediately along the shoreline, with small stands of *Phragmites* and groundselbush (AES 2003, AKRF 2007).

Phragmites-Dominated Emergent/Scrub-Shrub Wetlands

Historically, many areas within Fresh Kills were vegetated with scrub-shrub and emergent species including blunt spikerush (*Eleocharis obtusa)*, sensitive fern (*Onoclea sensibilis)* and other common emergent species (SCS Engineers 1990). However, *Phragmites*-dominated emergent and scrub-shrub wetlands are common communities in wetland areas, in both tidal areas and areas isolated from any tidal exchange. As observed in marshlands throughout the region, *Phragmites* is becoming increasingly dominant in emergent/scrub-shrub wetlands in many areas of the project site (SCS 1990, AES 2003, AKRF 2007). It occurs in the ponded area at the southeast edge of Landfill Section 6/7, and the stormwater management basin to the north, in depressions at the base of some of the mounds, adjacent to roadways (i.e., West Shore Expressway), within the drainage between the two portions of Landfill Section 2/8 that is a tributary to Richmond Creek, and on the eastern side of Isle of Meadows.

Palustrine Forested Wetlands

Palustrine forested wetlands are present within Fresh Kills—south and east of the West Shore Expressway, across from Arden Heights Woods, and south of Landfill Section 2/8. Here, red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), pin oak (*Quercus palustris*), and green ash (*Fraxinus pennsylvanica*) are the dominant tree species (SCS Engineers 1990). These communities are relatively undisturbed and of similar composition to those described in earlier studies. Spicebush (*Lindera benzoin*) and arrow-wood (*Viburnum dentatum*) are the dominant understory shrub species. Jewelweed (*Impatiens capensis*) is the common herbaceous species.

Phragmites occurs along the outer edges of these forested communities. Poison ivy (*Toxicodendron radicans*) and Virginia creeper (*Parthenocissus quinquefolia*) occur within the interior and along the upland-wetland edges. Japanese knotweed (*Polygonum cuspidatum)*, an invasive species, also occurs within these communities.

Mixed Palustrine Forested and Emergent Wetlands

As described above, under "Wetlands," a mix of palustrine forested and emergent wetlands exists along the northwestern border of the North Park section of the project site and in the basins east of Landfill Section 6/7. Within the freshwater wetlands of North Park, the northeastern section of the observed wetland system extends toward tidal wetlands associated with Main Creek, while the southwestern section extends toward West Shore Expressway (Hartzel 2007). As previously described, plant species associated with the emergent wetland areas include *Phragmites*, spike rush, switchgrass, smartweeds, and sedges. The forested wetlands are characterized by red maple, pin oak, sweet gum, black gum, gray birch, black willow, sassafras, arrowwood, smartweeds, and greenbrier (AKRF 2007).

AES further described wetlands along the northwestern border of North Park and other areas centrally located within the North Park section of the site. These areas are described as being vegetated with native grasses, rushes, sedges, and include woody plants such as elderberry (*Sambucus sp.*), blackberry (*Rubus sp.*), arrow-wood, and sweet gum (AES 2007).

Phragmites/Mugwort-dominated Field with Woody Vegetation

Fresh Kills has approximately 150 acres of areas vegetated predominantly with *Phragmites* and mugwort (SCS Engineers 1990, AES 2003). During 2007 AKRF field observations, *Phragmites* and mugwort (*Artemisia vulgaris)* were the most abundant species at former landfill areas in the northern (i.e. Travis Landfill area, northern portion of North Park) and southern (i.e., Arden Avenue Landfill (future Owl Hollow Park) and West Shore Expressway Landfill located east of the West Shore Expressway and south of Landfill Section 2/8) portions of the project site. These areas are typically composed of early successional native species and introduced species that colonize urban vacant land. Subdominant species observed throughout these areas included tree-of-heaven *(Ailanthus altissima)*, black cherry (*Prunus serotina*), black locust (*Robinia pseudoacacia*), Japanese knotweed, ragweed (*Ambrosia* spp.), and goldenrod (*Solidago* spp.).

Maturing Woodland

A maturing woodland community not previously mapped was observed in the southeastern portion of the East Park area (southeast of Landfill Section 6/7). This woodland was observed to be densely vegetated with a mixture of upland and wetland tolerant species including sweetgum, grey birch, arrowwood, blackberry, poison ivy, and Japanese honeysuckle.

Maturing woodlands are also present on the landscaped berms along Richmond Avenue to visually screen the landfill from neighboring areas. These linear woodlands support species such as red oak (*Quercus rubra*), tulip poplar (*Liriodendron tulipifera*), black cherry, with an understory of multiflora rose, poison ivy, and Virginia creeper, and less-frequently observed *Phragmites*, grape (*Vitis* sp.), blueberry (*Vaccinium* sp.), black locust, and groundselbush (2007 AKRF).

Grass/Forb Dominated

Landfill sections at Fresh Kills (see Figure 10-7) are characterized by a vegetative cover of *Phragmites*, mugwort, cool season grasses, and native grasses (AES 2003, AKRF 2007). Common species include switchgrass (*Panicum* spp.), fescue (*Festuca* spp.), asters (*Symphyotrichum* spp.), hopclover, and Kentucky blue grass (*Poa pratensis*). *Phragmites* observed within grass/forb dominated areas was found on mounds, but not as a dominant species. Grass/Forb dominated communities also were observed in non-mound areas, including a portion of Isle of Meadows, and supported several upland and wetland grass and forb species, including *Panicum* spp. grasses, mugwort, common ragweed (*Ambrosia artemisiifolia*) in dry areas, and broad-leaved cattail (*Typha latifolia*) and several species of sedges and rushes in the wet areas (AKRF 2007).

Young tree species, including black locust, cottonwood, tree-of-heaven, and white mulberry (*Morus alba*), are present in the grass/forb dominated areas and adjacent swales, suggesting some forest succession and seed dispersal on the site, as well as planting activity over the past 20 years.

Secondary Study Area

Introduction

The secondary study area is composed of city-owned parklands, natural areas, and undeveloped land with varied levels of human use, including Willowbrook Park, the north section of the William T. Davis Wildlife Refuge, LaTourette Park, Willowbrook Park, Arden Heights Woods Park, South Shore Golf Course and marshes along the Arthur Kill. A description of each follows.

William T. Davis Wildlife Refuge

A large proportion of the 340-acre William T. Davis Wildlife Refuge, located north of Fresh Kills Landfill Sections 3/4 and 6/7, is divided by the northern border of the project site. Therefore, the refuge exists in both the project site and the secondary study area. The refuge is the first and oldest wildlife refuge in New York City, and was the home to the first Audubon Center of New York City (Staten Island Greenbelt 2007). Plant communities on-site include:

- *Spartina*-dominated marsh containing saltmarsh cordgrass, salt hay, groundsel bush, and common reed, consistent with other tidal communities observed at the project site and surrounding areas;
- Palustrine forested wetlands containing red maple, sweetgum, arrow-wood, and spicebush; and
- Mainly mature forested uplands containing red maple, tulip tree, red and white oak, and Virginia creeper. In some areas, introduced species such as Japanese knotweed and tree-of-heaven are beginning to become established.

A detailed site assessment of William T. Davis Refuge was conducted in 2005 by the Staten Island Museum, DPR -NRG, and other organizations (Johnson and Matarazzo 2006). The study was funded by the NYC Environmental Fund (NYCEF) to inform upcoming initiatives proposed for the refuge, including habitat management, trail creation, development of interpretive signage, and environmental education programs. In addition to coastal Spartina marshes and freshwater marshlands, high-quality swamp forest was noted as a dominant habitat, with canopy (i.e., sweetgum, American elm, red maple and white ash) and understory (i.e., arrow-wood, spicebush, elderberry and swamp dogwood) similar to swamp forests in other secondary study areas and within the project area. Approximately 57 plant species were noted as new to the refuge since plant surveys conducted in the 1950’s, with 31 percent of these being invasive species (i.e., garlic mustard, Norway maple, multiflora rose, black locust, etc.). Few common mammal, reptile and amphibian species were observed at the refuge; however, the northern diamondback terrapin A New York state game species and watch list species on NYNHP’s 2007 Rare Animal Status List) was observed. Numerous bird species (including waterfowl, shorebirds, wading birds, and songbirds) were observed in the relatively diverse habitats of the refuge, including breeding willet, great horned owl and yellow-billed cuckoo. Additional site work at the refuge, including an environmental education program for the NYC High School for Environmental Studies, is planned for 2008 (Lisa Garrison, NYCEF, 8 January 2008).

LaTourette Park

LaTourette Park is a large, 540-acre open space area located east of Landfill Section 6/7 and Richmond Parkway. Communities within the park include:

- *Spartina*-dominated marsh containing saltmarsh cordgrass, salt hay, groundsel bush, and common reed bordering Richmond Creek, which traverses the park;
- Palustrine forested wetlands containing red maple, sweetgum, black willow, ash (*Fraxinus* sp.), arrow-wood, highbush blueberry, jewelweed, and skunk cabbage *(Symplocarpus foetidus)*;
- Young and mature forested uplands containing various oak species, tulip tree, tree-of-heaven, black cherry, and witch hazel (*Hamamelis virginiana*);
- Grass/forb dominated areas containing goldenrod, aster, and mixed grasses; and
- Active, managed recreational fields, a golf course, and park facilities.

Willowbrook Park

This DPR property is a 164-acre park located east and south of the intersection of Richmond Avenue and Victory Boulevard, and northeast of Landfill Section 6/7. It has both active recreational uses and unpaved hiking trails through natural woodland areas. Plant communities within the park include:

- Mature woodlands containing tulip tree, red and white oak (*Quercus alba)*, black cherry, tree-of-heaven, black locust, American elm (*Ulmus americana)*, and Japanese knotweed;
- Palustrine forested wetlands (as indicated in Figures 10-5 and 10-6) containing red maple, sweet-gum, arrow-wood, spicebush, and jewelweed;
- Active, regularly maintained grass recreational fields; and
- Open water (pond).

Arden Heights Woods Park

The 185-acre Arden Heights Woods Park is located south of West Shore Expressway and Landfill Section 1/9. The park is listed as a NY-NJ HEP priority restoration site, and an adjoining woodland area to the east listed as a priority acquisition site (HEP 2007). Most of the park is a palustrine forested wetland, and is the largest of this wetland type classified by DEC within the New York metropolitan area. It contains several kettle ponds that are connected by streams and mature forested uplands. The main stream passes under Arthur Kill Road and continues into the project site at a location south of Muldoon Avenue. DEC has identified the freshwater wetlands within Arden Heights Woods as freshwater wetland AR-5 freshwater wetland, and classified these wetlands as a Class I wetland system. The majority of wetlands within AR-5 are described as palustrine, broad-leaved deciduous forested wetlands with seasonal flooding. DPR has identified 14 plant communities within the park, closed forest, swamp forest, emergent wetland, denuded forest understory, and shrub swamp, with closed forest as the most prevalent coverage. The varied topography of the area allows for freshwater marshes, ponds, streams, grassy fields, as well as uplands dominated by oak and hickory (*Carya spp*.).

Most of the Arden Heights Woods Park appears to be relatively undisturbed with few invasive plant species. However, Japanese knotweed does occur along the periphery at the southern and southwestern edges of the park. Vegetation in upland portions of the park include mixed species of oak, beech (*Fagus sp.*), red maple and sweetgum, with poison ivy and Virginia creeper comprising the understory. Other species known to occur in the upland woods include eastern hemlock (*Tsuga canadensis*), black cherry, persimmon (*Diospyros sp.*), and eastern white pine (*Pinus strobus*) (DPR 2007). Red maple, sweetgum, pin oak, highbush blueberry (*Vaccinium corymbosum*), spicebush, jewelweed, and poison ivy occur in the forested wetlands within the park.

South Shore Golf Course Park

The South Shore Golf Course Park includes an 18-hole golf course in addition to undeveloped young and mature upland forest sections. A portion of the woodland has species tolerant of wet conditions and is mapped as palustrine forested wetlands by the NWI. Sweet-gum, red maple, sassafras, tulip poplar, poison ivy, and Virginia creeper are present within the woodlands. The remainder of this property consists of the golf course and other managed facilities.

Arthur Kill Coastal Area - Neck Creek Marsh to Victory Boulevard

Two undeveloped parcels of land, zoned as 'industrial' and totaling approximately 110 acres, are located north of the project site along the Arthur Kill. These parcels are listed as an HEP priority acquisition sites (HEP 2007), and described as valuable to regional wildlife and plant communities in Trust for Public Land's "An Islanded Nature" (2001). The northern parcel contains Neck Creek Marsh and associated uplands, is bisected by Route 440 and located west of the Travis neighborhood. The southern parcel contains a variety of undeveloped land west of Route 440, south of Victory Boulevard and north of Little Fresh Creek. These parcels contain the following communities:

- *Spartina*-dominated and mixed marsh containing saltmarsh cordgrass, salt hay, groundsel bush, and common reed, consistent with other tidal communities observed at the project site and surrounding areas;
- *Phragmites*-dominated emergent/scrub-shrub wetlands surrounding freshwater ponds;
- Palustrine forested wetlands containing red maple, sweetgum, arrow-wood, and spicebush;
- Young and mature forested uplands containing red maple, tulip tree, red and white oak, and Virginia creeper. In some areas, introduced species such as Japanese knotweed and tree-of-heaven are beginning to establish a foothold; and
- Various paved and unpaved roads.

WILDLIFE

Introduction

The various ecological communities, terrestrial and aquatic, present at Fresh Kills, the project site and surrounding areas provide suitable habitat for a variety wildlife species including a diverse number of birds, mammals, and reptiles (in addition to the aquatic species discussion above). The following section presents an overview of the species observed during 2007 AKRF field observations; wildlife observed during other surveys and investigations of the project site; publicly documented records of wildlife use of the project site and secondary study area; other species known to occur on Staten Island; and species with the potential to use the project site and secondary study area on the basis of existing habitats observed during the field studies. It is assumed that wildlife known to occur within the larger Fresh Kills property as well as the secondary study area would have the potential to occur at the project site should similar habitat also be present.

Birds

As described above, Fresh Kills provides a diverse range of habitats and ecological communities including tidal wetlands and tidal waters, freshwater emergent and forested wetlands, freshwater ponds and streams, upland forests, and a variety of fields and open meadow habitats available for use by birds as foraging, nesting, breeding, and roosting habitat. Additionally, the Arthur Kill provides important foraging areas for many waterbirds (i.e., ducks, wading birds, shorebirds). Until 2001, several species of wading birds (i.e., herons, egrets, ibis), gulls, and waterfowl nested within the Isle of Meadows. Fresh Kills also provides important foraging habitat for migratory songbirds and raptors, and nesting habitat for several grassland and marsh-obligate species (USFWS 1997). The Arthur Kill and its tributaries are known to be important to both resident and migrating birds (Kane et. al 1991). Migrating songbirds using areas around the project site as stopover sites may prefer larger woodland areas on and adjacent to the project site, rather than edge and scrub habitats, as observed by Kerlinger (1996). *Phragmites* marshes such as those found within and adjacent to the project site are also known to provide habitat for a number of resident bird species, including rails and other rare breeding species (Kane 2001).

Landfilling activity at Fresh Kills officially ceased in March 2001. With the exceptions of current closure construction at Landfill Sections 6/7 and 1/9, and the ongoing maintenance of landfill infrastructure (i.e., methane and leachate collection systems), periodic mowing, and a variety of activities on Landfill Sections 3/4 and 2/8, large areas of grasslands, marshes, and forests at Fresh Kills are relatively free of human activities. Freshwater wetlands, including the two stormwater management ponds east of Landfill Section 6/7 and the wetland area to the north that they ultimately drain to, other open water areas west of Landfill Section 6/7, and smaller ponds throughout the project site, also provide foraging habitat for birds. The diversity of habitats, proximity to a major estuary and the relative low level of human use on the project site contribute to its value as bird habitat.

Table 10-6 provides a list of birds observed at Fresh Kills from 2000-2007. A total of 211 species have been reported within the project site during various bird surveys permitted by DSNY, including National Audubon Society's Christmas Bird Count (NAS 2007), DEC's Breeding Bird Atlas, NYSOA's January Waterfowl Count, and several university field studies (NAS Christmas Bird Count data 2000-2007, Atlas 2000, NYSOA 2000-2006, A. Bernick, 2007 pers. comm.).

Table 10-7 lists breeding birds known to occur at Fresh Kills between 2000 and 2007 (DEC 2007, Bernick 2007 pers comm.). The 61 nesting species include those that nest in tidal wetlands (i.e., American black duck [*Anas rubripes*], clapper rail [*Rallus longirostrus*], marsh wren [*Cistothorus palustris*]), scrub-shrub areas (i.e., song sparrow [*Melospiza melodia*]), upland grasslands (i.e., savannah sparrow, indigo bunting [*Passerina cyanea*]), and woodlands (i.e., red-tailed hawk [*Buteo jamaicensis*], downy woodpecker [*Picoides pubescens*]).

The 2007 AKRF field observations confirmed the presence of 84 bird species (Table 10-8). Of these, 49 bird species observed have nested within the project site or secondary study area in previous years (DEC 2007, Table 10-9). Ducks and waterfowl, foraging colonial waterbirds and other wetland-obligate species, migrating and resident shorebirds, raptors, and numerous resident and migrating passerines (e.g., blackbirds, warblers, and sparrows) were observed within the project site.

Table 10-6
Bird Species With the Potential to Occur at Fresh Kills and in the Surrounding Area

Common Name	Scientific Name	Present in 2007
Snow Goose	*Chen caerulescens*	
Canada Goose	*Branta Canadensis*	X
Altlantic Brant	*Branta bernicla*	X
Tundra Swan	*Cygnus colombianus*	
Mute Swan	*Cygnus olor*	X
Wood Duck	*Aix sponsa*	X
Gadwall	*Anas strepera*	X
American Wigeon	*Anas americana*	
American Black Duck	*Anas rubripes*	X
Mallard	*Anas platyrhynchos*	X
Blue winged Teal	*Anas discors*	X
Northern Shoveler	*Anas clypeata*	X
Northern Pintail	*Anas acuta*	X
Green winged Teal	*Anas crecca*	X
Canvasback	*Aythya valisineria*	
Ring necked Duck	*Aythya collaris*	
Greater Scaup	*Aythya marila*	
Lesser Scaup	*Aythya affinis*	X
Long-tailed Duck	*Clangua hyemalis*	
Bufflehead	*Bucephala albeola*	
Common Goldeneye	*Bucephala clangula*	
Hooded Merganser	*Lophodytes cucullatus*	
Red-breasted Merganser	*Merganser serrator*	X
Ruddy Duck	*Oxyura jamaicensis*	
Northern Shelduck	*Tadorna ferruginea*	
Ring necked Pheasant	*Phasianus colchicus*	X
Red throated Loon	*Gavia stellata*	
Common Loon	*Gavia immer*	
Pied billed Grebe	*Podilymbus podiceps*	
Horned Grebe	*Podiceps auritus*	
Double-crested Cormorant	*Phalacrocorax auritus*	X
Great Cormorant	*Phalacrocorax carbo*	
American Bittern	*Botaurus lentiginosus*	X
Great Blue Heron	*Ardea Herodias*	X
Great Egret	*Ardea alba*	X
Snowy Egret	*Egretta thula*	
Little Blue Heron	*Egretta caerulea*	
Tricolored Heron	*Egretta tricolor*	
Cattle Egret	*Bubulcus ibis*	
Green Heron	*Butorides virescens*	
Black-crowned Night-heron	*Nycticorax nycticorax*	X
Yellow-crowned Night-Heron	*Nyctanassa violacea*	X
Glossy Ibis	*Plegadis falcinellus*	X
Turkey vulture	*Cathartes aura*	X
Osprey	*Pandion haliaetus*	X
Bald Eagle	*Haliaeetus leucocephalus*	
Northern Harrier	*Circus cyaneus*	X
Sharp-shinned Hawk	*Accipiter striatus*	
Cooper's Hawk	*Accipiter cooperii*	
Red-shouldered Hawk	*Buteo lineatus*	
Broad-winged Hawk	*Buteo platypterus*	
Red-tailed Hawk	*Buteo jamaicensis*	X
American Kestrel	*Falco sparverius*	X

Table 10-6 (cont'd)
Bird Species With the Potential to Occur at Fresh Kills and in the Surrounding Area

Common Name	Scientific Name	Present in 2007
Merlin	*Falco columbarius*	X
Peregrine Falcon	*Falco peregrinus*	
Clapper Rail	*Rallus longirostrus*	
Virginia Rail	*Rallus limicola*	
Sora	*Porzana caroline*	
Common Moorhen	*Gallinula chloropus*	
American Coot	*Fulica americana*	
American Woodcock	*Scolopax minor*	X
Black bellied Plover	*Pluvialis squatarola*	
Semipalmated Plover	*Charadrius semipalmatus*	
Killdeer	*Charadrius vociferous*	X
Greater Yellowlegs	*Tringa melanoleuca*	X
Lesser Yellowlegs	*Tringa flavipes*	X
Solitary Sandpiper	*Tringa solitaria*	
Willet	*Catoptrophorus semipalmatus*	
Spotted Sandpiper	*Actitus macularia*	
Whimbrel	*Numenius phaeopus*	
Ruddy Turnstone	*Arenaria interpres*	
Red Knot	*Calidris canutus*	
Sanderling	*Calidris alba*	
Semipalmated Sandpiper	*Calidris pusilla*	X
Least Sandpiper	*Calidris minutilla*	X
Hudsonian godwit	*Limosa haemastica*	X
Wilson's phalarope	*Phalaropus tricolor*	X
Laughing Gull	*Larus atricilla*	X
Bonaparte's Gull	*Larus philadelphia*	
Ring-billed Gull	*Larus delawarensis*	X
Herring Gull	*Larus argentatus*	X
Iceland Gull	*Larus glaucoides*	
Lesser Black-backed Gull	*Larus fuscus*	
Glaucous Gull	*Larus hyperboreus*	
Great Black-backed Gull	*Larus marinus*	X
Common Tern	*Sterna hirundo*	
Forster's Tern	*Sterna foresteri*	
Black Skimmer	*Rynchops niger*	X
Rock Pigeon	*Columba livia*	X
Mourning Dove	*Zenaida macroura*	X
Black billed Cuckoo	*Coccyzus erythropthalmus*	
Yellow-billed Cuckoo	*Coccyzus americanus*	X
Barn Owl	*Tyto alba*	
Eastern Screech Owl	*Megascops asio*	
Great Horned Owl	*Bubo virginianus*	
Snowy Owl	*Bubo scaniacus*	
Short eared Owl	*Asio flammeus*	
Common Nighthawk	*Chordeiles minor*	
Chimney Swift	*Chaetura pelagica*	
Ruby throated Hummingbird	*Archilochus colubris*	
Belted Kingfisher	*Ceryle alcyon*	X
Red-bellied Woodpecker	*Melanerpes carolinus*	X
Yellow-bellied Sapsucker	*Sphyrapicus varius*	
Downy Woodpecker	*Picoides pubescens*	X
Hairy Woodpecker	*Picoides villosus*	X
Northern Flicker	*Colaptes auratus*	X
Eastern Wood-Pewee	*Contopus virens*	
Yellow-bellied Flycatcher	*Empidonax flaviventris*	
Willow Flycatcher	*Empidonax traillii*	

Table 10-6 (cont'd)
Bird Species With the Potential to Occur at Fresh Kills and in the Surrounding Area

Common Name	Scientific Name	Present in 2007
Eastern Phoebe	*Sayornis phoebe*	
Great Crested Flycatcher	*Myiarchus crinitus*	
Ash-throated Flycatcher	*Myiarchus cinerascens*	
Eastern Kingbird	*Tyrannus tyrannus*	
Northern Shrike	*Lanius excubitor*	
White eyed Vireo	*Vireo griseus*	
Blue headed Vireo	*Vireo solitaries*	
Warbling Vireo	*Vireo gilvus*	
Red-eyed Vireo	*Vireo olivaceus*	
Blue Jay	*Cyanocitta cristata*	X
American Crow	*Corvus brachyrhynchos*	X
Fish Crow	*Corvus ossifragus*	
Common Raven	*Corvus corax*	
Horned Lark	*Eremophila alpestris*	
Purple Martin	*Progne subis*	
Tree Swallow	*Tachycineta bicolor*	
Northern Rough winged Swallow	*Stelgidopteryx serripennis*	
Bank Swallow	*Riparia riparia*	
Barn Swallow	*Hirundo rustica*	
Black capped Chickadee	*Poecile artricapillus*	X
Tufted Titmouse	*Baeolophus bicolor*	X
Red breasted Nuthatch	*Sitta canadensis*	
White-breasted Nuthatch	*Sitta carolinensis*	
Brown Creeper	*Certhia americana*	
Carolina Wren	*Thryothorus ludovicianus*	X
House Wren	*Troglodytes aedon*	X
Winter Wren	*Troglodytes trogloytes*	
Marsh Wren	*Cistothorus palustris*	X
Golden-crowned Kinglet	*Regulus satrapa*	
Ruby-crowned Kinglet	*Regulus calendula*	
Blue-gray Gnatcatcher	*Polioptila caerulea*	
Eastern Bluebird	*Sialia sialis*	
Veery	*Catharus fuscenscens*	
Gray-cheeked Thrush	*Catharus minimus*	
Swainson's Thrush	*Catharus ustulatus*	X
Hermit Thrush	*Catharus guttatus*	X
Wood Thrush	*Hylocichla mustelina*	X
American Robin	*Turdus migratorius*	X
Gray Catbird	*Dumetella carolinesis*	X
Northern Mockingbird	*Mimus polyglottos*	X
Brown Thrasher	*Toxostoma rufum*	X
European Starling	*Sturnus vulgaris*	X
American Pipit	*Anthus rubescens*	
Cedar Waxwing	*Bombycilla cedrorum*	X
Blue winged Warbler	*Vermivora pinus*	
Orange-crowned Warbler	*Vermivora celata*	
Nashville Warbler	*Vermivora ruficapilla*	
Northern Parula	*Parula americana*	X
Yellow Warbler	*Dendroica petechia*	X
Chestnut sided Warbler	*Dendroica pensylvanica*	
Magnolia Warbler	*Dendroica magnolia*	
Black-throated Blue Warbler	*Dendroica caerulescens*	X
Yellow-rumped Warbler	*Dendroica coronata*	X
Black-throated Green Warbler	*Dendroica virens*	
Blackburnian Warbler	*Dendroica fusca*	
Pine Warbler	*Dendroica pinus*	

Table 10-6 (cont'd)
Bird Species With the Potential to Occur at Fresh Kills and in the Surrounding Area

Common Name	Scientific Name	Present in 2007
Prairie Warbler	*Dendroica discolor*	X
Palm Warbler	*Dendroica palmarum*	X
Bay-breasted Warbler	*Dendroica castanea*	
Blackpoll Warbler	*Dendroica striata*	
Black-and-White Warbler	*Mniotilla varia*	
American Redstart	*Setophaga ruticilla*	
Ovenbird	*Seiurus aurocapilla*	
Northern Waterthrush	*Seiurus noveboracensis*	
Louisiana Waterthrush	*Seiurus motacilla*	
MacGillivray's Warbler	*Oporornis tolmiei*	
Common Yellowthroat	*Geothlypis trichas*	X
Hooded Warbler	*Wilsonia citrine*	
Wilson's Warbler	*Wilsonia citrine*	
Canada Warbler	*Wilsonia canadensis*	
Scarlet Tanager	*Piranga olivacea*	
Eastern Towhee	*Pipilo erythrophthalmus*	X
American Tree Sparrow	*Spizella arborea*	
Chipping Sparrow	*Spizella passerine*	
Field Sparrow	*Spizella pusilla*	
Savannah Sparrow	*Passerculus sanwichensis*	X
Saltmarsh Sharp-tailed Sparrow	*Ammodramus caudacutus*	
Seaside Sparrow	*Ammodramus maritimus*	
Fox Sparrow	*Passerella iliaca*	
Song Sparrow	*Melospiza melodia*	X
Lincoln's Sparrow	*Melospiza lincilnii*	
Swamp Sparrow	*Melospiza georgiana*	X
White-throated Sparrow	*Zonotrichia albicollis*	X
White-crowned Sparrow	*Zonotrichia leucophrys*	
Dark-eyed Junco	*Junco hyemalis*	
Snow Bunting	*Plectrophenax nivalis*	
Northern Cardinal	*Cardinalis cardinalis*	X
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	
Indigo Bunting	*Passerina cyanea*	
Dickcissel	*Spiza americana*	
Bobolink	*Dolichonyx oryzivorus*	
Red-winged Blackbird	*Agelaius phoeniceus*	X
Eastern Meadowlark	*Sturnella magna*	
Common Grackle	*Quiscalus quiscula*	X
Boat-tailed Grackle	*Quiscalus major*	
Brown-headed Cowbird	*Molothrus ater*	X
Orchard Oriole	*Icterus spurious*	
Baltimore Oriole	*Icterus galbula*	X
Purple Finch	*Carpodacus purpureus*	
House Finch	*Carpodacus mexicanus*	X
Red Crossbill	*Loxia curvirostra*	
Pine Siskin	*Carduelis pinus*	
American Goldfinch	*Carduelis tristis*	X
House Sparrow	*Passer domesticus*	X

Notes: This list represents all resident, migrant, and wintering bird species observed within the project site from 1996-2006. Birds observed during 2007 AKRF field observations are also noted.
Sources: DSNY 1996, NYSARC 2000-2006, NAS 2007, AKRF May and October 2007 Field survey, Bernick 2007, DEC 2007.

Table 10-7
Reported Breeding Birds at Fresh Kills and the Secondary Study Area: 2000-2007

Common Name	Scientific Name	Observed in 2007	Habitat
Canada Goose	*Branta canadensis*	X	Lakes, ponds, bays, marshes, fields
Gadwall	*Anas strepera*	X	Lakes, ponds, marshes
American Black Duck	*Anas rubripes*	X	Marshes, lakes, bays, fields
Mallard	*Anas platyrhynchos*	X	Marshes, wooded swamps, grainfields, ponds, rivers, lakes, bays
Ring necked Pheasant	*Phasianus colchicus*	X	Farms, fields, marsh edges, brush
Pied billed Grebe	*Podilymbus podiceps*		Ponds, lakes, marshes, salt bays
Least Bittern	*Ixobrychus exilis*		Marshes, reedy lakes
Great Egret*	*Ardea alba*	X	Marshes, ponds, shores, mud flats
Snowy Egret*	*Egretta thula*		Marshes, swamps, ponds, shores, tidal flats
Little Blue Heron*	*Egretta caerulea*		Marshes, swamps, rice fields, ponds, shores
Cattle Egret*	*Bubulcus ibis*		Farms, marshes, highway edges, near cattle
Green Heron	*Butorides virescens*		Lakes, ponds, marshes, swamps, streamsides
Black-crowned Night-heron*	*Nycticorax nycticorax*	X	Marshes, shores
Yellow-crowned Night-Heron	*Nyctanassa violacea*	X	Cypress swamps, mangroves, bayous, marshes, streams
Glossy Ibis*	*Plegadis falcinellus*		Marshes, rice fields, swamps
Osprey	*Pandion haliaetus*	X	Rivers, lakes, coasts
Northern Harrier	*Circus cyaneus*	X	Marshes, fields, etc.
Red-tailed Hawk	*Buteo jamaicensis*	X	Open country, woodlands, prairie groves, mountains, plains
Peregrine Falcon	*Falco peregrinus*		Open country, some cities
Clapper Rail	*Rallus longirostrus*		Salt marshes, rarely brackish, locally mangroves
Virginia Rail	*Rallus limicola*		Mainly fresh and brackish marshes; salt marshes
Sora	*Porzana caroline*		Fresh marshes, wet meadows, salt marshes
Common Moorhen	*Gallinula chloropus*		Fresh marshes, reedy ponds
American Coot	*Fulica americana*		Ponds, lakes, marshes
American Woodcock	*Scolopax minor*	X	Grasslands
Killdeer	*Charadrius vociferous*	X	Fields, airports, lawns, river banks, shores
Willet	*Catoptrophorus semipalmatus*		Marshes, wet meadows, mud flats, beaches
Spotted Sandpiper	*Actitus macularia*		Pebbly lakeshores, ponds, streamsides, seashores
Herring Gull	*Larus argentatus*	X	Various estuarine and freshwater habitats, terrestrial
Rock Pigeon	*Columba livia*	X	Sustains self in wild about cities, farms, cliffs, bridges
Mourning Dove	*Zenaida macroura*	X	Farms, towns, open woods, scrub, roadsides, grasslands
Black billed Cuckoo	*Coccyzus erythropthalmus*		Wood edges, groves, thickets
Yellow-billed Cuckoo	*Coccyzus americanus*	X	Wood edges, groves, thickets
Barn Owl	*Tyto alba*		Woodlands, groves, farms, barns, towns, cliffs
Eastern Screech Owl	*Megascops asio*		Woodlands, farm groves, shade tress
Great Horned Owl	*Bubo virginianus*		Forests, woodlands, thickets, streamsides, open country
Chimney Swift	*Chaetura pelagica*		Open sky, cities, towns, nests in chimneys
Ruby throated Hummingbird	*Archilochus colubris*		Flowers, gardens, wood edges
Belted Kingfisher	*Ceryle alcyon*	X	Streams, lakes, bays, coasts, banks
Red-bellied Woodpecker	*Melanerpes carolinus*	X	Woodlands, groves, orchards, towns
Downy Woodpecker	*Picoides pubescens*	X	Forests, woodlots, willows, river groves, orchards, shade trees
Hairy Woodpecker	*Picoides villosus*	X	Mature forest
Northern Flicker	*Colaptes auratus*	X	Open forests, woodlots, groves, farms, towns, semi-open country
Willow Flycatcher	*Empidonax traillii*		Bushes, willows, thickets
Great Crested Flycatcher	*Myiarchus crinitus*		Woodlands, groves
Eastern Kingbird	*Tyrannus tyrannus*		Wood edges, river groves, farms, shelterbelts, orchards, roadsides, fencerows, wires
White eyed Vireo	*Vireo griseus*		Wood edges, brush, brambles, undergrowth
Warbling Vireo	*Vireo gilvus*		Deciduous and mixed woods, aspen groves, poplars, shade trees

Table 10-7 (cont'd)
Breeding Birds at Fresh Kills and in the Secondary Study Area 2000-2007

Common Name	Scientific Name	Observed in 2007	Habitat
Blue Jay	*Cyanocitta cristata*	X	Oak and pine woods, suburban gardens, groves, towns
American Crow	*Corvus brachyrhynchos*		Woodlands, farmland, agricultural fields, river groves, shores
Fish Crow	*Corvus ossifragus*		Similar to American Crow, more confined to tide water and lower valleys of large rivers
Tree Swallow	*Tachycineta bicolor*		Marshes, meadows, streams, lakes, wires
Northern Rough winged Swallow	*Stelgidopteryx serripennis*		Near streams, lakes, river banks
Barn Swallow	*Hirundo rustica*		Open lands, farms, fields, marshes, lakes, wires
Black capped Chickadee	*Poecile artricapillus*	X	Mixed and deciduous woods; willow thickets, groves, shade trees
Tufted Titmouse	*Baeolophus bicolor*	X	Woodlands, shade trees, groves; feeders
White-breasted Nuthatch	*Sitta carolinensis*		Forests, woodlots, groves, river woods, shade trees, visits feeders
Carolina Wren	*Thryothorus ludovicianus*	X	Tangles, brushy undergrowth, suburban gardens, towns
House Wren	*Troglodytes aedon*	X	Open woods, thickets, towns, gardens
Marsh Wren	*Cistothorus palustris*	X	Marshes
Wood Thrush	*Hylocichla mustelina*	X	Deciduous woodlands
American Robin	*Turdus migratorius*	X	Cities, towns, farmlands, lawns, shade trees, forests
Gray Catbird	*Dumetella carolinesis*	X	Undergrowth, brush, thorn scrub,
Northern Mockingbird	*Mimus polyglottos*	X	Towns, farms, roadsides, thickets
Brown Thrasher	*Toxostoma rufum*	X	Thickets, brush, shrubbery, thorn scrub
European Starling	*Sturnus vulgaris*	X	Cities, parks, farms, open groves, fields, open country
Cedar Waxwing	*Bombycilla cedrorum*	X	Open woodlands, fruiting trees, orchards
Yellow Warbler	*Dendroica petechia*	X	Bushes, swamp, edges, streams, gardens
Common Yellowthroat	*Geothlypis trichas*	X	Swamps, marshes, wet thickets
Eastern Towhee	*Pipilo erythrophthalmus*	X	Open woods, undergrowth, brushy edges
Field Sparrow	*Spizella pusilla*		Bushy pastures, scrub
Savannah Sparrow	*Passerculus sanwichensis*	X	Open fields, meadows, salt marshes, prairies, dunes, shores
Saltmarsh Sharp-tailed Sparrow	*Ammodramus caudacutus*		Marshes, muskeg; coastal marshes
Song Sparrow	*Melospiza melodia*	X	Thickets, brush, marshes, roadside, gardens
Swamp Sparrow	*Melospiza georgiana*	X	Fresh marshes with tussocks, bushes or cattails
Northern Cardinal	*Cardinalis cardinalis*	X	Woodland edges, thickets, suburban gardens, towns
Indigo Bunting	*Passerina cyanea*		Brushy pastures, bushy wood edges
Red-winged Blackbird	*Agelaius phoeniceus*	X	Breeds in marshes, brushy swamps, hayfields; forages in cultivated land
Eastern Meadowlark	*Sturnella magna*		Fields, meadows, prairies
Common Grackle	*Quiscalus quiscula*	X	Croplands, towns, groves, streamsides
Boat-tailed Grackle	*Quiscalus major*		Resident near salt water along coasts; marshes
Brown-headed Cowbird	*Molothrus ater*	X	Farms, fields, barnyards, roadsides, wood edges, river groves
Orchard Oriole	*Icterus spurious*		Wood edges, orchards, shade trees
Baltimore Oriole	*Icterus galbula*	X	Open woods, elms, shade trees
House Finch	*Carpodacus mexicanus*	X	Cities, suburbs, farms
American Goldfinch	*Carduelis tristis*	X	Thistles and weeds, dandelions, open woods, edges, open roads
House Sparrow	*Passer domesticus*	X	Cities, farms

Notes: Common names in **bold** represent birds that were confirmed as nesting within project site atlas blocks. All other common names were reported as breeding within the secondary study area. Both the project site and secondary study area are represented by Atlas 2000 blocks 5648a, 5649a, 5649b, 5649c, and 5649d. Species observed within the project site in 2007 are noted.

* = Wading birds last nested on Isle of Meadows in 2001.

Source: DEC 2007, Habitat information from Peterson 1980.

Table 10-8
Mammals Documented at Fresh Kills and the Secondary Study Area: 1991-2007

Common Name	Scientific Name	Observed in 2007	Habitat*
Likely to be present			
Eastern cottontail	*Sylvilagus floridanus*	X	Bottomlands, swamps, lake borders, coastal waterways.
Muskrat	*Ondatra zibethica*	X	Fresh, brackish, or saltwater marshes, ponds, lakes, rivers, canals.
Domestic cat	*Felis silvestris*	X	Residential areas.
House mouse	*Mus musculus*	X	Buildings; areas with good ground cover, including cultivated fields. Uncommon in undisturbed or natural habitats.
Meadow vole	*Microtus pennsylvanicus*	X	Lush grassy fields; also marshes, swamps, woodland glades, mountaintops.
Virginia opossum	*Dipelphis virginiana*	X	Open woods, bushy wastelands, farmlands.
Raccoon	*Procyon lotor*	X	Various, but most common along wooded streams.
Gray squirrel	*Sciuris carolinensis*	X	Hardwood or mixed forests with not trees, especially oak-hickory forests.
Norway rat	*Rattus norvegicus*	X	Farms, cities, many types of human dwellings; in summer: often cultivated fields.
White footed mouse	*Peromyscus leucopus*	X	Wooded and bushy areas.
Eastern chipmunk	*Tamias striatus*		Open woodland; forest edges; brushy areas; bushes and stone walls in cemeteries and around houses.
Little brown bat	*Myotis lucifugus*		In summer, form nursery colonies in buildings. In winter, hibernates in caves and mines in the East.
Red bat	*Lasiurus borealis*		Typical migrant through coastal areas
Hoary bat	*Lasiurus cinereus*		Typical migrant through coastal areas
Silver-haired bat	*Lasionycteris noctivagans*		Typical migrant through coastal areas
Short-tailed shrew	*Blarina brevicauda*		Woods and wet areas in warmer and drier parts of range.
Eastern mole	*Scalopus aquaticus*		Open fields, waste areas, lawns, gardens, and sometimes woods, in well-drained loose soil.
Feral dog	*Canis lupus familiaris*	X	
Uncommon for Staten Island but reported within the secondary study area since 2002			
White-tailed Deer	*Odocoileus virginianus*	X	Woodlands, fields, suburbs.
Red fox	*Vulpes vulpes*		Varied; mixed cultivated and wooded area, brushlands.
Striped skunk	*Mephitis mephitis*		Woodlands, grassy plains, suburbs.

Notes: Habitat information from Whitaker 1993.
Sources: SCS Engineers 1991, DSNY 1996, AKRF May and October 2007 Field observations.

Mammals

The diverse terrestrial habitats at both Fresh Kills and in the secondary study area are suitable for numerous species of mammals commonly observed in the more developed portions of the region (Table 10-10). Freshwater wetlands, including the open water and vegetated wetland habitats east of Landfill Section 6/7 formed by the two stormwater management basins and adjacent wetland areas, other open water areas west of Landfill Section 6/7, and smaller ponds throughout the project site, also provide foraging and nesting habitat for muskrats (*Ondatra zibethica)*, raccoons (*Procyon lotor)*, and other mammals. Of the 21 species likely to be present based on the 1996 DEIS and habitat considerations, eight mammal species were observed during 2007 field observations. Species observed included muskrat, eastern cottontail (*Sylvilagus floridanus)*, house cat (*Felis silvestris)*, house mouse (*Mus musculus)*, and meadow vole (*Microtus pennsylvanicus)*. White-tailed deer (*Odocoileus virginianus)* and raccoon tracks were also observed.

Table 10-9
Reptiles and Amphibians at Fresh Kills or Within the Secondary Study Area

Common Name	Scientific Name	Observed in 2007
Expected within the project site or secondary study area		
American toad	*Bufo americanus*	
Bullfrog	*Rana catesbiana*	
Fowler's toad	*Bufo fowleri*	
Green frog	*Rana clamitans*	X
Southern leopard frog	*Rana sphenocephala*	
Spring peeper	*Hyla crucifer*	X
Red-backed salamander	*Plethodon cinereus*	
Eastern painted turtle	*Chrysemys picta*	X
Snapping turtle	*Chelydra serpentine*	X
Eastern garter snake	*Thamnophis sirtalis*	
Eastern milk snake	*Lampropeltis triangulum*	
Northern black racer	*Coluber constrictor*	
Northern brown snake	*Storeria dekayi*	
Northern water snake	*Nerodia sipedon*	
Uncommon but documented at the project site or secondary study area since 1995		
Northern diamondback terrapin	*Malaclemys terrapin*	
Eastern box turtle	*Terrapene carolina*	
Pickerel frog	*Rana palustris*	
Eastern mud turtle	*Kinosternon subrubrum*	
Northern ringnecked snake	*Diadophis p. edwardsi*	
Rare for Staten Island and unlikely to occur in project site or secondary study area		
Wood frog	*Rana sylvatica*	
Spotted turtle	*Clemmys guttata*	
Four-toed salamander	*Hemidactylium scutarum*	
Northern dusky salamander	*Desmognathus fuscus*	
Northern two-lined salamander	*Eurycea bislineata*	
Northern red salamander	*Pseudotriton rubber*	
Red-spotted newt	*Notophthalmus viridescens*	
Northern fence lizard	*Sceloporus u. hyacinthinus*	
Sources: DSNY 1996, DEC Herp Atlas 2007, AKRF 2007 May and October Field observations.		

While some of the mammals species noted in the 1996 species list are uncommon on Staten Island (i.e., red fox [*Vulpes vulpes*], skunk [*Mephitis mephitis*]), they have been increasingly reported within the vicinity of the project site in recent years (DPR 2007, SIIAS 2007 pers. comm.). Another example is white-tailed deer, which have had increasing populations on the Staten Island mainland and Arthur Kill islands over the past decade (DPR 2007). White-tailed deer were confirmed breeding on Isle of Meadows and Prall's Island in 2006, and presumably breed in mainland of Staten Island as well (Bernick 2006). Some mammals, particularly red (*Lasiurus borealis)*, hoary *(L. cinereus)*, and silver-haired bats (*Lasionycteris noctivagans)*, would only likely be found in the area during seasonal migrations through the Staten Island area. On the basis of the habitats observed within the project site and surrounding areas, ermine (*Mustela erminea*) and long-tailed weasel (*M. frenata*), previously listed as a potentially occurring species (DSNY 1996), are not likely to be found in the area.

Table 10-10
Insect Orders Likely to be Present at Fresh Kills and in the Secondary Study Area

Order	Example(s)	Average Size (Length)	North American species
Anoplura	Sucking lice	0.25”	62
Coleoptera	Beetles	(lg. tropical s p.)	30,000
Collembola	Springtails (wingless)	0.06”-0.25”	315
Dermaptera	Earwigs (some sp. wingless)	0.75”-1.4”	20
Diptera	Flies, mosquitoes	0.1”-0.7”	17,130
Diplura	Two-pronged bristletail (wingless, blind)	<0.25”	25
Hemiptera	True bugs	0.3”-0.8”	4,500
Homoptera	Aphids, leaf hoppers, cicadas	0.25”-1.5”	6,700
Hymenoptera	Bees, wasps, ants	0.5”-1.0”	17,300
Isoptera	Termites (winged and wingless)	0.2”-1.0”	41
Lepidoptera	Butterflies, moths	0.4”-10.6” (wingspan)	11,000
Mallophaga	Chewing lice, bird lice	0.05-0.12”	318
Mecoptera	Scorpionflies, earwigflies	0.6”-1.0”	85
Microcoryphia	Jumping bristletails (wingless)	0.6”	25
Megaloptera	Antlions, lacewings, dobsonflies	0.4”-2.75”	338
Odonata	Dragonflies, damselflies	0.75”-5.0”	450
Orthoptera	Roaches, grasshoppers, crickets, mantids	1.5”	1,000
Protura	Minute white insect (wingless, eyeless)	0.06”	20
Plecoptera	Stone flies	1.0”-3.0”	400
Psocoptera	Book lice, bark lice	0.04”-0.12”	150
Siphonaptera	Fleas (wingless)	<0.25”	250
Strepsiptera	Minute, beetle-like (only males have wings)	0.13”	60
Thysanoptera	Thrips (winged and wingless)	0.5 mm-0.13”	606
Thysanura	Bristletails, silverfish (wingless)	0.5”	40

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

Reptiles and Amphibians

Table 10-9 lists of reptiles and amphibian with the potential to occur at Fresh Kills or in secondary study area, on the basis of reptiles and amphibians noted in the 1996 DEIS, existing habitats, and species distribution noted in the DEC’s Herp Atlas. Fourteen species of reptiles and amphibians, commonly occurring within similar habitats on Staten Island, have the potential to be present at the project site (i.e., spring peeper [*Hyla crucifer*], bullfrog [*Rana catesbiana*], green frog [*R. clamitans*], garter snake [*Thamnophis sirtalis*], Dekay’s snake [*Storeria dekayi*], snapping turtle [*Chelydra serpentine*], red-eared slider [*Trachemys scripta elegans*]). An additional 13 species listed in the 1996 DEIS may be present within the secondary study area, and could possibly occur in older palustrine forested wetlands (i.e., box turtle [*Terrapene Carolina*], various frogs) and tidal wetlands (i.e., northern diamondback terrapin [*Malaclemys terrapin*]) within the project site.

During the 2007 AKRF field observations, four species of reptiles and amphibians were observed or heard at Fresh Kills. These species include snapping turtle, eastern painted turtle, green frog, and spring peeper. Painted turtles were observed in the stormwater management basins and adjacent wetland areas east of Landfill Section 6/7, adjacent to Richmond Avenue. Snapping turtles were observed in all basins and ponds east of Landfill Section 6/7, in the ponds southwest of Landfill Section 2/8, and the stormwater basin C1 located at the confluence of Richmond and Main creeks. Open water areas, and emergent and forested wetlands on the project site provide the main on-site foraging and breeding areas for some amphibians (i.e., frogs and toads) and reptiles (i.e., turtles), although water quality will be the most important factor in determining what species exist within these water bodies. Green frogs and spring peepers were observed dispersing through forested wetlands and present in ponded ruts along unpaved roads in many areas of the property.

Insects

Detailed surveys to document insect presence at Fresh Kills was not performed as part of the 2007 AKRF field observations. However, the most commonly observed species noted during the October 2007 field survey included various butterflies (red admiral [*Vanessa atalanta*], monarch butterfly [*Danaus plexippus*]) and dragonflies (green darner [*Anax junius*]). Existing habitats observed within the project site would be expected to support a diverse insect community.

The presence and complexity of insect communities is regulated by various factors, including: 1) specific plants, as many insects are co-adapted to specific plant genera or species; 2) habitat complexity; and 3) microhabitat, specifically subtle differences in biotic and abiotic conditions (Gullen and Cranston 2005). Within the Fresh Kills grassland and woodland habitats, substantial insect communities are likely to exist. Changes in insect communities relating to large-scale habitat shifts (i.e., landfill cover, followed by growth of native and introduced grass and forb species) is likely to drive further changes in insect diversity and density.

A general profile of insect diversity can be established for Fresh Kills based on existing conditions. Table 10-10 is a list of insect taxa expected to be present based on current conditions and previous observations of insects at Fresh Kills (SCS Engineers 1990, DSNY 1996).

Information on charismatic insect species such as lepidopterans (i.e., butterflies, moths and skippers) and odonates (i.e., dragonflies and damselflies) exists for the New York City area, including Staten Island (Hennessey 1990). Over 100 species of butterflies commonly occur in the New York City area, including various species of swallowtails, whites, sulphurs, gossamer-wings, nymphalids, satyrs, and skippers. Over 50 species of damselflies and dragonflies have been documented within New York City, including broad-winged and true damselflies, spreadwings, petaltails, darners, Aeshna “mosaic” darners, clubtails, spiketails, cruisers, emeralds, basketails, and skimmers. Many of these species could be expected to inhabit communities present at the project site, including fields, wooded areas, streams, ponds, brackish waters, and coastal habitats.

One insect species, the Asian Longhorned Beetle (*Anoplophora glabripennis*), could have important impacts on any landscape enhancement occurring in within the project site. In March and April 2007, researchers from the United States Department of Agriculture’s Animal and Plant Health Inspection Service (USDA-APHIS) detected Asian Longhorned Beetles (ALBs) on Prall’s Island and Old Place Marsh in the Arthur Kill (DPR 2007), north of the project site. The ALB is a native of China, and was first detected in New York City in 1998. Since this time, there has been a substantial eradication effort conducted in New York by USDA, DEC, and NYC Parks. ALBs are known to use a variety of tree species as sites for egg-laying and development, including maples and birches (USDA 2007), which occur within the project site. Approximately 3,000 ALB host trees were cut on Prall's Island and 10,000 host trees within the vicinity of Old Place Marsh. Current management plans call for a ½ mile cut of all host tree species when an infested tree is located, and an additional area surrounding that is designated for chemical treatment (imidacloprid) and monitoring (USDA 2007).

Secondary Study Area

The following sections describe wildlife occurrence in properties within the secondary study area, based on available habitat, 2007 AKRF field observations, and existing information.

Birds

Birds that are likely to be present in the secondary study area include species that are particularly common throughout New York City in residential or vacant lot habitats, such as ring-necked pheasant (*Phasianus colchicus)*, mourning dove (*Zenaida macroura)*, gray catbird (*Dumetella carolinesis)*, American robin (*Turdus migratorius)*, song sparrow, and house sparrow (Table 10-8). Migrant songbirds (i.e., warblers, tanagers) would likely find more suitable cover and food resources during migration in mature woodland areas within the secondary study area (i.e., Willowbrook Park, LaTourette Park, Arden Heights Woods) than within many habitats at the project site. Certain habitat-specific species, such as marsh-obligate breeding birds like marsh wrens and salt marsh sharp-tailed sparrows (*Ammodramus caudacutus*), would most likely be found in appropriate habitats within the secondary study area. The William T. Davis Wildlife Refuge and Arthur Kill parcels northwest of the project site would provide adequate breeding habitat for this species.

According to the DPR, more than 117 bird species have been recorded at the William T. Davis Wildlife Refuge, including sharp-tailed sparrow and wood duck (*Aix sponsa*) (DPR 2007). Bird species recorded at the Refuge would be expected to occur within the project site if suitable habitat was observed there during the 2007 field observations. In addition, common owls and hawks also are likely to be present in this area, including barn owl (*Tyto alba*), great horned (*Bubo virginianus*), short-eared owl (*Asio flammeus*), and red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), and rough-legged hawk (*Buteo lagopus*).

Wildlife known to occur in Arden Heights Woods, and expected to occur in all other mature wooded secondary study area sites, and possibly portions of the project site, include: red-tailed hawk, American kestrel, screech owl (*Otus asio*), saw whet owl (*Aegolius acadicus*), great horned owl (*Bubo virginianus*), barn owl (*Tyto alba*), barred owl (*Strix varia*), indigo bunting, veery, brown thrasher, robin, blue jay, mocking bird, catbird, blue-winged warblers, mallards, Canada geese, little green heron, American egret, kingfisher, oriole, vireo, cardinal, song sparrow, common crow, and grackle, bank swallow (*Riparia riparia*), and northern rough-winged swallow (*Stelgidopteryx serripennis*). Migrant species known to use the site include hermit thrush (*Catharus guttatus*). Birds known to breed in the woods include brown thrasher, eastern kingbird, Baltimore oriole, red-bellied woodpecker, Eastern towhee, red-winged blackbird, wood duck (*Aix sponsa*), and wood thrush.

DPR's Natural Resources Group (NRG) conducted breeding bird surveys as part of the New York City Department of City Planning's Northwest Staten Island Corridor Project. NRG conducted breeding bird surveys on a parcel north of Little Fresh Kill and south of Victory Boulevard in 2003 and 2004, and in 2002 and 2007 on a parcel west of the West Shore Expressway, bounded by Neck Creek to the north and Victory Boulevard to the south. These sites represent important buffer zones to Fresh Kills Park, with valuable habitat for breeding songbirds and foraging wading birds, particularly in the event of a recolonization of the former wading bird nesting colony at Isle of Meadows.

Mammals

Mammals expected to occur in all sites within the secondary study area include ubiquitous urban mammals, such as raccoon, Virginia opossum (*Dipelphis virginiana)*, and gray squirrel (*Sciuris carolinensis)*. Some of the mammals species noted in the 1996 species list are uncommon on

Staten Island (i.e., red fox, skunk). Other species were not noted in the 1996 list (i.e., white-tailed deer), but have been increasingly reported within the vicinity of the secondary study area in recent years (DPR 2007, SIIAS 2007 pers. comm.).

Reptiles and Amphibians

Species with the potential to occur in palustrine forested wetlands within the secondary study area include common species for Staten Island (i.e., spring peeper, bullfrog, green frog, garter snake, Dekay's snake, snapping turtle, red-eared slider). Based on habitat complexity and quality, several amphibians (i.e., woodland salamander, Fowler's toad [*Bufo fowleri*]) and reptiles (i.e., box turtle) are likely to be found within the secondary study area alone (i.e., Willowbrook Park, LaTourette Park, Arden Heights Woods). The northern diamondback terrapin (a New York State Game Species and NYNHP Watch List Species) was noted in a trap within Main Creek, which traverses the project site and William T. Davis Wildlife Refuge (DSNY 1996). This species forages in estuarine systems and nests on bare sand and rocky areas (R. Burke, 2007, pers. comm.).

Insects

Insect species that are found within the secondary study area are potentially more numerous in terms of species diversity and density than for the project site, as the available habitats tend to be more complex. The species expected to occur would include those listed in Table 10-12. In contrast, landfilling activities at the project site followed by the growth of native and invasive flora likely continues to change the project site's insect community. No insect species were noted in the May 2007 observations within the secondary study areas.

THREATENED OR ENDANGERED SPECIES

Information requests for rare, threatened or endangered species within one half mile of the project site were submitted to USFWS (NY office), NMFS, and DEC's NYNHP. With the exception of an occasional transient occurrence of shortnose sturgeon (*Acipenser brevirostrum*), no federally listed or proposed threatened or endangered species under federal jurisdiction are known to occur at the proposed project site, or in its vicinity (USFWS 2007). NMFS (2007a) stated that while the federally endangered shortnose sturgeon and several species of threatened and endangered sea turtles are known to occur in New York waters, they are not typically known to occur in the Arthur Kill, and no further coordination with respect to these species is anticipated for the project site. NMFS indicated that EFH has been identified within the project site for one or more species (NMFS 2007b). A discussion of EFH identified within the project site is presented above under "Aquatic Resources."

The NYNHP database (Seoane 2007) indicated the following threatened, endangered, or protected species, significant ecological communities, and colonial waterbird nesting area as being recently recorded on or in the vicinity of the project site. Table 10-11 lists threatened or endangered species contained in historical records (i.e., species not documented since 1979) and the date of the last reported observation. None of these species have been reported within the vicinity of the project site since the early 1900s and none were observed during the May 2007 field observations.

Seven species of New York State "protected birds" (i.e., birds defined in New York's ECL 11-0103 as wild birds), two species of vascular plants, and two ecological communities were reported by the NYNHP as occurring on or in the vicinity of the project site, and their recent status at or near the project site is discussed below. An additional two bird species (black-crowned night-heron and northern harrier) and one reptile (northern diamondback terrapin) have been added to this discussion as they have been reported to occur at or near the project site since 1995.

Table 10-11
Historical Records of New York State Threatened/Endangered Species In The Vicinity Of The Project Site

Species	Last Reported Occurrence
Northern cricket frog (*Acris crepitans*), E	Unknown
Cattail sedge (*Carex typhina*), T	1902
Dwarf hawthorn (*Crataegus uniflora*), E	1907
Log fern (*Dryopteris celsa*), E	1907
American strawberry-bush (*Eunonymus americanus*), E	1901
American ipecac (*Euphorbia ipecacuanhae*), E	1882
Scirpus-like rush (*Juncus scirpoides*), E	1901
Bead pinweed (*Lechea pulchella* var. *moniliformis*), E	1901
Orange fringed orchid (*Platanthera ciliaris*), E	1905
Rose-pink (*Sabatia angularis*), E	1908
Primrose-leaf violet (*Viola primulifolia*), T	1902

Notes: E—New York State Endangered; T—New York State Threatened.
Source: Seoane (2007).

Colonial Waterbird Nesting Area and Relevant Species

The six species of wading birds (i.e., herons, egrets, and ibis) noted in correspondence with DEC (Seoane 2007), and a seventh not mentioned (i.e., black-crowned night-heron), comprise the species known to nest on Isle of Meadows, a wading bird and gull nesting colony within the project site. Along with nearby nesting islands at Prall's Island (in the Arthur Kill) and Shooter's Island (in the Kill Van Kull), these islands formed the largest heronry in New York State and accounted for 25 percent of the wading birds that breed in coastal New Jersey, New York, and Connecticut (USFWS 1997). Wading bird species reported to nest within the area, described as the 'Harbor Herons Region' in the Trust for Public Land's 'An Islanded Nature' (2000), include black-crowned night heron (*Nycticorax nycticorax*), snowy egret (*Egretta thula*), great egret (*Ardea alba*), cattle egret (*Bulbulcus ibis*), glossy ibis (*Plagidis facinellus*), and yellow-crowned night heron (*Nyctanassa violacea*) (USACE 2004). From 1992-1998, an average of 612 pairs of wading birds nested each year on Isle of Meadows. A sharp population decline occurred in the late 1990's, and the last consistent nesting of wading birds in the area was on Isle of Meadows in 2001. Suggested causes for the declines include regular inputs of organic and inorganic contaminants driving negative neurological and reproductive effects (Parsons 2004), changes in habitat suitability (USACE 2004), and mammalian predation and disturbance (Kerlinger 2004).

Suitable nesting habitat for wading birds remains on Isle of Meadows and Shooter's Island (Bernick 2007), and these islands continue to be recognized as potential nesting areas. Waterbird breeding colonies are known to shift locations unpredictably, so wading birds may be reasonably expected to recolonize in future years. Colonial waterbird species that nested within the project site included:

- Great egret (*Ardea alba*): Between 1985 and 2001, great egrets nested at one wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in NYC (Parsons 1994, Kerlinger 2002). Recent surveys indicate that great egrets have not nested on any of these breeding colonies since 2001, although they do nest on islands elsewhere in NY/NJ Harbor (Bernick 2007). Great egrets forage primarily on estuarine and freshwater fish and some terrestrial vertebrates, and are routinely observed foraging in all areas of the project site and throughout the secondary study area from April to October, and rarely as winter residents (DPR 2007, Maccarone and Brzorad 2002). Great egrets were observed during 2007 AKRF field observations.

- Cattle egret (*Bubulcus ibis*): Cattle egrets, in contrast to other wading birds nesting in the NY/NJ Harbor area, feed predominantly in terrestrial habitats on small vertebrates and invertebrates. Between 1985 and 2001, cattle egrets nested at one wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in NYC (Parsons 1994, Kerlinger 2002). Recent surveys indicate that cattle egrets have not nested on any of these breeding colonies since 2001, and have essentially ceased breeding activity in NY/NJ Harbor (Bernick 2007). In recent years, they have rarely been observed within the project site (DPR 2007) and have not been noted in any site within the secondary study area. Cattle egrets were not observed during 2007 AKRF field observations.
- Little blue heron (*Egretta caerulea*): Between 1985 and 2001, little blue herons nested in small numbers at one wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in NYC (Parsons 1994, Kerlinger 2002). Recent surveys indicate that little blue herons have not nested on any of these breeding colonies since 2001, although they do nest on islands elsewhere in NY/NJ Harbor (Bernick 2007). Little blue herons forage primarily on estuarine fish and invertebrates, and are occasionally observed foraging in coastal areas within the project site and secondary study area from April to October (DPR 2007, Maccarone and Brzorad 2002). Little blue heron were not observed during 2007 AKRF field observations.
- Snowy egret (*Egretta thula*): Between 1985 and 2001, snowy egrets nested at one wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in NY City (Parsons 1994, Kerlinger 2002). Recent surveys indicate that snowy egrets have not nested on any of these breeding colonies since 2001, although they do nest on islands elsewhere in NY/NJ Harbor (Bernick 2007). Snowy egrets forage primarily on estuarine fish and invertebrates, and are routinely observed foraging in estuarine areas of the project site and secondary study area from April to October (DPR 2007, Maccarone and Brzorad 2002). Snowy egrets were not observed during 2007 AKRF field observations.
- Yellow-crowned night-heron (*Nyctanassa violacea*): Between 1985 and 2001, yellow-crowned night-herons nested at one wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in New York City (Parsons 1994, Kerlinger 2002). Recent surveys indicate that this species has not nested on Isle of Meadows since 2001 (Bernick 2007). They have been reported since 2001 as nesting in mainland areas in northwestern Staten Island (E. Johnson, SIIAS, 2007, pers. comm.), and attempting to nest at nearby Prall's Island (DPR data). They nest on islands and mainland areas elsewhere in NY/NJ Harbor (Bernick 2007). Yellow-crowned night heron were not observed nesting during 2007 AKRF field observations.
- Glossy ibis (*Plegadis falcinellus*): Between 1985 and 2001, glossy ibis nested at one wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in New York City(Parsons 1994, Kerlinger 2002). Recent surveys indicate that glossy ibis have not nested on any of these breeding colonies since 2001, although they do nest on islands elsewhere in NY/NJ Harbor (Bernick 2007). Glossy forage primarily in muddy areas, probing for invertebrates, and are routinely observed foraging in estuarine areas of the project site and secondary study area

from April to October (DPR 2007, Maccarone and Brzorad 2002). Glossy ibis were not observed during 2007 AKRF field observations.

- Black-crowned night-heron (*Nycticorax nycticorax*): Although not listed by the NYNHP in their response, between 1985 and 2001, black-crowned night-herons nested at the wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in NYC (Parsons 1994, Kerlinger 2002). Recent surveys indicate that black-crowned night-heron have not nested on any of these breeding colonies since 2001, although they do nest on islands elsewhere in NY/NJ Harbor (Bernick 2007). Black-crowned night-heron forage on a wide variety of estuarine, freshwater, and terrestrial prey, and are routinely observed foraging in all areas of the project site and throughout the secondary study area from March-October, and often overwinter in several of the sites (DPR 2007, Maccarone and Brzorad 2002, Bernick 2007). Black-crowned night-heron were observed during 2007 AKRF field observations.

An additional "protected bird" species on the NYNHP list not associated with colonial waterbirds:

- Barn owl (*Tyto alba*): At least two barn owl nest sites have been reported in the project site and within the secondary study area in recent years (DEC 2007). Barn owls were not observed during 2007 AKRF field observations.

One bird species absent from the NYNHP response letter, northern harrier, has been known to occur in the vicinity of the project site and should be mentioned in the discussion of bird species of conservation interest.

- Northern harrier (*Circus cyaneus*), New York State Threatened. The northern harrier breeds and forages in upland and marsh grassland and low scrub habitats. These habitat types are prevalent in both the project site and secondary study area, and this species is frequently seen in both locations throughout the year. Between 2000-2006, individuals of this species were known to nest in properties to the north of the secondary study area site at Neck Creek marsh. This is one of the few recent nesting records for the NYC area (Sierra Club 2006, DEC 2007).

One reptile species absent from the NYNHP response letter, northern diamondback terrapin, has been known to occur in the vicinity of the project site and should be mentioned in the discussion of species of conservation interest.

- Northern diamondback terrapin (*Malaclemys terrapin*), New York State Games Species and NYNHP Watch List Species. An adult was caught and released during a fish study conducted in June 1995, and observed in Main Creek at the William T. Davis Refuge during that year. A limited harvest of northern diamondback terrapin is allowed in New York State via DEC permit.

Two threatened or endangered plant species reported to occur on or in the vicinity of the project site are presented below.

- Glaucous sedge (*Carex glaucodea*), New York State Endangered. Glaucous sedge has been reported as occurring within the vicinity of the project site, outside the primary and secondary study areas. This species occurs in wet to dry-mesic deciduous forests and old fields, on the edges of seasonal swamps, and in seasonally wet depressions in more open environments (Seoane 2007). Plants can often be found in roads and deer or human paths through forests. Glaucous sedge was not observed during 2007 AKRF field observations.

- Persimmon (*Diospyros virginiana*), New York State Threatened. Persimmon has been reported as occurring within the vicinity of the project site, within the secondary study area (Seoane 2007). This tree species typically prefers moist well-drained soils but also can often found in somewhat dry to mesic rocky or sandy woods, thickets, fields, and roadsides (Brooklyn Botanic Garden 2007). Persimmon was not observed during 2007 AKRF field observations.

Two significant ecological communities were also reported to occur within the secondary study area, outside the project site (Seoane 2007). Significant ecological communities are identified by DEC on the basis of significance criteria and are considered to have high ecological and conservation value. They are either an occurrence of a community type that is rare in the state, or represent a high quality example of a more common community type.

- Red maple-sweetgum swamp—This ecological community exists within the secondary study area (i.e., Arden Avenue Woods). It is described as a moderate-sized community with a low abundance of exotic species, located within a small but intake forested landscape that is surrounded by development (Seoane 2007). This community was observed during field investigations, and is described in greater detail above in the plant communities descriptions.
- Oak-tulip tree forest—This ecological community has been reported as occurring at two locations within the secondary study area (Willowbrook Park and LaTourette Park). It is described as a very large forest containing a significant component of mature forest with large trees and few exotics, although other portions of the forest are disturbed with exotic species. Within the forest are small, open patches of degraded serpentine barrens, small vernal pools, and small patches of red maple-sweetgum swamp, coastal oak-beech forest, ponds and intermittent streams (Seoane 2007). This community was observed during field investigations, and is described in greater detail above.

SIGNIFICANT COASTAL FISH AND WILDLIFE HABITAT

In 1992, NYSDOS identified Fresh Kills as a Significant Coastal Fish and Wildlife habitat, in spite of the severe degradation of the site by human activities (i.e., landfilling, dredging, oil spills). The designation was based on certain factors evaluated for the site such as ecosystem rarity, species vulnerability, human use, population level, and replaceability. Fresh Kills is the largest tidal wetland ecosystem in the Manhattan Hills ecological region, and at one time was one of the largest coastal wetland areas in New York State. The wetlands and other natural communities associated with Fresh Kills are among the most valuable fish and wildlife habitats occurring on Staten Island. Herons, waterfowl, shorebirds, raptors, and passerines may occur in Fresh Kills (especially during spring and fall migrations). Additionally, the tidal creeks and freshwater inflows within this habitat system provide potential spawning and nursery habitats for a variety of anadromous, estuarine, and resident freshwater fishes (NYSDOS 1992).

PROJECT SITE SUMMARY

Terrestrial Habitats

With respect to terrestrial resources and habitat communities, the East Park largely comprises Landfill Section 6//7 which is currently undergoing landfill closure construction. Thus, the landfill portion of the site is largely an engineered landscape that, in part is currently a construction in site, and in part, is a recently seeded landfill cover with the associated landfill stormwater management infrastructure (the northern portion). To the east of the landfill are structural drainage basins that receive runoff from the landfill. It is assumed for this SEIS that the final vegetative cover on the landfill would include the seed mix of grasses as specified in the approved cover plan.

Wetlands

Off the landfill section there are structured wetlands composed of two stormwater management ponds east of Landfill Section 6/7 and a wetland area to the north to where they ultimately drain. There are also other open water areas west of Landfill Section 6/7 and smaller ponds that provide foraging habitat for birds. The diversity of habitats, proximity to a major estuary and the relative low level of human use on the project site contribute to its value as bird habitat. There is also a larger, emergent wetland to the south of the basins and nearer to Richmond Creek.

The project site also contains relatively undisturbed *Spartina*-dominated salt marsh (SCS Engineers 1990, AES 2003, AKRF 2007) along the Richmond Creek shoreline as well as along Main Creek in an area northwest of Landfill Section 6/7. These tidal marshes are predominantly low marsh vegetated with *Spartina alterniflora*, with smaller areas of high marsh vegetation (i.e., *Spartina patens*, *Distichlis spicata).* Groundselbush (*Baccharis halimifolia*) is present as well in the salt marsh communities.

Wildlife

The structured and natural wetlands of the site provide open water and vegetated wetland habitats with foraging and nesting habitat for muskrats (*Ondatra zibethica),* raccoons (*Procyon lotor),* and other mammals. Of the 21 species likely to be present at Fresh Kills, eight were observed during 2007 field observations. Species observed included muskrat, eastern cottontail (*Sylvilagus floridanus),* house cat (*Felis silvestris),* house mouse (*Mus musculus),* and meadow vole (*Microtus pennsylvanicus).* White-tailed deer (*Odocoileus virginianus)* ; raccoon tracks were also observed. Waterbirds and shorebirds common to Fresh Kills are also likely to use the site (see also “Aquatic Resources” and “Fish” below).

Aquatic Resources

As described above, painted turtles were observed in the stormwater management basins and adjacent wetland areas east of Landfill Section 6/7, adjacent to Richmond Avenue. Snapping turtles were observed in all basins and ponds east of Landfill Section 6/7, and stormwater Basin C1 located at the confluence of Richmond and Main creeks. Open water areas, and emergent and forested wetlands on the project site provide the main on-site foraging and breeding areas for some amphibians (i.e., frogs and toads) and reptiles (i.e., turtles), although water quality will be the most important factor in determining what species exist within these water bodies.Green frogs and spring peepers were observed dispersing through forested wetlands and present in ponded ruts along unpaved roads in many areas of the property

Freshwater benthic invertebrate sampling was performed in five areas within the project site during the fall 2007 AKRF field investigation (2 October 2007). To document the presence of macroinvertebrates in these water bodies, a dip net and small shovel were used to collect sediment, and a series of sieves (mesh sizes of 9.52, 4.70, 0.25 and 0.119 millimeter (mm)) were used to sort macroinvertebrates from the sediment. All organisms were then identified in the field to the lowest taxonomic level possible with the aid of a 10-times field hand lens. The sample locations and results are described below:

- Stormwater management Basin C1 just east of the confluence between Main Creek and Richmond Creek (see FGEIS Appendix C, Figure 1, “Natural Resources Survey Data

Collection Points," Data Collection Point 18)—Basin sediment consisted of fine brown silt. Three worm species (Subclass Oligochaeta) and one nematode (Phylum Nematoda) were collected.

- Stormwater management Basin B2, east of Landfill Section 6/7 (East Park) (see FGEIS Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 1)—Basin sediment consisted of coarse sand with gravel and silt. Invertebrates collected included two worm species (Subclass Oligochaeta) and two unidentified insect larvae (Order Diptera). Small freshwater snails (Class Gastropoda) were observed on riprap within this basin.
- Stormwater management Basin B1, east of Landfill Section 6/7 (East Park) (see FGEIS Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 3)—Basin sediment consisted of coarse sand with gravel and silt. Two oligochaete worms, two unidentified insect larvae (Order Diptera), and one unidentified insect larva (Class Insecta) were collected.
- Freshwater open water/palustrine forested wetland north of Basin B1 (see FGEIS Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 6)—Basin sediment consisted of deep, fine, brown silt. Invertebrates collected in this area included two worm species (Subclass Oligochaeta), one leech (Class Hirudinea), and two unidentified insect larvae (Order Diptera).

Insects

With respect to insects, within the Fresh Kills grassland and woodland habitats, substantial insect communities are likely to exist. Changes in insect communities relating to large-scale habitat shifts (i.e., landfill cover, followed by growth of native and introduced grass and forb species) is likely to drive further changes in insect diversity and density.

Fish

Fish sampling was performed in six open water areas within the project site during the fall 2007 AKRF field investigation (2 October 2007) to document the presence of fish in these water bodies. One standard round minnow trap was used at each sampling site. Each trap was baited (one cup of dry cat food), set at a depth of 1 to 5 feet, and collected after approximately four hours. Individual fish collected in the traps were identified in the field and returned to the water body. The sample locations and trapping results are described below:

- Stormwater management basin (Basin C1), east of the confluence between Main Creek and Richmond Creek (see FGEIS Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 18)—A baited minnow trap was placed approximately 3 feet below the surface. Fifty-four mummichogs (*Fundulus heteroclitus*, Family Cypronodontidae), ranging in length between 1 to 3 (and greater) inches, were collected.
- Stormwater management basin (Basin C2), east of the confluence between Main Creek and Richmond Creek, and east of Basin C1 (see FGEIS Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 17)—A baited minnow trap placed at a depth of approximately 3 to 5 feet. Ninety-two mummichogs, ranging in length between 1 to 3+ inches, were collected.
- Stormwater management Basin B2, east of Landfill Section 6/7 (East Park) (see FGEIS Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection

Point 1), Stormwater management basin B1, east of Landfill Section 6/7 (East Park) (see Appendix C, Figure 1, “Natural Resources Survey Data Collection Points,” Data Collection Point 3), and freshwater open water/palustrine forested wetland north of Basin B1 (see Appendix C, Figure 1, “Natural Resources Survey Data Collection Points,” Data Collection Point 6)—At Basins B2 and B1, baited minnow traps were placed at depths of 3 feet and 2 feet, respectively. Due to the relatively dry conditions at the period of the sampling, the baited trap was set at a depth of about 6 inches within the freshwater open water/palustrine forested wetland north of Basin B1. No fish were captured in traps at these three sampling locations, although movement at the surface indicated the presence of fish in these water bodies. Carp (Family Cyprinidae) were noted at the surface of the open water portion of the freshwater wetland north of Basin B1, and sunfish (Family Centrarchidae) and catfish (Family Ictaluridae) were observed previously in Basins B1 and B2, and the freshwater open water/palustrine forested wetland north of Basin B1.

Rare and Endangered Species

Based on the data gathered for the FGEIS, it would not be expected that the project site hosts any rare or endangered species populations with the exception of the occasional foraging transient barn owl or Northern Harrier.

Significant Coastal Fish and Wildlife Habitats

Main Creek and Richmond Creek which form the western and southern boundaries of the East Park project site are part of the Fresh Kills Significant Coastal Fish and Wildlife Habitat described above. These water bodies are the receiving waters for the drainage from Landfill Section 6/7 and the East Park project site.

D. THE FUTURE WITHOUT THE PROPOSED PROJECT

The following sections describe the future without the proposed project within the project site and secondary study area in the 2011, 2016 and 2036 analysis years.

2011: THE FUTURE WITHOUT THE PROPOSED PROJECT

LANDFILL SECTION 6/7 CLOSURE

In 2011, in the absence of the proposed project, it is expected that Landfill Section 6/7 would be closed under the approved cover plan and the final Fresh Kills closure construction activities (i.e., final grading and cover installation) currently underway for Landfill Sections 6/7 would be completed.

It is expected that approved mix of final cover grasses would be used to establish the vegetative final cover, but that by 2011 little else would occur with respect to the evolution of habitat and plant communities at site beyond the existing conditions described above.

Chapter 1, “Project Description,” provides a description of the post-closure monitoring and maintenance activities being implemented by DSNY. These activities include the following:

- Monitoring and maintenance of the final cover and drainage systems.
- Monitoring and maintenance of leachate collection system and treatment plant.
- Monitoring and maintenance of stormwater management system.

- Maintenance of groundwater monitoring wells, and landfill gas migration monitoring wells and methane sensors.
- Monitoring and maintenance of landfill gas emission control, odor control and processing systems.
- Maintenance of on-site access roads and bridges.
- Environmental monitoring—quarterly groundwater monitoring, annual surface water monitoring, biennial sediment and benthic macroinvertebrate monitoring, and quarterly landfill gas migration monitoring.
- Vegetation management (i.e., occasional mowing and herbicide application).

Implementation of the post-closure monitoring and maintenance activities in the future condition without the proposed project would not be expected to result in significant changes to terrestrial or aquatic natural resources within the project site. In addition, maintenance of the landfill cover (including periodic mowing) would be expected to limit any changes in habitat cover on Landfill Section 6/7.

Stormwater Runoff and Water Quality

With respect to stormwater runoff and management, an assessment of the proposed final closure condition (No Build Condition) of Section 6/7 was conducted to determine the water quality and sediment impacts based on this future condition. The assessment was made to determine the effects on water quality and sedimentation rates to the existing landfill storm water management basin outlet receiving waters (i.e., Main Creek and Richmond Creek).

Water quality modeling, using the EPA Storm Water Management Model (SWMM) Version 5, provides estimates of expected total annual loads of pollutants. A discussion of the model preparation and input parameters is presented below.

Pollutants of particular concern in storm water quality modeling include total annual nitrogen (TN), total phosphorus (TP), total suspended solids (TSS) and total lead or metals (TPb). These pollutants come from a variety of sources including, fertilizers, vehicles, unstabilized soils, and the natural degradation of organic matter in the environment. Table 10-12 provides a breakdown of the pollutant mean runoff concentrations in milligrams per liter (mg/L) for different land use categories. SWMM estimates pollutant buildup and washoff from subcatchment areas through the assignment of a percentage of land use type for the entire subcatchment. For the analyses presented in this report, the two representative land use types chosen were industrial, which is equivalent to impervious area (i.e., paths, roads or parking areas) and recreation, open space, range (i.e., fully vegetated landfill cover).

The annual water quality and sediment loadings were analyzed as input to Richmond Creek and Main Creek. The input to Richmond and Main Creeks includes the output from the existing storm water management basins at Landfill Section 6/7. The New York State Storm Water Management Design Manual (NYS Design Manual) requires water quality management be provided to capture and treat 90 percent of the average annual runoff volume discharging from a developed site. Storm water management practices must be selected from a pre-approved practice list from the NYS Design Manual and sized for control of the water quality volume (WQ_v). In accordance with the NYS Design Manual, storm water quality basins sized to hold the water quality volume have an average pollutant removal efficiency of 80 percent for total suspended solids, 50 percent for total phosphorous, and 35 percnt for total nitrogen.

Table 10-12
Mean Runoff Concentrations

Land Use Category	Pollutant (mg/l)			
	TN	TP	TSS	TPb
Low Density Residential	1.77	0.18	19.1	0.058
Medium Density Residential	2.29	0.3	27	0.091
High Density Residential	2.22	0.47	71	0.091
Low Intensity Commercial	1.18	0.15	81	0.158
High Intensity Commercial	2.83	0.43	94.3	0.214
Industrial	1.79	0.31	93.9	0.202
Pasture	2.48	0.48	55.3	0.025
Crops	2.68	0.42	55.3	0.025
Citrus	2.05	0.14	55.3	0.025
Agriculture-Other	2.32	0.34	55.3	0.025
Mining	1.18	0.15	93.9	0.202
Recreation, Open Space, Range	1.25	0.05	11.1	0.025

The WQ_v is directly related to the amount of impervious cover created at a site. The following equation can be used to determine the water quality storage volume WQ_v (in acre-feet of storage):

$$WQ_v = \frac{(P)(R_v)(A)}{12}$$

where:

WQ_v = water quality volume (in acre-feet)
P = 90% Rainfall Event Number
R_v = 0.05 + 0.009(I), where I is percent impervious cover
A = site area in acres

A minimum R_v of 0.2 is required, regardless of percent impervious cover. The DEC Manual suggests that by meeting the WQ_v requirements through employment of the standard approved storm water management practices a project will, by default, meet water quality objectives.

The No Build condition model, which is based solely on a closed landfill condition (i.e., 100 percent completion of landfill Section 6/7 closure construction as currently permitted), assumes runoff concentrations based on Recreation and Open Space land use. Under this closure condition, the storm water management basins were not designed to function as water quality basins and, although some water quality improvements may be provided, no improvements are accounted for in this report.

Annual water quality loadings for the 1-year and 2-year, 24-hour design storms, equivalent to a 2.50 inches and 3.30 inches, respectively, were calculated. These storm sizes were chosen as representative storms to estimate the annual loading when sizing treatment storm water management practices.

Table 10-13 provides the annual water quality loading for total suspended solids, total nitrogen, total phosphorous, and total lead and metals from the storm water management basins to Richmond and Main Creeks, for the No Build Condition. The No Build annual loadings are used as a baseline for comparison against the proposed future development build years presented below. This condition includes an impervious area of 29 acres, about 6 percent of the entire watershed. The impervious areas are paved and gravel service roads.

Table 10-13
Annual Water Quality Loading for 2011 No Build Condition

Water Quality Impacts to Receiving Water	1-year, 24-hour design storm				2-year, 24-hour design storm			
	TSS (lb/yr)	TN (lb/yr)	TP (lb/yr)	TPb (lb/yr)	TSS (lb/yr)	TN (lb/yr)	TP (lb/yr)	TPb (lb/yr)
Richmond Creek	311.83	12.57	1.11	0.68	416.56	16.79	1.49	0.90
Main Creek	125.92	8.83	0.50	0.28	150.76	10.50	0.60	0.33

2016: THE FUTURE WITHOUT THE PROPOSED PROJECT

PROJECT SITE

In the future without the proposed project, it is anticipated that by the 2016 analysis year, the post-closure monitoring and maintenance activities being implemented by DSNY would continue as described above. These activities are not expected to result in significant changes to terrestrial or aquatic natural resources within the project site. In addition, long-term monitoring and maintenance of the landfill covers (including periodic mowing) would be expected to limit any changes in habitat cover on the landfill section.

Changes in natural resource conditions at the project site are expected to be an evolution of the habitats off the landfill cover with maturing or natural succession in the surrounding communities. Phragmites is not as dominant on the landfill slopes as it is in the low lying areas around the edges.

Upland and wet woods would continue to mature (e.g., along the Richmond Avenue berm), and may support additional wildlife populations. Palustrine emergent and scrub-shrub wetlands in the southern portion of the sits would continue to mature and may gain additional woody plant species. Invasive plant species would continue to colonize some portions of the project site. The tidal creeks and wetlands along Richmond and Main Creeks, freshwater wetlands and open water basins, would continue to provide habitat for fish and wildlife currently described as using the project site habitat.

Annual water quality and sediment impacts are not anticipated to change as the vegetation matures during the 2016 analysis year. The intended maintenance (i.e., mowing) would not provide any additional sediment or water quality impacts to the existing stormwater management basins.

BACKGROUND CONDITIONS

Introduction

In addition to the aforementioned landfill post-closure and monitoring activities, there are proposed and ongoing regional projects associated with the New York/New Jersey Harbor Estuary Program (HEP), the Hudson-Raritan Estuary Ecosystem Restoration Project (HRE), and New York City projects identified in PlaNYC that have the potential to result in improvements to water quality and aquatic habitat of the Arthur Kill and the Fresh Kills estuary as well as terrestrial habitat within the project site. These projects are described below.

New York/New Jersey Harbor Estuary Program (HEP) Projects

The HEP Final Comprehensive Conservation and Management Plan (CCMP) included a number of goals to improve water quality and aquatic resources throughout the Harbor Estuary. To meet these goals, the CCMP outlines objectives for the management of toxic contamination, dredged material, pathogenic contamination, floatable debris, nutrients and organic enrichment, and rainfall-induced discharges. The HEP Habitat Workgroup developed watershed-based priorities for acquisition, protection, and restoration of sites within the Harbor Estuary for the preservation and enhancement of tidal wetlands that will provide improved habitat for fish and macroinvertebrates as well as the birds, mammals, and reptiles that depend on these habitats Feasibility studies were initiated in 2001 to assess some of these potential habitat restoration sites. Within the project site, Richmond Creek has been identified as a HEP restoration site. The project identified for Richmond Creek is the installation of an anadromous fish passage ladder to open up additional areas of the creek to anadromous fish.

The Hudson-Raritan Estuary Ecosystem Restoration Project (HRE)

HRE is a cooperative project being led by the USACE that was funded by a House of Representatives Resolution on 15 April 1999. The Port Authority of New York and New Jersey (PANYNJ) is a co-sponsor of this project. Other cooperating agencies include USEPA, USFWS, NOAA, National Resource Conservation Service, New Jersey Department of Environmental Protection (NJDEP), New Jersey Department of Transportation (Office of Maritime Resources), DEC, NYSDOS, NYCDEP, New York City Parks and Recreation, and New Jersey Meadowlands Commission. The focus of the study is to identify the actions needed to restore the Hudson-Raritan Estuary and develop a plan for their implementation. The study area for the program includes all the waters of the New York and New Jersey Harbor and the tidally influenced portions of all rivers and streams that empty into the Harbor and ecologically influence the Harbor. The program has drafted a plan that presents an ecosystem approach to restoration of the estuary, guidance for selecting specific projects, setting measurable objectives, called target ecosystem characteristics (TEC), and tracking program performance (Bain et al. 2007).

The Hudson-Raritan Estuary Ecosystem Restoration Project Environmental Restoration Feasibility Study prepared for Arthur Kill/Kill Van Kull, identified 30 potential restoration sites within the Arthur Kill/Kill Van Kull study area, two of which are within the project site: Fresh Kills landfill (restoration/enhancement of shoreline/coastal fringe habitat (bird habitat)) and Richmond Creek (restoration of fishery habitats (anadromous fish migration, artificial reefs))(USACE 2004). Implementation of these restoration projects in the 2016 and 2036 analysis years would benefit wildlife resources within and adjacent to project site.

New York City Projects

- PlaNYC—PlaNYC identifies initiatives to be implemented with respect to land, air, water, energy, and transportation to achieve the sustainability goals for the city (http://www.planyc.com). Air Quality Initiative 12 sets a goal for reforesting 2,000 acres of parkland within the City not currently occupied by ballfields by the year 2017, as one of the natural solutions proposed for improving air quality. This reforestation effort is to begin in 2009 and to be completed by 2017. One of the designated locations is Fresh Kills Park—the mapped parkland adjacent to Richmond and Main Creeks within the project site. It is anticipated that some planting of trees would occur within Fresh Kills Park as part of this initiative in the future without the proposed project. Planting of trees within the project site would benefit wildlife.

SECONDARY STUDY AREA

Overview

Similar to the project site, there are proposed and ongoing regional projects associated with the HEP, New York City projects identified in PlaNYC, the construction of Owl Hollow Park, and the remediation of the Brookfield Avenue landfill, that have the potential to result in improvements to water quality and aquatic habitat of the Fresh Kills estuary as well as terrestrial habitat within the secondary study area. These projects are described below. Improvements that result from these projects would occur without the proposed project, and are expected to continue through the No Build analysis years.

Other projects proposed for the secondary natural resources study area that have the potential to affect terrestrial and aquatic resources include the operation of the DSNY Waste Transfer Station at the northwest corner of the project site, and private residential or commercial development projects. These projects are also described in the following sections. In general, the construction and operation of these projects would not be expected to result in significant adverse impacts to terrestrial or aquatic resources within or in the vicinity of the project site.

DEP Remediation of the Brookfield Avenue Landfill

The Brookfield Avenue Landfill, located at the southeast corner of the project site, received municipal solid waste from 1966 until 1980. Between 1974 and 1979, industrial hazardous wastes (i.e., waste oil, sludges, metal plating wastes, lacquers and solvents) were reported to have been illegally dumped at the site. The Preliminary Design for Remedial Action prepared for the Record of Decision (ROD) incorporates measures that are protective of public health and the environment and consistent with conversion of the landfill to a public park. These measures—landfill cap, landfill gas collection and treatment system, 3-foot wide subsurface barrier wall extending approximately 40 feet into the ground around the periphery of the two landfill mounds within Brookfield Avenue Landfill, leachate collection and pretreatment system, and stormwater management system—will contain contaminants within the landfill and facilitate treatment of leachate and landfill gas. See Chapter 2, "Land Use, Zoning and Public Policy," for a more detailed description of the remedial program.

No hazardous materials will be removed from the site and only uncontaminated soils and topsoil will be brought to the site for the construction of the cap. Construction of the remediation system is anticipated to take between 3 to 3.5 years, and is expected to be compled by the 2016 analysis year.

Construction of the remediation system will result in the loss of the successional old field/shrubland habitat that currently covers much of the landfill and the loss of the landfill as wildlife habitat for the four-year period anticipated for remediation to be completed. This loss of habitat may result in the loss of some wildlife individuals that are unable to find suitable available habitat nearby. However, the loss of these individuals would not be expected to result in significant adverse impacts to populations of these species in the New York metropolitan region. Erosion and sediment control measures implemented during vegetation clearing, construction of subsurface barrier, and construction of other elements of the remediation system will minimize potential impacts to Richmond Creek and the tidal wetlands bordering the base of the landfill. By eliminating a source of contaminants, remediation of the Brookfield Avenue landfill will benefit water and sediment quality and aquatic resources of Richmond Creek and the tidal wetlands along the creek, including the portion within the Fresh Kills Park project site.

New York/New Jersey Harbor Estuary Program (HEP) Projects

Within the secondary natural resources study area, Arden Heights Woods located at the southern border of the project site has been identified as a HEP restoration site. Restoration activities would include protecting and restoring the habitat at the perimeter of the park and implementing measures to reduce non-point source impacts. These measures would improve habitat quality and benefit wildlife within and adjacent to Arden Heights Woods.

New York City Projects

- Owl Hollow Park is expected to be completed and operational. This 21-acre park will comprise four synthetic turf soccer fields (two of which will be lighted), a paved perimeter path around the athletic fields with benches, tables, nature trail, comfort station, playground, natural area, as well as the seven existing landfill gas monitoring wells and one groundwater monitoring well. The Owl Hollow Park project has undergone a separate environmental review. Construction and operation of this recreational facility will not result in significant adverse impacts to natural resources.
- PlaNYC—Water Quality Initiative 5 is to expand the bluebelt program to other areas of Staten Island, beginning in 2009, and expand the Bluebelt program to other areas of the city, where possible by 2015. The Main Creek Watershed is not currently within the Blue Belt. Expanding the Bluebelt program to the Main Creek Watershed, and to portions of the Richmond Creek watershed not currently included within the Bluebelt system would have the potential to improve water quality and aquatic habitat in the secondary study area and also within the project site

Private Development Projects

- Residential development projects—Privately sponsored residential developments in the vicinity of the secondary natural resources study area include: Wainwright Avenue Residential Development (16 dwelling units) located at the southeast corner of the project site, across from the Brookfield Landfill; Presentation Convent Residential Development (76 dwelling units) located adjacent to the southeastern border of Arden Heights Woods, and Victory Estates (100 dwelling units) located just north of the project site, within the portion of the secondary natural resources study area forming the northern portion of the Neck Creek watershed and adjacent to NWI designated estuarine emergent wetlands. The Presentation Convent Residential Development and Victory Estates Development would result in the loss of plant communities that currently provide wildlife habitat. While the loss of wildlife habitat within these two sites would have the potential to affect wildlife individuals, the loss of habitat would be small and the developments would not result in significant adverse impacts to wildlife populations within the metropolitan region. However, both projects are located adjacent to wetlands and have the potential to affect these habitats due to non-point source pollutant discharges.
- Commercial development projects—The L.A. Fitness health club (to be developed within an existing one-story building), and Holiday Inn Express plus two other possible hotels (two-acres of manufacturing land) would be located northwest of project site, within an area east of the West Shore Expressway and south of Victory Boulevard. These projects would not be expected to result in adverse impacts to natural resources. Pratt Industries is expected to expand the facilities at the existing Visy Paper plant on Victory Boulevard, in the Travis neighborhood, northwest of the project site. As part of this expansion, the New York City Economic Development Corporation (EDC) will assist in the construction of a spur from the Travis branch of the Staten Island Railroad to Visy's facilities. Potential impacts to tidal wetlands resulting from the construction of the new facility and rail spur would be assessed through a separate regulatory review process.

FRESH KILLS PARK PROJECT

Overview

As presented in Chapter 1, "Project Description," the Fresh Kills Park project would create a large new open space with significant cultural, recreational and environmental amenities while at the same time protecting and enhancing aquatic and terrestrial habitats. The objectives of the landscaping plan at Fresh Kills Park are to protect the existing natural resources, while building upon those resources that would benefit local and regional ecology and park users, and converting the four landfill sections into ecologically productive landscapes with recreational fields for active and passive pursuits. The park elements identified in the Fresh Kills Park FGEIS (March 2009) will ultimately be designed around existing natural resources and habitats identified for enhancement, with the development of the park and ecological improvements phased in as the park is developed.

- North Park, which includes recreational fields, ecological restoration, and waterfront recreation projects. It is assumed that North Park would be largely completed by 2016 including the habitat restorations.
- South Park, which would include a recreational center, recreational facilities on the landfill section (e.g., mountain biking), recreational fields, and ecological restoration. It is assumed most of South Park would be completed by 2016 including the habitat restorations.

Natural Area Restoration Program

With respect to natural area restoration, the major objectives of the park are:

- Enhancement and expansion of the existing freshwater wetlands, including the potential enhancement at the existing stormwater basins;
- Enhancement and expansion of the existing tidal wetlands through removal of invasive species such as *Phragmites* and enhancement of the native intertidal and high marsh plant communities;
- Development of native grassland and meadow habitats on the landfill sections; and
- Expansion of woodlands to provide a buffer for the site perimeter and provide an ecological connection with woodlands adjacent to the project site.

The objectives of Fresh Kills Park are to protect existing natural resources, while building on these resources to create a more diverse landscape. Integral to the plan is the enhancement of wetland and upland habitats to enhance and encourage complex associations between native habitats and wildlife found in limited abundance in urban areas. The proposed overall enhancement plan includes:

- Enhance wetland and upland habitats through the use of native plant species and genotypes that would be expected to colonize former landfill areas, where conditions are suitable for these species; and
- Establish novel upland and wetland communities in areas previously used for landfill activities (i.e., detention basins, drainage ditches).
- Enhance and restore native plant and animal biodiversity and distribution, while acknowledgeing emerging novel ecosystems at Fresh Kills;
- Adaptively manage ecosystems to understand the effects of habitat enhancement and mitigation and to address new and evolving stressors and threats to these systems over time;
- Manage the invasion and spread of highly invasive non-native species;

- Develop native grassland and meadow habitats on landfill sections;
- Expand woodlands to provide a buffer for the site perimeter and an ecological connection with woodlands adjacent to the project site;
- Avoid and minimize impacts to natural hydrological connections between tidal habitats and upland habitats;
- Avoid and minimize impacts to upland and wetland habitats to the extent practicable;
- Avoid and minimize impacts that lead to increased habitat fragmentation, with a goal of maintaining corridor connections;
- Provide habitat elements of cover, foraging areas, and breeding sites for endemic wildlife (e.g., avian guilds, small mammals, and native insects);
- Mitigate impacts to wetlands and other sensitive habitats due to road fill and shading impacts;
- Exceed mitigation needs where feasible; and
- Carry out resource stewardship to initiate natural, self-maintaining, ecologically functional habitat mitigation that is well-integrated into the park landscape and adjacent natural systems.

Future landscape enhancements at Fresh Kills with grasslands, upland woodlands, and freshwater and tidal marshes have been proposed for all park areas with restoration moving forward by 2016 in North Park and South Park (see Tables 10-14 and 10-15).

Table 10-14
Upland and Wetland Habitat Enhancement Acreage at Fresh Kills Park: 2016

Location	Total acreage of park areas	Projected upland enhancement (acres)		Projected wetland enhancement (acres)	
		Grassland	Woodland	Freshwater	Tidal
North Park	280	130	65	9.5	40
South Park	425	75	12	14	4
East Park	482	0	0	0	0
West Park	545	0	0	0	0
Confluence—The Marsh	20	0	0	4	0
Confluence—The Terrace	10	0	0	1	0
Confluence—The Point	50	0	0	0	0
Confluence—Creek Landing	20	0	0	1	1
Total	1,832	205	77	29.5	45

Source: Total park areas and projected upland and wetland enhancement acreages derived from Fresh Kills Park: Lifescape, Staten Island New York, Draft Master Plan, prepared by Field Operations for the City of New York, March 2006.

Table 10-15
Upland and Wetland Landscape Enhancement Acreages at Fresh Kills Park: 2036

Location	Total acreage of park areas	Projected upland enhancement (acres)		Projected wetland enhancement (acres)	
		Grassland	Woodland	Freshwater	Tidal
North Park	280	130	65	9.5	40
South Park	425	75	12	14	4
East Park	482	130	153	24.5	28
West Park	545	178	220	0	0
Confluence—The Marsh	20	0	0	4	0
Confluence—The Point	50	0	0	2	3
Confluence—The Terrace	10	0	0	1	0
Confluence—Creek Landing	20	0	0	1	1
Total	1,832	513	450	56.0	761

Source: Total park areas and projected upland and wetland enhancement acreages derived from Fresh Kills Park: Lifescape, Staten Island New York, Draft Master Plan, prepared by Field Operations for the City of New York, March 2006.

Wetland enhancement would include tidal wetlands (i.e., Spartina and mixed marsh enhancement along tidal creeks), freshwater wetlands (i.e., palustrine scrub shrub and forested wetlands) and wetland creation (i.e., conversion of detention basins to sunken forest habitats). The Fresh Kills Park Plan proposes to protect and enhance the condition of current wetlands, while offsetting adverse impacts to wetlands resulting from construction of park roads that need to cross wetlands in order to provide an east/west connection across the Park. Table 10-16 identifies the area of wetlands that would be impacted as a result of the construction of the proposed park roads for the 2016 and 2036 build years, as well as the areas of proposed wetland enhancement and mitigation measures for these impacts. A detailed discussion of these potential adverse impacts to wetlands and aquatic habitats is presented below for the 2016 and 2036 Build years. The proposed project wetland improvements include enhancement of degraded wetlands, enhancement of significantly altered wetlands, and creation of new wetlands including the following:

Table 10-16
Potential Impacts to Wetlands and Aquatic Habitats: Project Roads, Bridges, and Habitat Enhancement Projects: 2016 and 2036

	Area of Wetlands Filled (Acres)		Area of Wetlands or Aquatic Habitat Shaded (Acres)		Proposed Area of Wetlands Enhancement[1]	
Project Element	**Freshwater**	**Tidal**	**Freshwater**	**Tidal**	**Freshwater**	**Tidal**
2016 Analysis Year						
Forest Hill Road Connection of Southern Park Road (1)			1.3		*North Park*— 9.5 acres *South Park*—14 acres *Confluence, The Marsh*—4 acres *Confluence, The Terrace*—1 acre *Confluence, Creek Landing*—1 acre	*North Park*— 40 acres *South Park—4 acres* *Confluence, The Marsh*—0 acres *Confluence, The Terrace—0 acres* *Confluence, Creek Landing*—1 acre
Loop Park Road, North Segment		0.3				
Loop Park Road, South Segment		0.4				
Northbound West Shore Expressway Service Road—Loop Park Road to Wild Avenue	0.02					
Northbound West Shore Expressway Service Road—Arden Avenue to Loop Park Road	0.20		0.02			
Main Creek Pedestrian/Bicycle Bridge				0.3		
Richmond Creek Pedestrian/Bicycle Bridge (e.g., marina, public overlooks, docks)				0.4		
Marine Infrastructure	0.0	0.0	0.0	0.2		
Subtotal (Acres)	-0.22	-0.7	-1.3	-0.9	+29.5	+45
2036 Analysis Year						
Park Road North—Richmond Road Connection (1)	4.3				*East Park*—24.5 acres *Confluence, The Point*—2 acres	*East Park*—28 Acres *Confluence, The Point*—3 acres
Signature Bridge		0.03		1.7		
Marine Infrastructure (e.g., marina, public overlooks, docks)	0.0	0.0	0.0	0.5		
Subtotal (Acres)	-4.3	-0.03		-2.1	+26.5	+31
Total	-4.52	-0.73	-1.3	-3.0	+56	+76

Note: [1] See Figure 1-15 in Chapter 1, "Project Description."
(1) Proposed Project

- Tidal wetland enhancement would include enhancement and expansion of the existing tidal wetlands at East Park. Methods would include removal of invasive species (primarily *Phragmites*) and enhancement of the native intertidal and high marsh plant communities. Tidal enhancement would include mudflats, low salt marsh, and high salt marsh.
- Freshwater wetland enhancement and expansion of the existing freshwater wetlands in Fresh Kills Park would occur, with possible creation of additional wetland habitats within existing

stormwater management basins, primarily forested wetlands, where compatible with the stormwater management plan developed for the park.

Tidal wetland enhancement at Fresh Kills Park would require the treatment and management of invasive *Phragmites* that currently dominates much of the project area. These measures may include repeated herbicide application, cutting and removal (some grubbing, very little excavation) with intensive native vegetation plantings, and modification of sediment surface elevations to create water depth/inundation conditions that do not support *Phragmites*.

In terms of the tidal wetland enhancements, edge conditions along tidal waterways are proposed to be improved using softer and less intrusive processes that do not involve significant excavation or dredging. These techniques include tidal wetland edge enhancement that can include minor water-ward fill with clean sandy material that would minimize impacts on open water habitat, along with marsh toe stabilization (rocks, logs, coir fiber rolls, etc), that improves hydrologic inundation periods, and native marsh plantings that are encompassed in a 'living shoreline' stabilization and enhancement approach. Further development of tidal wetland enhancement measures will involve determining tidal flows, tidal elevations, and sedimentation patterns.

Some elements of existing wetland conditions may be enhanced through very minor surface elevation changes, debris removal, targeted invasive species management, in-fill native plantings or channel modifications. Enhancement designs would be patterned after local native wetland systems in form, function and biological diversity.

Upland Enhancement

Upland vegetation communities are an important ecological feature of Fresh Kills Park in terms of enhancing native plant biodiversity, wildlife habitat and species diversity, soil stabilization and erosion control, nutrient management/carbon sequestration, and air and water quality improvement. Upland plant communities would include managed, non-native/non-invasive grasses turf in park areas, native grassland communities on former mounds, and native woodlands and scrub-shrub communities on moderate to steep slopes and off-mound areas.

Enhancement of upland communities at Fresh Kills Park would include retaining existing native vegetation where possible, planting and seeding native plant species, and encouraging natural succession. Long-term monitoring of vegetation conditions and management and maintenance of native communities including control of invasive species, supplemental planting, and other maintenance activities would be carried out. Soil stabilization measures would comply with standard erosion and sediment control regulations, and would include the use of silt fences, sediment traps, swales, temporary seeding, phased grading, and permanent cover establishment via native plantings.

Grassland

Grassland enhancement projects, through a considered management approach, have been known to be successfully reestablished on previously degraded landscapes in short time periods (2-4 years, Chino Farms, MD; Gill et al. 2006). Former landfills can offer some additional barriers to native grassland enhancement, such as infrastructure, slope, soil composition and source, hydrology, and existing vegetation. Successful reestablishment of grasslands and suites of grassland-obligate species have been noted (Simmons 1999), with two ongoing enhancement projects in the NYC area (Pennsylvania and Fountain Avenue Landfills, Brooklyn, NY) showing positive signs of development (J. McLaughlin, NYCDEP).

Target species would include those found in meadows (with native wildflowers and prairie grasses such as switchgrass, big bluestem, Indian nut grass, blue grama, butterfly weed, beardtongue, black-eyed susan, and smooth aster) and typical Eastern dry grassland habitats (including Indian nut grass, little bluestem, sideoats grama, broomsedge, switchgrass, Canada goldenrod, grass-leaved goldenrod, and frost aster). The initial grassland enhancement project would include the following habitat types: flowering meadow, native grassland, and maintained turfgrass.

Scrub-shrub and Forest

In non-slope areas of Fresh Kills, species prevalent in upland hardwood forest (i.e., white, red, post, and scarlet oaks, black cherry, tulip poplar, American beech, sassafras, witch hazel, and lowbush blueberry) and lowland mesic forest (e.g., American sycamore, Eastern cottonwood, Sweetgum, American hornbeam, Spicebush, Sweet pepperbush, Southern arrowwood, and Highbush blueberry) would be planted.

Vegetation and Wildlife Management

The ultimate goal of the various park enhancement projects over the 30 year build period would be the development of a suite of self-sustaining ecosystems. These ecosystems would ideally require minimal management effort (e.g., mowing, continued plantings, etc.) to maintain the desired communities over time, and would target complex wildlife-habitat relationships, such as the creation of grassland habitat, to encourage development of grassland-breeding bird communities.

During the DSNY closure activities, DPR has recommended that mowing activities in upland mound areas should occur between early September and spring thaw; with an ideal period of September to October. This mowing schedule would accommodate the nesting schedule of grassland birds (i.e., late spring to late summer), would adequately control invasive or otherwise non-target plant species on the landfill mounds, and would allow the majority of mowing activity to occur outside of the warmest months of the year (Edward Toth, DPR, 4 January 2008). An alternate time to mow, from a vegetation control perspective, would be at the beginning of spring plant growth. However, this would necessitate mowing activity on wet slopes (from spring precipitation) and could conflict with nesting activity of grassland bird species. Mowing height is also critical, and typically mowing grasses to at least six inches is recommended (Lauren Stewart, DPR, 4 January 2008).

2036: THE FUTURE WITHOUT THE PROPOSED PROJECT

PROJECT SITE

Within the project site, post-closure and maintenance activities would be expected to continue through the 2036 analysis year. Natural resources on the landfill section are expected to be managed and similar to the 2016 conditions; off the landfill there would be some additional changes in plant communities due to maturation of the habitat and natural succession. No new projects would occur on the project site in the 2036 future without the proposed project.

Annual water quality and sediment impacts are not anticipated to change as the vegetation matures through the 2036 analysis year. The intended maintenance (i.e., mowing) would not provide any additional sediment or water quality impacts to the existing stormwater management basins.

FRESH KILLS PARK

Between 2016 and 2036 the following areas of Fresh Kills Park are expected to be completed:

- West Park, which includes a September 11 Monument on top of the landfill section, and ecological restoration.
- The Confluence, which is the recreational and cultural center of the proposed Fresh Kills Park. The confluence includes subareas such as the Point creek landing, the Marsh, and the Terrace, all of which would be accessible by the Confluence Loop Park Road.

In addition, by 2036, East Park, some 530 acres in size, would be completed, East Park would comprise a mix of fields and landscape enhancement areas for passive recreational opportunities that would include the following:

- Hilltop field (23 acres), located in the north portion of the closed landfill mound of Landfill Section 6/7.
- A successional meadow (187 acres) located on Landfill Section 6/7. Approximately 130 acres of this area is anticipated to be meadow habitat, similar to that described for North Park.
- Picnic lawn (2 acres), and flare station screen, located on Landfill Section 6/7, south of the recreational fields/successional meadow.
- Mixed woodland community (187 acres) would be sited along the northern, eastern and southern base of Landfill Section 6/7. This mixed woodland community would be expected to contain species similar to those described for the upland woodland community for North Park.
- Freshwater wetland enhancement (13 acres) on the east side of Landfill Section 6/7 that would include the enhancement of the existing stormwater basins with public access via a boardwalk constructed at the edge of the wetland and a nature education center (outdoor classroom [600 square feet] and nature education center [4,000 square feet]).
- Berm overlooks (about 900 square feet each).
- Marsh enhancement (about 28 acres)—The wetlands south of stormwater basins B1 and B2 would be enhanced, a portion of which would include tidal wetlands.
- Multi-use recreational path (12 miles)—Located around the base of Landfill Section 6/7.
- Bosque parking (6 acres) along the east side of the freshwater wetland complex on the east side of Landfill Section 6/7, and along the Loop Road.

The overall habitat restoration design for Fresh Kill Park is described above.

SECONDARY STUDY AREA

Natural resources within the secondary study area in the 2036 future without the proposed project is assumed to be a continuation of the conditions discussed above for the 2016 analysis year.

E. THE FUTURE WITH THE PROPOSED PROJECT

INTRODUCTION

As described in Chapter 1, “Project Description,” the proposed project would create new roads across East Park including a crossing at Yukon Avenue by 2016 (the Yukon Avenue Connection) with completion of the East Park Road system between 2017 and 2036. Completion of the East Park Road system could occur in one of the following options:

- Connections to Richmond Avenue with four-lane-wide park roads at Richmond Hill Road, Yukon Avenue, and Forest Hill Road;

- Connections to Richmond Avenue with two-lane-wide park roads at Richmond Hill Road, Yukon Avenue, and Forest Hill Road;
- Connections to Richmond Avenue with four-lane-wide park roads at Yukon Avenue; and
- A two-lane Loop Park Road with two-lane connections to Richmond Avenue at Richmond Hill Road and Forest Hill Road, and a four-lane road connection at Yukon Avenue.

The analysis below provides a discussion of potential project impacts to natural resources associated with the construction and operation of park roads under these project scenarios. Mitigaiton measuses and and measures that would be implemented during the development of the park to minimize these impacts are presented in Chapter 23 "Impact Avoidance Measures and Mitigation."

CONSTRUCTION

LAND DISTURBING ACTIVITIES

Construction of the proposed roads would result in the following land disturbance activities that could impact natural resources:

- Land clearing—removal of existing vegetation or other existing cover material;
- Temporary stockpiling of fill to be used as final cover material;
- Grading and construction of surface drainage systems; and
- Installation of infrastructure and roads.

These activities have the potential to impact terrestrial and aquatic resources through:

- Discharge of stormwater to freshwater wetlands present within the project site;
- Deposition of fugitive dust resulting from grading activities into terrestrial and aquatic habitats;
- Impacts to vegetation retained (i.e., above ground portion of the plants and the below ground portion of the tree protection zone for trees identified for retention);
- Modification or loss of habitat due to physical removal of plant community or grading and loss of individual wildlife due to collision with or as a result of operation of construction equipment (i.e., direct impacts);
- Loss of habitat due to avoidance of noise, vehicle traffic, or other human activity (i.e., indirect impacts); and
- Potential impacts to existing landfill environmental control systems (i.e., leachate and landfill gas control systems), (see Chapter 1, "Project Description" for a discussion of these systems).

Potential impacts to natural resources as a result of these activities would be minimized through the implementation of measures and guidelines discussed below.

Measures to Reduce Potential Wildlife Impacts During Construction

A detailed discussion of the potential natural resources impacts of the project during construction is presented in Chapter 20, "Construction." As detailed in that chapter, short-term construction impacts to wildlife could include direct impacts such as loss of habitat from land-clearing activities and development of staging areas for construction equipment and work sites, loss of individuals due to wildlife/construction vehicle impacts, habitat degradation due to partial removal of habitat or necessary substrate for wildlife activity (i.e., non-permanent removal or damage of vegetation as a result of a temporary project, such as tree trimming or temporary blocking of a drainageway to limit stormwater runoff), and indirect impacts such as wildlife avoidance of construction sites due to noise, human disturbance, lighting, and other factors that cause habitat to be unsuitable. Wildlife use of a particular area would be expected to return upon completion of construction and enhancement activities. The enhanced habitats proposed for Fresh Kills Park would be expected to benefit wildlife through the introduction of plant communities of higher quality and diversity than currently present within much of the project site.

Strategies to limit wildlife impacts as a result of road construction activities would depend on the duration and extent of the disturbance. The use of physical barriers at construction and staging areas, such as drift fencing, would be useful to restrict movement of ground-dwelling wildlife (i.e., small mammals, reptiles and amphibians), thereby limiting loss of individuals from direct contact with construction vehicles. Direct impacts to wildlife would also be reduced by limiting the speed of construction vehicles, and avoiding nighttime construction operations. Additionally, the phasing of the park development activities over a 30 year period would limit the extent of land disturbance and area of in-water construction activities at a given time, increasing the potential that suitable habitats may be available to wildlife affected by development of a certain elements of the park and reducing the potential for significant adverse impacts.

Soil Erosion and Sediment Control

It is expected that construction activities under the 2011 Modified Closure Plan would be addressed under the DSNY individual State Pollution Discharge Elimination System (SDPES) permit at Fresh Kills Landfill. Requirements of this permit include measures to reduce sediment and erosion impacts during construction activities, monitoring, and maintenance practices that cumulatively would minimize erosion and sedimentation impacts (and the resulting impacts on local water quality or wetland habitats) during construction.

For the construction of the proposed road segments (2016 and 2036), it is expected that similar practices would be implemented through an individual SDPES permit for the proposed park roads. It is expected that this permit would similarly have requirements for minimizing soil erosion and sediment impacts from construction activities, as well as requirements for monitoring and maintance practices that would minimize construction period impacts for the proposed roads. A project-specific erosion control plan would be expected to include design controls and practices that would be implemented during construction to minimize the release of pollutants in stormwater runoff, and would take into account unique site conditions such as proximity to landfill units, environmental control systems, slopes, and proximity to sensitive natural resources. These measures would be detailed in the permit which would be expected to contain the following:

- Flagging and staking to define the limits of disturbance and locations to install controls—This would include identification of the tree protection zone (TPZ) by a certified/registered arborist for trees that are to be preserved;
- Stockpile management controls;
- Stabilized construction entrances/exits and construction entrance postings;
- Appropriate inlet and outlet protection areas that have the potential to be affected by land disturbing activities—it is anticipated that during construction, site drainage would be equipped with appropriate outlet protection devices and best management practices as specified in a stormwater pollution prevention plan. Specific details for inlet and outlet

protection devices would be included in the site-specific erosion control plan, but would likely include sediment barriers such as drop inlet protection and inlet filter berms;

- Perimeter controls in areas to be disturbed during grading activities (i.e., sediment barriers such as compost socks, gravel bag/sand bag berms);
- Stormwater conveyances (i.e., channels, swales, diversion berms, etc) to direct runoff to one of the existing stormwater basins, as is appropriate for the site-specific erosion control plan;
- Fugitive dust control measures (e.g., seeding or wet suppression), including minimizing the amount of exposed soil at any given time;
- Stabilization of disturbed areas with temporary seeding or permanent cover—seeding should be consistent with landscaping and enhancement plans developed for the portion of the park under construction; and
- Removal of temporary BMPs following final stabilization.

A construction monitoring program would be implemented during construction to document that construction is consistent with and meets the requirements of the SPDES permit including all ongoing monitoring and record keeping during construction that would be defined for each capital park project. In addition, the design must reflect that the existing environmental monitoring control systems (i.e., landfill gas and leachate collection systems) and landfill cover remain intact and functioning during and after road construction to minimize the potential for adverse impacts to terrestrial and aquatic resources as well as public health and safety.

Protection Plan for Trees and Plant Communities to be Preserved

A protection plan will be prepared for each portion of the park under development that identifies trees, sensitive plant communities such as wetlands, and any other plant communities that have been identified for retention through out the development of the proposed project, and establish a a protection zone around these resources to minimize the potential for adverse impacts. The protection zone for these resources would be flagged and staked in the field by a professional (i.e., certified/registered arborist for trees, and by a horticulturist or botanist for wetlands and other sensitive plant communities), and will be identified on all construction drawings along with notes indicating activities allowed and prohibited within each protection zone.

Clearing of staging areas for road construction, as well as construction of other park elements, would be conducted in a manner consistent with minimizing impacts to large trees (e.g., trees with 12 inches or greater dbh). Maintaining existing mature trees provides benefits in temperature reduction (via shading, evapotranspiration potential, air quality improvements) and aesthetic value to park visitors that would take decades to restore through reforestation programs. It is also consistent with PlaNYC initiatives regarding the importance of urban forests and reforestation (i.e., the “Million Trees” initiative). When road plans have been finalized, trees located within impacted areas would be inventoried prior to construction for the purposes of identifying tree clearing impacts and opportunities for new tree plantings within the park.

CONSTRUCTION ACTIVITIES IN WETLANDS AND WATER AREAS

Construction of the proposed park roads would require the following activities in wetlands and water areas that have the potential to affect the existing aquatic habitats:

- Construction of best management practices and stormwater outlets;

- Placement of fill material, culverts, and other structural elements within the existing surface waters or wetlands;
- Removal of sediment and the grading of shorelines;
- Installation of underground utilities.

These activities have the potential to impact aquatic resources and wetlands through:

- Temporary increases in suspended sediment and resuspension and redeposition of sediment contaminants during sediment disturbing activities such as filling and grading;
- Temporary loss of habitat due to temporary water quality changes and noise impacts associated with construction;
- Temporary loss of wetland habitat due to installation of underground utilities; and
- Direct loss of wetlands, or bottom habitat and associated benthic invertebrates and fish habitat within the footprint of fill material, culverts, and other structural elements associated with the proposed park road and viaducts.

On the basis of the mixing and flushing characteristics of the Fresh Kills system, any temporary increase in suspended sediment resulting from in-water construction activities would be localized and are expected to dissipate shortly after the completion of the sediment disturbing activity. Therefore, in-water construction activities would not be expected to result in significant adverse impacts on water quality or aquatic biota. Similarly, any contaminants released to the water column as a result of sediment disturbance would be expected to dissipate rapidly and would not be expected to result in significant long-term impacts on water quality. While the Arthur Kill and Fresh Kills system sediments have been found to contain contaminants at concentrations that may pose a risk to some benthic macroinvertebrates, the relatively rapid flushing of the Fresh Kills system and large influence from the Arthur Kill suggests that these sediments would dissipate such that redeposition within or outside the project area would not be expected to significantly adversely affect benthic macroinvertebrates or bottom fish. Additionally, measures would be developed in consultation with DEC and the USACE during the permit review process to minimize potential impacts to fish and fish habitat resulting from sediment disturbing construction activities (e.g., use of silt curtain and seasonal restrictions on in-water construction activities to protect specific aquatic biota).

Life stages of estuarine-dependent and anadromous fish species, bivalves and other macroinvertebrates are fairly tolerant of elevated suspended sediment concentrations and have developed behavioral and physiological mechanisms for dealing with variable concentrations of suspended sediment (Birtwell et al. 1987, Dunford 1975, Levy and Northcote 1982 and Gregory 1990 in Nightingale and Simenstad 2001a, LaSalle et al. 1991). Fish are mobile and generally avoid unsuitable conditions in the vicinity such as increases in suspended sediment and noise (Clarke and Wilber 2000). While the localized increase in suspended sediment may cause fish to temporarily avoid the area around where piles or other in-water structures are being installed, the affected area would be expected to be small. Similar suitable habitats would be available for use by fish to avoid the area of in-water construction. Fish also have the ability to expel materials that may clog their gills when they return to less sediment-laden waters. Most shellfish are adapted to naturally turbid estuarine conditions and can tolerate short-term exposures by closing valves or reducing pumping activity. More mobile benthic invertebrates that occur in estuaries have been found to be tolerant of elevated suspended sediment concentrations. In studies of the tolerance of crustaceans to suspended sediments that lasted up to two weeks, nearly all mortality was caused by extremely high suspended sediment concentrations (greater than 10,000 mg/L)

(Clarke and Wilber 2000) which would not occur from the in-water work associated with the proposed project.

The installation of outfall structures, would result in the permanent loss of a small amount of bottom and water column habitat for each structure, and the benthic macroinvertebrates associated with the bottom habitat within the structure footprint. The loss of this small area of habitat that could occur would be determined for each capital project with an in-water element. However, the majority of in-water elements are limited and the benthic habitat for macroinvertebrates and fish is not expected to be significantly impacted nor are the populations of aquatic species using the Arthur Kill or the Fresh Kills system.

Potential impacts to natural resources as a result of these activities would be minimized through implementation of the following:

- Measures to minimize increases in turbidity and suspended sediment in the water column, and to capture floating debris during sediment removal and grading activities, and installation of in-water structures. Examples of measures to be considered include silt curtains and coffer dams. Measures would be selected on the basis of on-site conditions and consultation with DEC and the USACE; and
- Measures to stabilize the wetlands enhancement areas as necessary during planting, such as the use of a biodegradable/geosynthetic erosion control mats or revegetation mats.

OPERATION

Operation of the proposed park roads would include the following project elements in common that have the potential to affect the existing terrestrial and aquatic resources and are described in described as occurring within the project site in Section C, "Existing Conditions."

- Vehicular traffic/human use;
- Stormwater management;
- Nighttime lighting; and
- Overwater cover/shading

The following sections provide a general discussion of the potential impacts to natural resources with the proposed project.

EAST PARK ROADS

As presented in Chapter 1, "Project Description," the intent of the overall vehicular circulation plan at Fresh Kills Park is that it be integrated to the natural setting, while providing new east-west connections between Richmond Avenue on the east and the West Shore Expressway on the West, and limiting environmental impacts to the extent possible. To that end, the segments of park roads traversing landfill sections would be designed so as to not compromise the function or integrity of the existing environmental control systems. Construction activities would also be monitored to ensure consistency with the design and a post-construction monitoring plan would be developed and implemented to document the long-term protections and maintenance of the landfill closure structures and environmental control systems, with a Project Management Plan developed to ensure that operation and maintenance of the park roads minimizes the potential for impacting terrestrial and aquatic resources.

As discussed above under "Construction," the development of the park roads has the potential to result in direct impacts to natural resources through the loss of habitat removed during road construction. Operation of the park roads has the potential to result in long-term adverse impacts to aquatic resources due to:

- Contamination of stormwater runoff by oil, grease, and application of road salt; and
- Hydrologic changes associated with the impervious surface of the roadway (Evink 2002).

Operation of the park roads also has the potential to result in long-term adverse impact to terrestrial biota where the roadway cuts through proposed landscape enhancement areas, or areas where existing plant communities would be retained. Roadway sections with the greatest potential to result in adverse impacts to natural resources would include:

- Forest Hill Road Connection as it extends through the wetland/stormwater basin system on the east side of Landfill Section 6/7 and the woodland habitats proposed for enhancement at the southern portion of East Park;
- Richmond Hill Road Extension as the park road extends through the wetland/stormwater management basin system on the east side of Landfill Section 6/7 (Yukon Avenue) to connect to Richmond Avenue;
- East Park Loop Park Road where the roadway runs adjacent to stormwater basins as well as upland of the shoreline of Main and Richmond Creeks; and
- Yukon Avenue Connection in a four-lane-wide road section in the segment between Landfill Section 6/7 and Richmond Avenue.

HUMAN USE AND IMPACT AVOIDANCE RESPONSE

The proposed East Park Road corridors have the potential to result in adverse impacts to habitat fragmentation. Public roads can impede wildlife movement between or within habitat areas, subdivide species into smaller subpopulations and disrupt wildlife movement. The general impact avoidance measures envisioned by the park plan and presented in the FGEIS (March 2009) include the potential to maintain wildlife corridors and connectivity between habitats. A well-designed circulation network and sensitively siting roads and paths can serve to minimize potential adverse impacts to wildlife. However, the design of specific road alignments width and materials is critical to minimizing adverse impacts to habitat. Such designs need to consider both upland terrestrial habitats as well as aquatic/wetland habitats.

With the proposed park roads, human activity would increased along the road corridors (described above), which are expected to be operating all day, in addition to the regular DSNY park maintenance traffic which occurs regardless of the proposed park roads. Based on the anticipated low-levels of human presence that would characterize the project site in the "Future without the Proposed Project," increased human use as a result of the proposed park roads would be expected to have some negative effect on wildlife habitat, activities, and on-site populations. Reductions in the ability for wildlife to move unimpaired from one habitat area to another, without mitigating measures, would be expected to result in some decline in habitat suitability, particularly due to the physical and operational presence of new public roads (Bissonette 2006). These impacts could be due to noise, motion, and other direct effects on wildlife behavior as a result of motorized vehicle activity (no bicycle or pedestrian activities are proposed along these roads), increased interspecific predation rates in proximity to road edges (Miller and Hobbs 2000), and mortality associated with wildlife collisions with motorized vehicles.

Wildlife communities occupying urban habitats have been observed to comprise a collection of subsets—where species in low species-richness locations are nested within more species-rich communities ("nestedness") (Fernandez-Juricic 2002). In fragmented systems, human disturbance occurs at different levels (i.e., undisturbed meadows versus meadow edge along a path), and species tolerate, or become accustomed to, human intrusion in different ways. The type and magnitude of respond may depend on behavioral traits (i.e., larger birds being less tolerant to human disturbance; Burger and Gochfeld 1991). When effects of pedestrian rate, fragment size of a particular habitat, and habitat structure on nestedness of bird communities within an urban forest fragment were examined, birds tended to occupy larger fragments with higher stem densities, spent less time foraging, or left to seek cover (Fernandez-Juricic 2002). This suggests that in some areas, as human activity increases, the suitability of smaller patches as wildlife habitat decreases, placing a premium on the preservation of larger, contiguous areas. Similar patterns of reduced suitability of fragmented areas as habitat have been observed for a variety of wildlife groups in urban landscapes, although species-specific differences in response to disturbance can be strong (Ficetola et al 2007). Increased rates of disturbance can result in decreases in local population size of a particular species due to increased anti-predator investment, decrease in body condition, and decreased reproductive success (Frid and Dill (2002).

In terms of disturbance to terrestrial invertebrates, a less well studied group, human disturbance of the landscape associated with metrics of biodiversity (i.e., total number of invertebrate families, number of Dipteran families, and taxa richness of predators and detritovores) indicated that undisturbed sites had the highest biological value, followed by construction and current waste disposal sites, with the lowest values at agricultural sites (Kimberling 2001). Also, indices of biological value were lowest in frequently disturbed sites. Therefore, the degree of disturbance may be expected to regulate some terrestrial invertebrate assemblages as well (Kimberling 2001).

At East Park and the proposed park roads, it would be reasonable to expect that increased levels of habitat segmentation driven by physical barriers (i.e., roads) coupled with the vehicular traffic would have the potential to adversely impact wildlife using existing and restored habitats. One strategy to minimize these potential adverse wildlife impacts, while still allowing for park roads to be constructed would be to modify habitat structure to allow for wildlife access to nearby cover, effectively increasing tolerance of wildlife to human presence (Fernandez-Juricic et al. 2001).

For example, the potential for fragmentation of habitat for the Florida panther, black bear and other species north and south of I-75 in Florida lead to the development of wildlife crossing structures along this roadway (Evink 1990 in Evink 2002). Similar potential impacts were identified for the TransCanada Highway through Banff National Forest (Leeson 1996 in Evink 2002). Nonetheless, the fragmentation of wildlife habitats by roads and other corridors has the potential to impede the dispersal of individuals between populations of the same species that is important for gene flow, movement of individuals to maintain small populations, and recolonizing areas where a species has been eliminated (Shaffer 1981, Dodd 1990, Gibbs 1993, Fahrig and Merriam 1994 in Evink 2002).

People have long had—and must continue to have—a significant presence at Fresh Kills, particularly in its history as an active landfill. Even as landfill maintenance and monitoring continues, the development of Fresh Kills Park will create and enhance vast areas of natural habitat in a previously degraded urban site. The co-existence of these functions—as a closed landfill, park, and habitat—is a key feature of the park design, which seeks to bring a broader public to experience this unique example of urban nature, and to deepen visitors' appreciation for and relationship to their environment.

Hundreds of acres of habitat will be introduced at Fresh Kills Park as well as in East Park creating many vast, uninterrupted habitats. Areas that today are dominated by invasive plants such as phragmites, or that contain only limited vegetation and habitat communities (e.g., on the landfill sections), will be replaced by new species selected specifically for their potential to thrive, and placed with techniques painstakingly developed to ensure their best chance for growth. At the same time, DSNY must also maintain access roads throughout East Park for management and monitoring operations.

One method for controlling the interaction between people and wildlife is to create a well-designed circulation network. For instance, sensitively siting of roads can minimize potential impacts. Where possible, proposed roads will be on or near existing access roads (e.g., the Yukon Connection). Road design is also critical to minimizing impacts. For instance, roads that are designed with the appropriate finishes and maintained can minimize potential impacts from human activity in a setting of wildlife habitats. Conversely, poorly designed roads can impact wildlife habitats by creating edge effects and barrier effects, and increasing species competition by providing additional access by invasive or non-native species. The degree of impact and its potential to cause habitat fragmentation is site specific and highly dependent on the location, design, construction and maintenance of the road. Recognizing this concern, design proposals for the Fresh Kills Park roads will consider many well-established guidelines that have been demonstrated to minimize impact on wildlife communities, and apply them based on site-specific factors, including location, and habitat and wildlife types which will be reviewed as each road segment proposal moves forward. To that end, the following general principles can minimize the potential habitat impacts of a road:

Park roads have the potential to impact or conflict with existing or proposed wildlife habitat in the following ways:

- Indirect impacts due to degradation of habitat quality and habitat avoidance (i.e., avoidance response)—noise, reduced air quality, light pollution, increased human activity and invasive exotic plant species along the road edge can lower the quality of the habitat adjacent to park roads. This change in habitat quality may result in a decreased use or avoidance of habitat within a zone near roads, as well as decreased wildlife diversity (Evink 2002). The size of this avoidance zone varies with wildlife species and individual. According to Forman and Deblinger (2000), white-tailed deer, for example, may adapt to roads by avoiding nearby habitats where traffic noise inhibits predator detection and by selecting advantageous routes and times to cross roads. Other species, such as amphibians or reptiles, would cross when needed to migrate to or from breeding locations For example, Forman and Deblinger (2000) identified that within 650 meters of a busy four-lane highway, populations of forest-interior bird species are one-third lower than at greater distances, and grassland birds were believed to be reduced in density and species number for hundreds of meters from the roadway. Decreases in breeding bird populations adjacent to roadways with high traffic volumes reported by Reijnen et al. (1995) and Reijnen and Thissen (1997) was attributed primarily to roadway noise, possibly due to its interference with bird communication during the breeding period.
- Direct loss of wildlife individuals due to impact with vehicles—Road type, adjacent habitat and abundance of individuals have been found to influence the number of deer, elk, and other ungulates/vehicle collisions along roadways (Bissonette 2006). Wildlife/vehicle collisions were also affected by length of road barrier and presence of median structure that limits or slows crossing (Bissonette 2006.

- Decreased access to habitat vital to the lifecycle of certain species—Amphibians and turtles may be cut off from aquatic or upland habitat necessary for breeding or foraging (Evink 2002).

Measures incorporated into the proposed project that would minimize the potential for park roads to result in significant adverse impacts to aquatic resources include the following:

- Collection and treatment of stormwater runoff from East Park Roads, incorporating control measures for oil, grease and grit;
- In areas where habitat is to be created as part of the overall park design, design roads so that they do not compromise the development and sustainability of the future functions and habitat structures;
- Design roads to minimize changes in hydrological systems; and
- Design roads to avoid existing habitats to the extent feasible and, where appropriate, to include an adequate vegetated buffer.
- Best Management Practices (BMPs) that include planting vegetation to control erosion, diverting runoff from exposed surfaces, and controlling the volume and velocity of runoff;
- Weed-free practices would be followed for road landscaping with follow-up inspections for invasive species;
- Implementation of an "Operations and Maintenance Plan" that includes alternative strategies for de-icing traveled routes recommended in the "High Performance Infrastructure Guidelines: Best Practices for the Public Right-of-Way" (New York City Department of Design and Construction and Design Trust for Public Space, 2005). Recommendations include prohibiting use of sodium chloride, considering the use of calcium magnesium acetate (CMA) near sensitive ecological areas and on bridges, using grit on less traveled pathways and within park areas, where de-icing salt is necessary, using good spreading techniques using a mix of de-icing salt and sand; and pre-treating roads to help prevent bonding of ice;
- Incorporate road-side maintenance in the IPM Plan prepared for the park to minimize the potential for adverse effects to stormwater runoff quality;
- Maintain hydrologic connection between existing wetlands and surface water bodies using viaducts where feasible, and culverts designed to facilitate movement of aquatic organisms, and to minimize impairment of flow pattern; and
- Consider restricting access to park roads by trucks carrying hazardous materials or petroleum products. The proposed park roads would be open to public and City vehicles, but would not be open to public commercial and truck traffic.

Measures that would minimize the potential for park roads to result in significant adverse impacts to terrestrial wildlife include the following:

- Incorporating measures to mitigate potential impairments to wildlife movement in the areas identified above by incorporating wildlife underpass features into culverts constructed under the park roads to maintain stormwater drainage and flow patterns, or separate wildlife underpass features where feasible;
- Using viaducts where feasible to minimize impairment of wildlife movement under roadways;
- Incorporating wildlife crossing warnings into roadway signage;

- Monitoring wildlife/vehicle collisions to identify the need for additional measures (e.g., speed reduction) to minimize wildlife losses and adverse effects to motorist safety due to collisions;
- Using vegetation that does not attract wildlife in roadside landscaping and keeping vegetation adjacent to the road low to provide wildlife with unobstructed view of oncoming traffic; and
- Establishing vegetation screens along roadway to reduce traffic noise in certain landscape enhancement areas.

The above measures are also presented in Chapter 23, "Impact Avoidance and Mitigation Measures."

STORMWATER MANAGEMENT AND WATER QUALITY IMPACTS

Discharge of stormwater from the proposed project has the potential to result in long-term impacts to water quality and aquatic biota of Fresh Kills, Main, and Richmond Creeks. Although overall the project is expected to reduce impervious surfaces, there are a number of park elements that, if constructed, would convert existing pervious surfaces (e.g., woodlands, wetlands, turf, landscaped areas, etc.) to impervious surfaces[1]. Because impervious surfaces do not allow precipitation to infiltrate into the soil, precipitation that falls on these surfaces runs off to down slope areas, infiltrating into soil where conditions are suitable, or conveyed into a ditch, storm sewer system, wetland, or receiving waterbody. Stormwater runoff from impervious surfaces can carry pollutants (i.e., suspended solids, nutrients, fecal coliform bacteria, petroleum hydrocarbons, metals, chlorides, insecticides and herbicides) that can affect the water quality and aquatic habitats of the receiving waterbody (USEPA 2005). Stormwater discharges have been identified as one of the leading sources of pollution for all waterbody types in the United States (USEPA 2007).

As discussed above, the construction and operation of Fresh Kills Park would be covered under the DEC individual SPDES permit, which is expected to address sedimentation and erosion control practices during construction as well as the long term control and management of runoff from the proposed park roads. It is expected that the technical standards for erosion and sediment control practices as presented in "New York Standards and Specifications for Erosion and Sediment Control," and DEC's technical standard for the design of post-construction stormwater control practices presented in *New York State Stormwater Management Design Manual* ("Design Manual") would also apply.

As discussed in Chapter 1, "Project Description," the conceptual stormwater management plan prepared for Fresh Kills Park has identified stormwater control practices that can be integrated with, and enhance, proposed park features, meet site constraints, and provide water quality treatment and quantity management in accordance with DEC's Design Manual during the operational phase of the proposed project. The proposed stormwater plan for the various park road phases of implementation are expected to complement and enhance the aesthetic and ecological purposes of the proposed park, with the overall stormwater management objective to improve upon the current hydrologic and water quality management provided by the stormwater management infrastructure installed for the Fresh Kills Landfill.

[1] Impervious surface is a land cover that impedes water percolation, such as road surfaces.

As described in Chapter 1, "Project Description," the approach to stormwater management includes a mix of traditional conveyance and storage measures that would incorporate existing armored downchutes and large-scale detention basins and Low Impact Development (LID) practices located throughout each subcatchment. LID is a stormwater management approach and set of practices that reduce runoff and pollutant loadings by managing the runoff close to its source using a set or system of small-scale practices that are linked together. LID techniques promote the use of natural systems to achieve stormwater quality requirements, and volume control through infiltration and evapotranspiration. Table 1-5 lists the stormwater Best Management Practices (BMPs) identified as appropriate for the proposed park features. Most of these BMPs are suitable LID techniques. BMPs such as bioretention and pocket wetlands that provide water quality treatment of stormwater runoff and wildlife habitat, aesthetic improvements and educational opportunities were included to the extent possible. Implementation of these measures, as well as other aspects of the stormwater management plan to be prepared for each phase of park development would minimize the potential for significant adverse impacts to aquatic resources resulting from the discharge of stormwater from Fresh Kills Park.

Based on the above assumptions for the proposed park features and roads, a hydrologic analysis conducted of the proposed Fresh Kills Park stormwater management plan (Geosyntec 2008) concluded that all New York State stormwater quality and quantity requirements would be met, with the proposed project.[1] For the portions of the park that would discharge to non-tidal waters, the proposed stormwater management plan would decrease in the 10-year and 100-year, 24-hour storm event peak discharges. Although not required under the New York State Storm Water Management Design Manual, peak discharges of stormwater would also be reduced for the portions of the park discharging to tidal waters. With the proposed stormwater management measures in place, the project would provide peak control and water quality benefits above and beyond those currently provided at the site. Additionally, the results of the pollutant loading under the proposed stormwater management plan indicate that in general, the total annual loading of total suspended solids (TSS), total nitrogen (TN), and total phosphorus (TP) would decrease in the 2016 and 2036 analysis years due to the overall decrease in impervious area that would occur within the project site as a result of the proposed project, and the proposed modifications to the existing stormwater basins. Compared to the existing conditions, the proposed stormwater management plan would result in reductions of 67,626 pounds per year for TSS, 676 pounds per year for TN, and 296 pounds per year for TP. With the implementation of LID practices, the estimated peak discharge rates and volume of stormwater runoff discharged from the park, as well as the estimated pollutant annual loading rates, would be reduced still further. Therefore, it is concluded that the discharge of stormwater with the proposed project would not result in significant adverse impacts to water quality or aquatic biota of the Fresh Kill creek system or the Arthur Kill (see also the discussion below for the three proposed project development scenarios).

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[1] The following conclusions are summarized from Fresh Kills Park Stormwater Management Plan Part I: Meeting New York State Criteria, Prepared by Geosyntec Consultants (February, 2008); Fresh Kills Park Plan Part II: Meeting Additional Criteria and Project Goals, Geosyntec Consultants, March 24, 2008.

OVERWATER COVER/SHADING

The proposed project includes viaducts across wetlands with both the Forest Hill Road and Richmond Hill Road connections. Development of structures would require the placement of structures over wetlands thereby creating the potential to result in long-term impacts to aquatic habitats due to shading.

Shading of estuarine habitats is of concern because decreased light levels can lower productivity of primary producers and adversely affect fish and invertebrates that use these areas to provide passage for various life stages, and as important areas for feeding, refuge, and spawning (Nightingale and Simenstad 2001b). Alteration of light regimes by overwater structures can limit plant growth and recruitment and result in altered animal behavior and assemblages. Factors affecting the shade footprint include height of overwater structure, width, construction materials, and orientation to the arc of the sun (Burdick and Short 1995, Fresh et al. 1995 and 2000, Olson 1996 and 1997 in Nightingale and Simenstad 2001b). Concrete and steel will refract more light to the environment than wood which absorbs light (Thom and Shreffler 1996 in Nightingale and Simenstad 2001b).

Light is necessary for the photosynthetic process, and shading can result in some degree of impairment, resulting in a decrease in primary production. Light energy beneath a structure can be reduced by 90 to 100 percent, which can growth of microalgae and macrophytes fro example. The minimal light requirement for estuarine primary producers such as phytoplankton is that 1 percent of the surface irradiance reach the lower depth limit for that species (Stickland 1958 in Nightingale and Simenstad 2001b). Potential shading impacts on phytoplankton are limited because of the low light requirements of phytoplankton combined with the relatively short residence time in shaded areas. Similarly, the increased shading effects resulting from the overwater coverage that would occur with the proposed project would not be expected to result in adverse effects to zooplankton communities. Many zooplankton graze on phytoplankton as well as detritus, and a steady supply of these suspended materials provides an adequate availability of food sources. While the increase in shaded area may decrease a visual feeder’s ability to locate prey, residence time of these planktonic organisms in such areas is expected to be short; thus, no significant adverse impacts would be expected.

Shading can adversely impact habitat for certain fish species dependent on sight and light for feeding, prey capture, schooling (due to dispersal under low light conditions), spatial orientation, predator avoidance and migration (change in migratory route to deeper waters to avoid shaded areas). Juvenile and larval fish are primarily visual feeders and can be affected by light levels (Nightingale and Simenstad 2001b). It has been maintained that shading of estuarine habitats can result in decreased light levels which can lower productivity of primary producers and adversely affect invertebrates, and fish that use these areas particularly with respect to use as foraging habitat (Able et al. 1998). Shadows cast by overwater structures may also increase predation on certain fish species by creating a light/dark interface that allows predatory fish to remain hidden from prey in a darkened area ((Helfman 1981 in NMFS 2003).

Lastly, the proposed road projects would be subject to the permitting requirements of DEC and USACE due to the presence of waters and wetlands. Therefore, with respect to protection of aquatic resources, any additional protection measures beyond those presented in this DSEIS resulting from that permit review process would be incorporated into the individual capital road projects prior to construction.

NIGHTTIME LIGHTING

There is limited nighttime lighting at Fresh Kills making it one of the darkest sites in the New York City area. Nighttime lighting is limited to the West Shore Expressway, adjoining public streets (such as Richmond Avenue), and lights along service roads, bridges and facility areas within former Fresh Kills Landfill. However, the majority of existing secondary roads, such as those surrounding or traversing landfill sections, are presently unlit.

Nighttime lighting can have a significant impact on wildlife activity, including insects, birds, and mammals. Pertinent features of lighting design include luminance (brightness of a light's surface), illumination (lighting a feature near the source of a light), and the quality or physical composition of the light (Health Council of the Netherlands 2000). Light pollution, the condition of periodically or chronically increased light conditions in an area, has known impacts on wildlife orientation or disorientation (i.e., birds or insects attracted to a light source), that may affect feeding, communication, reproduction, communication, critical interspecific interactions, and other behaviors (Longcore and Rich 2004). Light pollution may have effects on individuals, communities, or ecosystems, influencing local behavioral patterns in communication (i.e., disruption of visual displays occurring only in dark settings) to community level effects (i.e., shift in movement of aquatic prey species, increasing food availability for predators).

Examples of wildlife impacts due to ecological light pollution include increased bird and bat collisions with structures, disorientation and reproductive effects in moths and other primarily nocturnal insects, disruption of biorhythms (i.e., sensitivity to photoperiod for species that use light as a cue for starting reproductive cycles), degradation of habitat quality (i.e., making grassland habitats unsuitable for breeding birds) and other effects. While some of the results of artificial lighting may appear positive for species that habituate to elevated light levels (i.e., increased feeding success due to the presence of artificial light), they may cause shifts in behavior and population structure that are not readily apparent from qualitative observation.

Long term field studies would typically be necessary to distinguish the ecological effects of nighttime lighting from those due to other disturbances that are co-located or in close proximity to lighting (i.e., traffic noise, proximity to human activity, etc.; Health Council of the Netherlands 2000). Measurements of current light levels within the project site are unavailable for use in projecting future nighttime light levels. However, measures to reduce light pollution or "trespass" (i.e., light or glare from an adjacent local lighting source) with the proposed roads (e.g., type of light source, light placement, and lighting schedules) will be explored that are consistent with safety requirements for lighting a particular area (i.e., illumination of roadways, paths, and parking areas where public safety is a primary concern).

Lighting guidelines developed by the New York City Department of Design and Construction ([DDC] 2005), and the Illuminating Engineering Society of North America (IESNA, 1999), suggest that areas with "intrinsically dark landscapes" (Zone E1, IESNA 1999), such as national parks and natural areas, receive zero lux or foot candles for areas where safety and security are not an issue. Some examples of strategies to light structures in the vicinity of Zone E1 areas include use of a limited, non-continuous lighting schedule in areas where darkness is preferred (reducing light use during low use periods), the use of shielding devices and cutoff-type luminaries with visors or hoods, reduction of ground-reflected light and upward light emissions (which accounts for up to 20 percent of 'sky glow' or atmospheric light pollution) by assigning proper directionality and pole heights suited to the appropriate use, limiting or adjusting illumination of non-target structures (i.e., bridges, secondary roads, etc.) to minimize light trespass, and using light sources suitable for the surface material of roadways or pathways (i.e. concrete vs. asphalt surfaces reflect light differently).

With the exception of areas of Fresh Kills Park where human activity would necessitate light while open to the public (i.e., park facilities open after dark, such as walkways, recreational fields, and roadways), most areas of the park would not need to be lit throughout the night. For areas being illuminated through the night, such as the park roads, minimizing glare and avoiding lights that illuminate structures in silhouette would be appropriate in these cases. Careful design and planning of lighting arrays—taking into consideration the amount of lighting, directional leakage, and wavelengths, compliance with the DDC guidelines and those of the Illuminating Engineering Society of North America, and using lighting fixtures with the International Dark-Sky Association (IDA) Fixture Seal of Approval—would minimize many significant adverse impacts associated with proposed roads, particularly in relation to wildlife activity. The objectives of the International Dark Sky Association would also be reviewed and applied at the site, where feasible.

WETLAND IMPACTS AND ENHANCEMENT

Table 10-17 identifies the area of wetland and habitats that would be be potentially impacted as a result of the construction of the proposed East Park roads. A detailed discussion of these potential adverse impacts to wetlands and aquatic habitats is presented below for the 2016 and 2036 build years. The proposed Fresh Kills Park project includes substantial wetland improvement projects including those that would enhance degraded wetlands and those that would create new wetland habitats. Mitigation measures for the impacts to wetlands that are presented below are described in Chapter 23 "Mitigation."

Table 10-17
Potential Impacts to Wetlands (including Aquatic Habitats): Proposed East Park Roads

Project Element	Acreage Impacted
Yukon Avenue Connection (4-lane road option)	+/- 0.25 acres (basin B2)
Forest Hill Road Connection to Richmond Avenue (4-lane road option)	+/- 1.13 acres
Richmond Hill Road Connection (4-lane road option)	+/- 4.3 (Basin B1 and wetlands/stream to the north)
Forest Hill Road Connection to Richmond Avenue (2-lane road option)	+/- 1.20 acres
Richmond Hill Road Connection (2-lane road option)	+/- 2.15 acres (Basin B1 and wetlands/stream to the north)
East Park Loop Road Alignment (option) [2]	+/- 1.92 acres

Notes:
[1] See Figure 1-15 in Chapter 1, "Project Description."
[2] This option would also need to be evaluated for potential wetland impacts on wetlands alogng Main and Richmond Creeks for potential impacts to tidal wetlands due to roads and stormwater management structures.
This table includes all wetlands and aquatic habitats within the East Park Road right of way. Thes are predominantly freshwater wetlands but could include estuarne wetlands with the Forest Hill Road connection depending furher investigation (although this area is not delineated as a DEC tidal wetland based on the current maps.)

2011: THE FUTURE WITH THE PROPOSED PROJECT

Implementation of the modified landfill cover would not result in significant adverse impacts to natural resources. The modified cover design incorporates appropriate engineering design performance standards and approaches that are consistent with New York Part 360 landfill final closure design requirements and previous final closure designs implemented at Fresh Kills Landfill and other locations. This modified design proposal would amend the landfill final closure grades such that the finished grade of the final cover system is below the proposed park road alignments proposed under this project. Because the breadth of final closure regrading and relocation of landfill infrastructure under this amended plan is consistent with each of the potential future park road designs, the 2011 construction would create two corridors across Landfill Section 6/7 that provide sufficient separation between the proposed roads and landfill infrastructure, such that no further relocation of the infrastructure is necessary to accommodate construction of the 2016 or 2036 park roads, specifically the Yukon Avenue and Forest Hill Road Connectors.

Construction of these two corridors under this proposed mofidication could increase the impervious area of Landfill Section 6/7 by approximately 3 percent above the No Build condition (or from 29 to 38 acres). This additional 9 acres assumes widening the landfill access roads along the Yukon and Forest Hill corridors from 30 feet wide to 65 feet wide, as well as the application of embankment material that would increase imperviousness.

This proposed modification of the landfill cover is not expected to result in impacts with respect to any of the following natural resources conditions:

- Terrestrial Resources (the site would be disturbed in the future under the approved final cover plan)
- Floodplains (there are no flood hazards areas on Landfill Section 6/7)
- Threatened or Endangered Species (there are no threatened or endangered species on the landfill section)
- Significant Coastal Fish and Wildlife Habitat

Landfill leachate is generated by percolation of precipitation through the landfill surface and into the waste. The percolation volume is minimized throughout the landfill life-cycle through the conformance with minimum operating standards, as prescribed in the solid waste regulations, during waste placement operations and through the application of engineered cover systems following cessation of waste placement. Typical minimum operating standards include: (i) performing waste operations within a limited area that can be easily managed; (ii) diverting stormwater run-on into the open waste areas; (iii) maintaining positive drainage on surfaces to prevent ponding of water; and (iv) application of temporary cover materials over waste overnight and during other periods of inactivity.

Liquid that does percolate into the waste mass migrates through the waste along the path of highest permeability resistance until it reaches the base of the landfill. Fresh Kills Landfill is underlain by a natural low permeability soil layer that impedes the downward migration of leachate. Around the perimeter of the landfill a high-permeability gravel drain is used to collect leachate from the waste mass. The gravel drain is continuously pumped and the removed leachate transported and processed at the on-site leachate treatment plant. The leachate collection and treatment system at the site was design and installed as approved by DEC under the Fresh Kills Consent Order. The system has been in operation for over 10 years and has continually operated within the parameters established as part of the approved design. During this time period the site has been in a state of intermediate closure (i.e., a soil cover is in place over the waste and cover slopes provide positive drainage), which is expected to have a higher percolation rate than following application of the engineered final cover system.

Considering that a significant reduction in percolation will occur with the approximately 50 percent of Landfill Section 6/7 will have an engineered final cover system in place during the 2011 build-out mass grading and waste relocation activities, it is concluded that the project construction activities, performed using appropriate landfill operating standards, would not increase the volume of leachate associated with this closure construction. Once the closure construction is completed, it would be as effective as the approved syste. Thus, the modified landfill cover would not have any impacts on groundwater us surface water during construction or during the operational period of the proposed road embankment.

This modified cover plan requires additional material for grading and contouring the landfill cover to provide the proposed road corridor embankment. This would include an estimated 77,000 cubic yards of materials for the Yukon Avenue Connection and 92,000 cubic yards for the Forest Hill Road connection. These additional materials would not have any natural resources impacts as they would be deposited and graded on the already disturbed landfill. The addition of this fill would require the continuation of sedimentation and erosion protection measures under a SPDES permit for the duration of the modified grading project; however, since these measures are in place and already permitted, and serve to minimize and avoid environmental impacts, continuation of these measures for the added construction period under the modified closure plan (given that an estimated 1,000,000 cubic yards of material is already required for constructing the final cover) would not be expected to result in any indirect impacts to local water quality, wetlands or habitats.

With respect to stormwater and water quality conditions, an assessment of the water and sediment quality for the proposed modified cover was conducted to determine the annual loading changes when compared to the "future without the proposed project" conditions discussed above.

The annual water quality and sediment loadings were calculated at the inflow to Richmond and Main Creeks, which includes the output from the existing storm water management basins at the Landfill. Annual loadings for the 1-year and 2-year, 24-hour design storms, equivalent to a 2.50 inches and 3.30 inches, respectively, were calculated. Table 10-18 presents runoff quality from the existing basins into the receiving waters presented for the 2011 project year. (The analysis does not include modifications made to existing storm water management basin BMPs since these modifications are not intended to be made until roadway construction occurs.)

Table 10-18
Modified Closure Condition (2011) Annual Water Quality Loading

Water Quality Impacts to Receiving Water	1-year, 24-hour design storm				2-year, 24-hour design storm			
	TSS (lb/yr)	TN (lb/yr)	TP (lb/yr)	TPb (lb/yr)	TSS (lb/yr)	TN (lb/yr)	TP (lb/yr)	TPb (lb/yr)
Richmond Creek	485.50	16.35	1.68	1.04	650.78	22.02	2.27	1.41
Main Creek	232.68	10.57	0.85	0.51	310.93	14.13	1.13	0.68

The water quality loading estimates for the 2011 final closure condition account for an increase in impervious area of 30 percent above the No Build condition (from 29 acres to 38 acres). This increase is due to widening of the landfill access roads along the Yukon and Forest Hill corridors from 30 feet width to 65 foot width and the application of the road embankment material. Comparison of the 2011 modified closure condition without modification of the stormwater basins for water quality function to the No Build condition reveals the following impacts to stormwater and sediment quality for the 2-year design storm:

- Richmond Creek: 31 to 56 percent increase in all water quality constituents; and
- Main Creek: 35 to 106 percent increase in water quality constituents.

The above projected increases in pollutant loading under the modified closure design are a worst case condition in that it assumes the installation of full width road embankment material (i.e., 60 feet wide) across Landfill Section 6/7. In fact, measures could be taken reduce the width of the embankment materials and to provide appropriate sedimentation and erosion control measures, including stabilizing the corridors with vegetation. Between this DSEIS and the FSEIS, DPR and DSNY will examine potential measures to reduce this level of interim pollutant loading which is primarily due to sedimentation and erosion. These measures will be presented in the FSEIS.

2016: THE FUTURE WITH THE PROPOSED PROJECT

As discussed in Chapter 1, "Project Description," the proposed park roads by 2016 would provide new east-west connections between Richmond Avenue and the West Shore Expressway, as well as access to park facilities. For the 2016 analysis year, the proposed vehicular park roads would include the Yukon Avenue Connections (see also Figure 1-8). With this connection, a park road would extending from the Yukon Avenue/Richmond Avenue intersection west into the park, across some buffer area and then across Landfill Section 6/7 connecting with the Confluence Loop Park Road near the main Creek Bridge. This segment of the proposed road covers a total distance of about 2,600 linear feet of which about 2/3 is on the landfill and 1/3 is east of the landfill. It is assumed to be two lanes wide (two-way circulation) with 11-foot-wide travel lanes, a shoulder width between 2 and 6 feet, and a flush textured median width of up to 4 feet. The road would widen at the intersection with Richmond Avenue to allow extra turning lanes. It is assumed for both road segments that the existing DSNY basins (B1 and B2) would be used for stormwater management.

Installation of the proposed Yukon Avenue Connection would place the finished public road on top of a pre-built embankment installed as part of the modified closure plan (see the discussion above). Installation of the road would not have any impacts on the following natural resources technical areas:

- Geology, Soils and Groundwater. While there would be some additional embankment and asphalt materials necessary for the proposed road this would not adversely impact of conflict with soil conditions or geology at the already engineered site. Relocation and modification of the leachate control and collections systems and modifications of the final cover will have already need addressed as part of the modified cover plan. Therefore, installing the proposed road would not impact this groundwater conditions. Is is estimated that upland grading for the proposed two-lane-road would require a cut of about 3,345 cubic yards and fill of about 2,040 cubic yards off Landfill Section 1/9. Given the length of the proposed roads and that much of the Yukon Connection is already an engineered landscape, this level of grading is not expected to result in any significant impacts on local geology or soils.
- Floodplains. There are no mapped flood hazard areas in the road alignment.
- Stormwater and water quality. Installation of the proposed project would not adversely impact local water quality (see the detailed discussion below).
- Wetlands. The 2-lane road design has no impact on wetlands/drainage basins in this area with side slopes and grading (see also Drawing No. R9-C-23.41 in Appendix B, road design schematics).
- Aquatic Resources. With the 2 lane road the side slopes could have a limited impact on the habitat of Basin B1 and B2; however these impacts are expected to be minor. The project could also be designed to allow open culvert connections between Basin B1 to the north and B2 to the south in order to provide both a hydrologic and wildlife connection between these basins (see also Chapter 23 "Impact Avoidance Measures and Mitigation").
- Terrestrial Resources. No significant terrestrial resources exist within the path of the proposed road. The corridor is mostly cleared and the final design could incorporate

measures that would minimize any impact related to habitat fragmentation (see also Drawing No. No. R9-C-23.41 in Appendix B, "Engineering Drawings").

- Threatened or Endangered Species. There are no threatened or endangered species that would be impacted by the roadway alignment.
- Significant Coastal Fish and Wildlife Habitat. The proposed project would have neither indirect nor direct impacts on the Fresh Kills Significant Coastal Fish and Wildlife Habitat.

With respect to stormwater and water quality impacts, to address the increases in water quality constituents entering Richmond and Main creeks, the existing storm water management basins can be retrofitted to treat water quality. The average pollutant removal efficiency, according to the NYS Design Manual, for wet basins (i.e., Basins A, B1, B2, C1 and C2) is 80 percent for total suspended solids, 10-50 percent for total nitrogen, 30-70 percent for total phosphorous, and 30-75 percent for total lead and metals. For dry basins (i.e., Basin R), the average pollutant removal efficiency for total suspended solids is 50 percent, total nitrogen, is 15-50, phosphorous is 10-30 percent and total lead and metals is 30-50 percent. Converting the existing storm water management basins to treat water quality would provide reduction prior to discharging to the receiving waters (i.e., Richmond and Main Creeks). Basins C1, C2 and R discharge to Richmond Creek, while Basins B1, B2 and A discharge to Main Creek.

During the build year 2016, the Yukon Avenue Connection (2016) condition, accounts for the construction of a four-lane road that connects Richmond Avenue (to the east) with the Confluence Loop Road in the center of the site. The Yukon Avenue Connection construction would discharge and impact Basins C1, C2, B1 and B2. Therefore, during 2016, these basins will be converted to water quality basins. Table 10-19 provides the annual water quality loading under the proposed project for the analyzed constituents.

Table 10-19
Yukon Avenue Connection (2016) Annual Water Quality Loading

Water Quality Impacts to Receiving Water	1-year, 24-hour design storm				2-year, 24-hour design storm			
	TSS (lb/yr)	TN (lb/yr)	TP (lb/yr)	TPb (lb/yr)	TSS (lb/yr)	TN (lb/yr)	TP (lb/yr)	TPb (lb/yr)
Richmond Creek	211.83	11.78	0.88	0.50	283.05	15.75	1.17	0.67
Main Creek	136.59	9.43	0.59	0.32	182.48	12.60	0.79	0.43

Note: This model run is for a 4-lane wide road. Therefore the results shown above are conservative for a 2-lane road which would have less road surface area.

Comparison of the Yukon Avenue Connection (2016) to the No-Build condition, discloses the following impacts to storm water and sediment quality for the 2-year design storm:

- Richmond Creek: 6 to 32 percent decrease in all water quality constituents; and
- Main Creek: 20 to 32 percent increase in all water quality constituents.

Stormwater and water quality management features would also be incorporated into the future design scenarios to mitigate potential water quality impacts to receiving waters. These features may include, but are not limited to, permanent vegetative stabilization, vegetated conveyances, storm water wetlands, storm water management ponds as well as water quality treatment systems as currently described in the New York State Stormwater Management Design Manual developed by the DEC and the Center for Watershed Protection (August 2003).

Storm water quality impacts related to road runoff and operations, soil erosion and sediment control practices, pollutant removal and runoff attenuation and can be managed with good construction practices.With minimal land disturbance and best management practices, pollutant removal and runoff attenuation can be maximized. The increased impervious area that would result from the proposed construction of roads is expected to increase both storm water quantity and constituents. However, by utilizing the existing storm water management infrastructure and implementing additional storm water management features, storm water quantity and quality can be improved during the proposed project.

2036: THE FUTURE WITH THE PROPOSED PROJECT

INTRODUCTION

The proposed East Park Roads that are the subject of this SEIS are all located within the East Park planning area of Fresh Kills Park. Under consideration for the 2036 analysis year are various options for completion of the East Park Road system. These options could could include two- or four-lane roads across East Park with new connections at Richmond Hill Road, Yukon Avenue, and Forest Hill Road, or a two-lane loop road around the base of the landfill with connections at Richmond Hill Road, Yukon Avenue, and Forest Hill Road. The analysis below presents the potential impacts of the proposed project under these options

EAST PARK ROADS—RICHMOND AND FOREST HILL ROAD CONNECTIONS (FOUR-LANE ROAD OPTION)

Description

As discussed in Chapter 1“Project Description,” under this option, the proposed 2036 park roads would provide new east-west connections between Richmond Avenue and the West Shore Expressway, as well as access to park facilities. These park roads are designed for four lanes, with two-way circulation with 11-foot-wide travel lanes, a shoulder width between 2 and 6 feet, and a flush textured median width of up to 4 feet. For the 2036 analysis year, the proposed vehicular park roads would include the following segments (see also Figure 1-9):

- A park road extending from the Forest Hill Road/Richmond Avenue intersection into the park, across a viaduct and culvert park road that would span the southern portion of the wetlands complex east of Landfill Section 6/7 and then continue west over Landfill Section 6/7 to connect with the Confluence Loop Park Road. This segment of the proposed road extends a total distance of about 4,420 linear feet.
- Completion of the Richmond Hill Road Connection—This park road would connect the Yukon Avenue crossing to the exiting Richmond Avenue/Richmond Hill Road intersection to the north. This portion of the road is anticipated to consist of a combination of viaducts or embankments and culverts where it crosses the northern wetlands and basins of East Park. This segment of the proposed road covering a total distance of about 4,990 linear feet

It is assumed for the Richmond Hill Road Connection and for the Forest Hill Road Connection west of the wetland area adjacent to Richmond Avenue that existing DSNY basins would be utilized for stormwater management. For the portion of Forest Hill Road Connection between Richmond Avenue and the Landfill service road, this viaduct structure (or embankment with culverts) would be provided with curbs at the back of shoulders, which would direct stormwater runoff to a closed drainage system just west of Richmond Avenue. This system would outlet to the wetland area just north of the intersection, where BMP treatment would be provided prior to discharging into the wetlands.

For the Richmond Hill Road Connection, the existing sediment basins (A, B1, and B2), which will receive runoff from the Richmond Hill Road alignment, would be modified to perform a water quality improvement function in the same manner as described for the 2016 modifications. The proposed roadway bisects Basin B2 and the retention basin, and it is anticipated that culverts or archways with natural bottoms will be provided for connectivity of the basins. Though the capacity of the basins are reduced by the roadway embankments, there is adequate capacity remaining in the basins to maintain their functionality as originally designed. The proposed roadway will also require the installation of a culvert along the emergency overflow ditch from the spillway at Basin A. This culvert would outlet to the retention basin north of Basin B1. This would result in Basins A, B1, and B2 operating as they currently do.

The following sections discuss the potential natural resources impacts resulting from the construction and operation of these park road elements. The cumulative impacts associated with the proposed East Park roads were described above.

Geology, Soils, and Groundwater

Completion of the East Park park roads would not result in significant adverse impacts to geology, soils or groundwater. As discussed above, for the proposed construction in areas of landfill infrastructure, a plan would be implemented to ensure that the construction of the 2036 roadway elements is consistent with the modified landfill closure design objectives such that the existing environmental control systems at Fresh Kills (i.e., landfill gas and leachate collection systems) remain functioning during and after road construction in order to minimize the potential for adverse impacts to the environment (see also Chapter 23). To the extent that any of these systems need to be modified for the proposed park roads, those modifications would only be made in accordance with DEC -accepted designs such that they maintain the objectives of the environmental control systems at Fresh Kills.

It is estimated that grading for the proposed Forest Hill Road Connnection would require a cut of about 1,195 cubic yards and filling of about 33,365 cubic yards to create the proposed roads. For the Richmond Hill Road Connection (with the Yukon Connection in place), it is estimated that grading would require a cut of about 21,265 cubic yards and fill of about 87,405 cubic yards to create the proposed roads (see also the wetlands analysis below). Both calculations are for off Landfill Section 6/7. See also Tables 20-8a and 20-8b in Chapter 20, “Construction.”

Stormwater and Water Quality

The proposed Richmond Hill and Forest Hill Connections would discharge stormwater into Basins R, A, B1, and B2. These basins are assumed to be converted to water quality basins with the proposed project. In addition, best management practices (BMP) and a closed drainage system located just west of Richmond Avenue would be installed to handle stormwater in the Forest Hill Road Connection. That BMP would outlet to the existing wetlands after BMP treatment. Based on this assumption, Table 10-20 presents annual water quality loading for total suspended solids, total nitrogen, and total lead and metals to Richmond and Main Creeks with the proposed park road connections in place.

Table 10-20
Richmond Hill and Forest Hill Road Connections (2036) Annual Water Quality Loading

Water Quality Impacts to Receiving Water	1-year, 24-hour design storm				2-year, 24-hour design storm			
	TSS (lb/yr)	TN (lb/yr)	TP (lb/yr)	TPb (lb/yr)	TSS (lb/yr)	TN (lb/yr)	TP (lb/yr)	TPb (lb/yr)
Richmond Creek	176.34	6.16	0.62	0.38	201.00	7.23	0.71	0.44
Main Creek	137.91	5.60	0.49	0.30	179.88	7.39	0.65	0.35

As shown in the table, a comparison of the 2036 Connection condition to the No Build condition identifies the following impacts to storm water and sediment quality for the 2-year design storm:

- Direct to Richmond Creek: 52 to 57 percent decrease in all water quality constituents; and
- Direct to Main Creek: 30 percent decrease in total nitrogen and a 7 to 19 percent increase in the other water quality constituents.

The conversion of the storm water management basins to water quality basins provides and vegetated water quality treatment swales along the road provide enough treatment to efficiently reduce the water and sediment quality impacts to Richmond Creek by 52 to 57 percent. Due to the large portion of runoff along the proposed Richmond Hill Road connection, an increase in the water and sediment quality constituents from 7 to 19 percent for total suspended solids, total phosphorous, and total lead and metals is expected.

Stormwater and water quality management features would also be incorporated into the future design scenarios to mitigate potential water quality impacts to receiving waters. These features may include, but are not limited to, permanent vegetative stabilization, vegetated conveyances, storm water wetlands, storm water management ponds as well as water quality treatment systems as currently described in the New York State Stormwater Management Design Manual developed by DEC and the Center for Watershed Protection (August 2003).

Storm water quality impacts related to road runoff and operations, soil erosion and sediment control practices, pollutant removal and runoff attenuation and can be managed with good construction practices. With minimal land disturbance and best management practices, pollutant removal and runoff attenuation can be maximized. The increased impervious area that would l result from the proposed construction of roads is expected to increase both storm water quantity and constituents. However, by utilizing the existing storm water management infrastructure and implementing additional storm water management features, storm water quantity and quality can be improved during the proposed project.

Floodplains

Development of the park roads would generally be outside the 100-year floodplain with limited exceptions. Development of road segments that would require activities in the floodplain would include vegetation clearing, placement of fill for construction of road bed and surface. This would include the viaduct supports for the Forest Hill Road Connection, and construction of stormwater outlets associated with the management of stormwater runoff from the road surfaces (e.g., the BMP west of Richmond Avenue). Stormwater runoff generated from the additional impervious surface developed on top of the new fill for these final portions of the park road system would be directed to the stormwater management system that would treat the runoff and attenuate the rate of discharge using best management practices and low impact designs. Neither the increased fill nor the increased runoff from the road would affect local flooding conditions. As discussed above, the floodplains of the project site are primarily influenced by coastal flooding. Increased stormwater flow and the limited amount of fill and structure to construct the proposed roadways would therefore not impact the mapped floodplain at the project site or in the adjacent areas.

Wetlands

Forest Hill Road Connection

As presented above under the general discussion of potential impacts from upland construction and wetland enhancement activities, implementation of erosion and sediment control measures included in the SDPES permit to be prepared for development of each segment of the proposed park roads, would minimize the potential for significant adverse impacts to wetlands from roadway construction. Additionally, implementation of best management practices and low impact design stormwater management measures along with road management practices to minimize the introduction of roadway pollutants into stormwater runoff, would minimize the potential for significant adverse impacts from the discharge of stormwater. It is expected that the existing wetlands would be an integral component of the stormwater management practices that would be implemented throughout the park.

The Forest Hill Road extension crosses over a wetland system east of Landfill Section 6/7. In the southeastern edge of the site where the Forest Hill Road connection is proposed, impacts could occur at the interface between the tidal wetland and the palustrine-forested and palustrine emergent wetland area. These areas are connected by two small streams running parallel to one another. The palustrine forested and emergent wetland habitats would be impacted by the proposed road, due to filling and changes to the hydrology inputs and outputs. The extent and type of wetland impacts would depend on the specific load alignment and design. It is anticipated that the crossing of this wetland would be accomplished with a viaduct structure, culverts, or an archway with a natural bottom. As currently contemplated, a viaduct structure would be approximately 260 feet long and about 60 feet wide, and would span a portion of the existing wetlands. Due to the need to meet existing grades at both Richmond Avenue and the slightly reconfigured Landfill haul road, there is limited clearance between the bottom of the proposed viaduct structure and the wetlands. Clearance requirements for maintenance result in the reduced viaduct length due to conflicts with existing wetland grades. The bottom of the viaduct would be elevated above the freshwater wetlands by approximately 4 feet.

Construction of the viaduct has the potential to result in impacts to wetlands within the construction corridor due to construction activities and installation of structures. It is estimated that about 1.3 acres of wetlands would be impacted. Construction techniques to minimize damage to wetlands would be implemented as part of the construction management plan and in coordination with the DEC and the USACE. However, construction of the viaduct would be expected to ultimately result in permanent loss of wetlands within the footprint of the road structures, although the hydrology of the wetland system would be maintained through the viaduct design.

Although the culvert/viaduct has been designed to avoid the placement of fill within the freshwater wetlands (with the exception of the supports) the viaduct would result in direct and indirect impacts (e.g. structures and shading) of approximately 51,320 square feet (1.3 acres) of wetlands beneath the structure. It would also require some filling for grading and support structures (about 33,365 cubic yards). While the height of the viaduct above the wetlands would allow sufficient light to reach under the structure from either side, it is likely that the amount of light would be insufficient to support significant plant growth, resulting in adverse impacts to the wetland plant community under the viaduct that would need to be mitigated. However, spanning the wetland with the viaduct maintains the hydrologic characteristics of the wetland system, and minimizes adverse impacts to wildlife by allowing the continued free movement of wildlife through the wetland. Operational measures would also be instituted to control the application of road chemicals on the viaduct to minimize potential adverse impacts to wetland vegetation (see Chapter 23).

It is expected that development of the proposed park roads would result in adverse direct and indirect impacts to both freshwater and tidal wetlands due to filling and shading. As described in the following sections, and presented in Table 10-17, the proposed Forest Hill Road connection would impact about 1.3 acres of wetlands. Significant adverse impacts to wetlands resources would be mitigated through a comprehensive project mitigation plan (e.g., wetlands creation, enhancement) which is described in greater detail in Chapter 23, "Impact Avoidance Measures and Mitigation."

As presented above, implementation of erosion and sediment control measures included in a project SPDES permit would minimize the potential for significant adverse impacts to wetlands from road construction. Additionally, implementation of post-construction stormwater management measures including best management practices and low impact designs as well as road management practices that minimize the introduction of roadway pollutants into local waterways would minimize the potential for significant adverse impacts from the discharge of stormwater (see also Chapter 23).

Richmond Hill Road Connection

Development of the proposed park road connection to Richmond Avenue at Richmond Hill Road would result in adverse impacts to both freshwater wetlands and DSNY basins due to filling and shading. The park road extension to Richmond Hill Road is expected to directly impacts by filling approximately 4.25 acres of freshwater wetlands within the wetland/stormwater basin complex on the east side of Landfill Section 6/7. This would include cutting of approximately 21,265 cubic yards of material and filling with approximately 87,405 cubic yards of which 29,720 cubic yards of fill material would be placed in wetlands/basins (see also Tables 20-8a and 20-8b in Chapter 20, "Construction").

It is assumed that indirect impacts with this filling could be minimized through the use of culverts that would be installed to maintain hydraulic connections and minimize adverse impacts to the wetlands in this area. However, the expected wetland impacts would be a significant adverse impact to wetlands resources that would need to be mitigated (see Chapter 23 "Impact Avoidance Measures and Mitigation").

In the northeast section of the site where the Richmond Hill Road connection is proposed, impacts could occur at the interface between the tidal wetland and the small forested wetland area. This tidal area is connected to the forested area via a stream. The hydrological connection between the nearby tidal wetlands and the forested wetland could be impacted by the proposed road segment. The degree of impacts would be dependent on the type of road design and footprint.

Aquatic Resources

Forest Hill Road Connection

As presented above under the general discussion of potential impacts from upland construction and wetland enhancement activities, implementation of erosion and sediment control measures of the SPDES permit as well as other measures to minimize sediment suspension during in-water construction activities (installation of sheet pile, culverts, outfalls, etc.) would minimize the potential for significant adverse impacts to water quality and aquatic resources during road construction. The implementation of post-construction stormwater management measures included in the projects stormwater management plan, and the proposed road stormwater runoff management practices would minimize the potential for significant adverse impacts associated with the increased pervious surface from the proposed roads and the discharge of stormwater during road operation.

Spanning the freshwater wetlands within the alignment of the Forest Hill Road connection using a culvert/viaduct minimizes potential adverse impacts to surface water resources and aquatic biota. Although the viaduct would result in adverse impacts to the streams within the wetland due to shading and support strucutres, the hydrologic connection between the areas above and below the viaduct would be maintained and disturbance of any drainage channels would therefore be minimized. Also, design measures would be installed to minimize impacts to habiats in this area (see also Chapter 23). Operational measures would also be instituted to control the application of road chemicals on the park road, thereby minimizing potential adverse impacts to local water quality.

Lastly, the in-water elements of the road construction would be subject to the permitting requirements of DEC and USACE with respect to protection of waters and wetlands. Any additional protection measures resulting from that permit review process would be incorporated into the road design and construction implementation.

Richmond Hill Road Connection

As stated above, implementation of erosion and sediment control measures to be included in a SPDES permit to be prepared for construction of the proposed park roads, along with other measures to minimize sediment suspension during in-water construction activities (installation of sheet pile, culverts, outfalls, etc.). Implementation of post-construction stormwater management measures such as best management practices and low impact designs prepared for the park roads, along with road management practices to minimize the introduction of pollutants into stormwater runoff, would also minimize the potential for significant adverse impacts associated with the increased pervious surface from the roadways and the associated discharge of stormwater during operation of the roadways.

Incorporating culverts/viaducts within the Richmond Hill Road Connection design would maintain the hydrologic connections in this area and water levels within the stormwater basin/wetland complex. Operational measures would also be instituted to control the application of road chemicals on the viaduct in order to minimize potential adverse impacts to water quality and freshwater wetlands (see Chapter 23).

Lastly, the in-water projects would be subject to the permitting requirements of DEC and USACE with respect to protection of wetlands and waters. Any additional protection measures resulting from that permit review process would be incorporated into the individual capital projects.

Terrestrial Resources

Construction

Construction of the proposed park roads has the potential to result in direct natural resources impacts (i.e., physical removal of plant community or grading of soil within the roadway alignments, loss of individual wildlife due to collision with or as a result of operation of construction equipment) and indirect impacts (avoidance of habitat due to noise, vehicle traffic, or other human disturbance) to wildlife. The Forest Hill Extension to Richmond Avenue would clear a linear wooded berm along Richmond Avenue that contains planted white pine, Douglas fir, and Norway spruce. This is a landscaped area that was created to screen the landfill and no natural resources impacts would occur with this clearing. As described above, further west, the Forest Hill Extension viaduct would span an area of mixed upland and freshwater wetlands of native and non-native scrub-shrub and *Phragmites*. The proposed road would extend through woodlands along the berm and the associated wooded area, resulting in removal of few large trees (i.e., greater than 12 inches diameter at breast height). It is concluded that the limited loss of habitat associated with this road construction would not result in significant adverse impacts to terrestrial wildlife resources.

While certain wildlife individuals may avoid habitats in the vicinity of the roads due to noise, vehicle traffic or increased human activity, the phased approach to development of the park would be expected allow wildlife to seek suitable available habitat impacted by decreases in habitat quality near roadway construction.

Construction of the park road connection to Richmond Hill Road also has the potential to result in direct impacts to habitats (i.e., physical removal of plant community or grading of soil within the roadway alignments, loss of individual wildlife due to collision with or as a result of operation of construction equipment) and indirect impacts (avoidance of habitat due to noise, vehicle traffic, or other human disturbance) to wildlife. The proposed project has minimized direct losses of habitat due to the proposed roads by using the existing landfill road network to the extent possible (e.g., the Confluence Loop Park Road), thereby limiting habitat loss. However, construction of this segment of 2036 roadway would require the removal of conifers and deciduous trees along the Richmond Avenue berm, and along a southerly segment west of the berm before heading west through a wooded area at the south end of Basin B1. The conceptual roadway design would require the removal of large trees along this route. While there would be impacts to trees, as described above, the proposed project would create extensive areas of woodlands and overall, even with the clearing for this segment of roads, there would be a significant net increase in woodland area at the project site with the proposed project. Thus, the limited loss of habitat associated with the road construction would not result in significant adverse impacts to woodland habitat or the associated wildlife in the context of the entire project.

Operation

Forest Hill Road Connection

A detailed discussion of operational impacts to wildlife associated with the proposed road was presented above. Potential impacts to wildlife include degradation of habitat quality due to noise, or nighttime lighting, habitat fragmentation, direct losses due to collisions with vehicles, and decreased access to vital habitat. Operation of the proposed park roads has the potential to result in long-term adverse impacts to terrestrial biota where the road cuts through proposed landscape enhancement areas (e.g., within East Park), or areas where existing plant communities would be retained. Park roads with the greatest potential to result in adverse impacts to wildlife resources would include the Forest Hill Road Connection where it separates the proposed woodland habitats proposed at the southern portion of East Park as well as the existing wetlands, thus mitigation and impact avoidance measure are appropriate for this road segment (see Chapter 23).

As described above, the reduced suitability of habitat associated with operation of the park roads has the potential to reduce wildlife utilization of the habitats within the park, potentially reducing existing wildlife use of the tidal creek and wetland areas, impeding daily activity patterns that require passage from upland to waterfront areas, and possibly impeding access to habitats needed for breeding. However, reductions in habitat quality adjacent to the roads could be minimized by incorporating vegetation screening into the roadside landscaping to reduce noise levels Additional measures to reduce habitat fragmentation associated with the proposed roads are provided in Chapter 23, “Impact Avoidance and Mitigation Measures.” In addition, roadside lighting would permanently change the existing nighttime habitat within the central portion of Fresh Kills Park. This change in nighttime conditions has the potential to result in adverse impacts wildlife individuals that use Main and Richmond creeks near these roads, for whom elevated nighttime light levels would make these areas unsuitable. Changes in habitat suitability due to increased nighttime lighting may not be negative for all species. Wading birds, for instance, have been observed feeding throughout nighttime hours along existing bridges at Main and Richmond creeks, including species that are considered primarily active during daylight hours (i.e., snowy egret, little blue heron, great egret). This suggests that wading birds, to a certain extent, may have habituated to increased light around existing bridge structures during the peak of reproductive demands (May-June). This increased nighttime foraging may have population or community level effects on estuarine fish, invertebrates, and other preferred prey species for wading birds. However, documentation of similar effects at other locations is limited. The habituation of urban nesting birds to many aspects of urban life (i.e., noise, light pollution) may indicate ecosystem-level effects of "non-natural" conditions in human dominated landscapes, although any ultimately negative effects of habituation are not readily apparent.

In order to minimize the potential for adverse impacts associated with nighttime lighting, design measures would be implemented for the park roads to minimize light pollution to the greatest extent possible while meeting safe operating conditions for the park roads (see Chapter 23).

Richmond Hill Road Connection

Operation of this segment of roadway through the enhanced habitats of Landfill Section 6/7 has the potential to result in conflicts with wildlife due to noise, air quality, or nighttime lighting, fragmentation of the enhanced habitats on either side of the road, and direct losses due to collisions with vehicles. This reduced suitability could reduce wildlife utilization of the habitats within this portion of the park. However, reductions in intended habitat quality adjacent to the road would be minimized by incorporating vegetation screening into the roadside landscaping and other practices that would reduce noise levels or road lighting to reduce light pollution (see Chapter 23).

Adverse impacts to wildlife associated with the Forest Hill Road connection have been minimized by spanning existing wetlands with a viaduct. The proposed viaduct would allow unimpaired movement of wildlife under the roadway, providing a safe route below the road and between the wetland and upland areas to the north and the wetland and those to the south. Lighting of the viaduct would be the minimum necessary to maintain safe road operations. Adverse impacts to wildlife associated with the Forest Hill Road Connection due to impedance of wildlife movement, and losses of wildlife due to collisions with vehicles, would be minimized by incorporating measures into the road design to facilitate safe passage from one side of the roadway to the other. Examples of the measures include:

- Wildlife tunnels within segments of the roads identified as having the potential for wildlife crossing;
- Vehicle signage warning of wildlife crossing area, providing unimpeded view of oncoming traffic; and
- Monitoring of wildlife vehicle collisions to identity areas where losses may require additional measures (see also Chapter 23, "Impact Avoidance and Mitigation Measures.".

Threatened or Endangered Species

Construction and operation of the proposed park roads would not be expected to result in significant adverse impacts to colonial waterbird nesting activity on Isle of Meadows. Barn owls have nested on bridges in the vicinity of Richmond Creek in recent years, and the proposed East Park Roads are distant enough from this site such that no impacts would be expected.

Significant Coastal Fish and Wildlife Habitat

Because the proposed construction and operation of the park roads requires minimal in-water activities and would not be expected to adversely affect water quality of Richmond, Main, or Fresh Kills, the proposed roads are not expected to conflict with the designation of Fresh Kills as a Significant Coastal Fish and Wildlife Habitat. With the proposed project, the principal objectives of the designation including protection of the tidal creek systems and their functions for spawning and nursery habitat for anadromous, estuarine, and resident fish, and would continue as would use by wading birds, waterfowl, shorebirds, raptors and passerines.

EAST PARK ROAD SYSTEM FOREST HILL ROAD AND RICHMOND HILL ROAD CONNECTIONS (TWO-LANE-WIDE ROAD OPTION)

As described in Chapter 1 “Project Description,” the footprint of the Two-Lane Park Road option is such that a two-lane park road could be designed within the width of the four-lane-road corridor with more room for alignment flexibility As described above, the majority of the area east of Landfill Section 6/7 contains wetlands and stormwater managment features for the landfill. In order for the proposed roads to connect to Richmond Avenue, it is necessary to cross these wetlands.

The Two-Lane Park Road option for the Richmond Hill Road Connection impacts approximately 2.15 acres of wetlands as compared with 4.3 acres under the four-lane-wide road option described above. Both options are assumed to be defined by retaining walls in the Richmond Hill Road connection in order to minimize impacts on the stormwater basins and wetlands for this segment of the proposed road.

Both the four-lane option and the two-lane option would also impact wetlands in the Forest Hill Road segment of the the proposed connection. Under this option for the Forest Hill Road segment, the wetland impacts for the Two-Lane Park Road total approximately 1.2 acres. This two-lane option would therefore only marginally reduce the wetland impacts as compared with the four-lane proposal (which impacts about 1.3 acres). The impact calculations correspond to the maximum amount of potential permanent footprint impacts associated with the full width of the Forest Hill Road connection across this wetland. In the four-lane proposal and this option, the viaduct roadway design option would have the opportunity to reduce the extent of actual wetland resource impacts in several ways. For example, the open areas under the viaduct and the hydrologic connectivity provided for the wetlands both north and south of the alignment are advantages of the viaduct option. The affected area is dominated by common reed (*Phragmites communis*), which would be replaced by native freshwater marsh plant communities. Under both the four-lane proposal and this option, new stormwater management controls are necessary in road segment.

With respect to grading, this Two-Lane Road option would have a cut volume of about 16,320 cubic yard and a fill volume of about 70, 550 cubic yards along the Richmond Hill Road Connection. Along the Forest Hill Road Connection, this Two-Lane Road option would have a cut volume of about 970 cubic yards and a fill volume of about 25, 175 cubic yards. It would require about 23,150 cubic yards of fill material along the wetlands of the Richmond Hill Road connection and 17, 360 cubic yards of fill material along the wetlands of the Forest Hill Road Connection (see also Tables 20-8a and 20-8b in Chapter 20, “Construction”).

In both the four-lane option and this two-lane option, as the road traverses the retention area between Basins A and B1, it severs the southern portion of the storage area, requiring a culvert or archway beneath the embankment to retain its hydraulic function. Similarly, culverts or archways are proposed to maintain the hydraulic connection at the north end of Basin B1.

YUKON AVENUE CONNECTION (FOUR-LANE ROAD)

Under this option, a park road would extend from the Yukon Avenue/Richmond Avenue intersection west into the park, across some buffer area and then across Landfill Section 6/7 connecting with the Confluence Loop Park Road near the main Creek Bridge. This segment of the proposed road covers a total distance of about 2,600 linear feet of which about 2/3 is on the landfill and 1/3 is east of the landfill. It is assumed for both road segments that the existing DSNY basins would be used for stormwater management. It is also assumed under this option that the proposed Yukon Avenue Connection is a four-lane-wide road.

Installation of the Yukon Avenue Connection would place the finished public road on top of a pre-built embankment installed as part of the modified closure plan (see the discussion above). As with the two-lane wide discussed above, installation of the four-lane-wide road would not have any impacts on the following natural resources technical areas:

- Geology, Soils and Groundwater. While there would be some additional embankment and asphalt materials necessary for the proposed road, this would not adversely impact of conflict with soil conditions or geology at the already engineered site. Relocation and modification of the leachate control and collections systems and modifications of the final cover will have already need addressed as part of the modified cover plan. Therefore, installing the proposed road would not impact this groundwater conditions. It is estimated that upland grading for the proposed four-lane-road would require a cut of about 15,125 cubic yards and filling of about 35,180 cubic yards. Given the length of the proposed roads and that much of the Yukon Connection is already an engineered landscape, this level of grading is not expected to result in any significant impacts on local geology or soils.
- Floodplains. There are no mapped flood hazard areas in the road alignment.
- Stormwater and water quality. Installation of the proposed project would not adversely impact local water quality (see the detailed discussion below).
- Wetlands. Unlike the two lane road option, the four-lane road design would require some limted filling in the portions of Basins B1 and B4. It is estimated that the proposed road would require about 10 cubic yards of fill in Basin B1 and 5 cubic yards of filling in Basin B2. It is estimated that the affected area with grading and slope restoration is about 250 square feet. Therefore, this option has a limited impact on wetlands/drainage basins (see also Drawing No. R9-C-23.41 in Appendix B). Mitigation for this potential impact is presented in Chapter 23, "Impact Avoidance Measures and Mitigation."
- Aquatic Resources. With the two-lane road the side slopes could have a limited impact on the habitat of Basin B1 and B2; however these impacts are expected to be minor. The project could also be designed to allow open culvert connections between Basin B1 to the north and B2 to the south in order to provide both a hydrologic and wildlife connection between these basins (see also Chapter 23 "Impact Avoidance Measures and Mitigation").
- Terrestrial Resources. No significant terrestrial resources exist within the path of the proposed road. The corridor is mostly cleared and the final design could incorporate measures that would minimize any impact related to habitat fragmentation (see also Drawing No. R9-C-23.41 in Appendix B).

- Threatened or Endangered Species. There are no threatened or endangered species that would be impacted by the roadway alignment.
- Significant Coastal Fish and Wildlife Habitat. The proposed project would have neither indirect nor direct impacts on the Fresh Kills Significant Coastal Fish and Wildlife Habitat.

Stormwater impacts under this option are expected to be similar to the two-lane 2016 Yukon Connection described above. With respect to stormwater and water quality impacts, to address the increases in water quality constituents entering Richmond and Main Creeks, the existing stormwater management basins can be retrofitted to treat water quality. The average pollutant removal efficiency, according to the New York State Design Manual, for wet basins (i.e., Basins A, B1, B2, C1, and C2) is 80 percent for total suspended solids, 10-50 for total nitrogen, 30-70 for total phosphorous, and 30-75 for total lead and metals. For dry basins (i.e., Basin R), the average pollutant removal efficiency for total suspended solids is 50 percent, total nitrogen is 15-50, phosphorous is 10-30, and total lead and metals is 30-50. Converting the existing stormwater management basins to treat water quality would provide reduction prior to discharging to the receiving waters (i.e., Richmond and Main Creeks). Basins C1, C2, and R discharge to Richmond Creek, while Basins B1, B2, and A discharge to Main Creek.

The Yukon Avenue Connection 2036 condition, accounts for the construction of a four-lane road that connects Richmond Avenue (to the east) with the Confluence Loop Road in the center of the site. The Yukon Avenue Connection construction would discharge and impact Basins C1, C2, B1, and B2. Therefore, it is expected that there basins would be converted to water quality basins under the proposed project. Table 10-21 provides the annual water quality loading under the proposed project for the analyzed constituents.

Table 10-21
Yukon Avenue Connection (2036) Annual Water Quality Loading

Water Quality Impacts to Receiving Water	1-year, 24-hour design storm				2-year, 24-hour design storm			
	TSS (lb/yr)	TN (lb/yr)	TP (lb/yr)	TPb (lb/yr)	TSS (lb/yr)	TN (lb/yr)	TP (lb/yr)	TPb (lb/yr)
Richmond Creek	211.83	11.78	0.88	0.50	283.05	15.75	1.17	0.67
Main Creek	136.59	9.43	0.59	0.32	182.48	12.60	0.79	0.43

Note: This model run is for a 4-lane wide road.

Comparison of the Yukon Avenue Connection (2016) with the No Build condition, discloses the following impacts to stormwater and sediment quality for the 2-year design storm:

- Richmond Creek: 6 to 32 percent decrease in all water quality constituents; and
- Main Creek: 20 to 32 percent increase in all water quality constituents.

Stormwater and water quality management features would also be incorporated into the future design scenarios to mitigate potential water quality impacts to receiving waters. These features may include, but are not limited to, permanent vegetative stabilization, vegetated conveyances, storm water wetlands, storm water management ponds as well as water quality treatment systems as currently described in the New York State Stormwater Management Design Manual developed by DEC and the Center for Watershed Protection (August 2003).

Stormwater quality impacts related to road runoff and operations, soil erosion and sediment control practices, pollutant removal and runoff attenuation and can be managed with good construction practices.With minimal land disturbance and best management practices, pollutant removal and runoff attenuation can be maximized. The increased impervious area that would result from the proposed construction of roads is expected to increase both storm water quantity and constituents. However, by utilizing the existing storm water management infrastructure and implementing additional storm water management features, storm water quantity and quality can be improved during the proposed project.

EAST PARK LOOP ROAD WITH RICHMOND AVENUE CONNECTIONS

Under this option, the Forest Hill Road, Richmond Hill Road, and Yukon Avenue Connections as well the the Loop Road segments would traverse wetlands or wetland adjacent areas. However, there would be a Loop Road around Landfill Section 6/7 and one way connectors at Richmond Hill and Forest Hill Roads.

This option would impact freshwater wetlands at multiple locations, specifically at the three connections between the park roads and Richmond Avenue and along the westernmost perimeter road. These impacts include:

- Filling impacts to the wetlands in multiple locations;
- Addition of impervious surface within the wetland areas at the Richmond Hill Road and Forest Hill Road crossings; and
- Shading impacts from structures developed over wetlands.

It is estimated that a total of about 1.92 acres of wetlands would be impacted under this option. Thus, it results in less wetland impact as compared toother options above. However, it is noted that the wetlands impacted under this option could be considered higher-value resources than those disturbed by the above alignments. Impacts to East Park wetlands in the above options are limited to wetlands east of Landfill Section 6/7 including the stormwater management basins, whereas this option primarily disturbs more naturally occurring wetlands and adjacent areas such as those along Main Creek that would be affected by the Loop Road segment and the northerly connections to Richmond Hill Road to Richmond Avenue. This option could result in more disturbance of natural wetlands with the Richmond Hill Road Connection (northeast segment in the triangle around location 104+00) and the Forest Hill Road Connection (in the easterly segmen), since the roads design calls for split road segments at these locations nearest the wetlands (see Drawings R6-C-23.31 and R6-C-23.33 in Appendix B). These impacts could include filling impacts to wetlands at multiple locations and the addition of impervious surfaces and runoff with expanded habitat fragmentation issues.

Floodplains

This option may increase the amount of roadway within the 100-year floodplain compared with the proposed project. However, neither has a significant adverse impact on the floodplain.

Roadway Pollutants

Stormwater runoff carries pollutants such as oil, grease, or de-icing salts that can contaminate downstream water bodies. The roadway option described in the FGEIS included provisions for collecting stormwater through a system of structures and detention basins. This process would serve to remove a portion of pollutants carried in stormwater runoff. This project option proposes to only convey stormwater from the perimeter roads into the nearest water body, or DSNY drainage basin, thereby eliminating the opportunity for pre-treatment and reducing overall stormwater quality as compared to the proposed project.

Hydrology

Road pavement increases the imperviousness of a site, thereby increasing the quantity of runoff. Table 10-22 summarizes the total impervious area due to roadways in the final condition under this option (the impervious area was estimated using lane-miles). For the purposes of developing this table, the 20-foot existing perimeter DSNY haul road was assumed to consist of 1.5 lanes.

Table 10-22
East Park Loop Road Option

Area of New Road (acres)	24.9
Less Existing Road Removed/Resurfaced	9.2
Total Area of New Impervious Surface	**15.7**

Source: Fresh Kills Landfill Staten Island Borough President's Office Evaluation of Roadway Alternative in East Park (Draft Report), prepared by URS for the New York City Department of Design and Construction, February 2, 2009.

Since large segments of the proposed park roads under this option would be constructed in the same location as existing DSNY haul roads, the changes in road surface represent only a small increase in total impervious area (and by extension stormwater runoff quantities).

With this option, there are changes in hydrology due to road runoff and changes in the DSNY stormwater management basins; however, unlike the options described above, this option would direct runoff to both Richmond Creek and Main Creek wetlands, as well as to DSNY stormwater basins and the wetland area along th Forest Hill Connection. The proposed interior Loop Road alignment is located along the entire base of the landfill. Thus, stormwater management under this option would have to be designed to avoid, minimize, and mitigate any impacts to tidal wetlands along Main and Richmond Creeks. However, unlike the proposed project, there is less wetland filling and associated hydrology impacts on Basins A and B1 as occurs on the Richmond Hill Road Connection.

Habitats

Under this option, like the options above, the park road could impair the functionality of habitats east of Landfill Section 6/7. For example, amphibians and reptiles are particularly susceptible to these impacts when roads are constructed near aquatic habitat, as these animals can be cut off from water bodies or upland areas that are used for breeding or foraging. Noise and air pollution, increased human activity, invasive species and potential vehicle collisions can have degrading effects on habitat located near roadways. This would include impacts due to the Yukon Avenue and Forest Hill Road Connections. L:ike the four-lane and two-lane road connections, these impacts would need to be avoided and minimized (see Chapter 23, Impact Avoidance Measures and Mitigation").

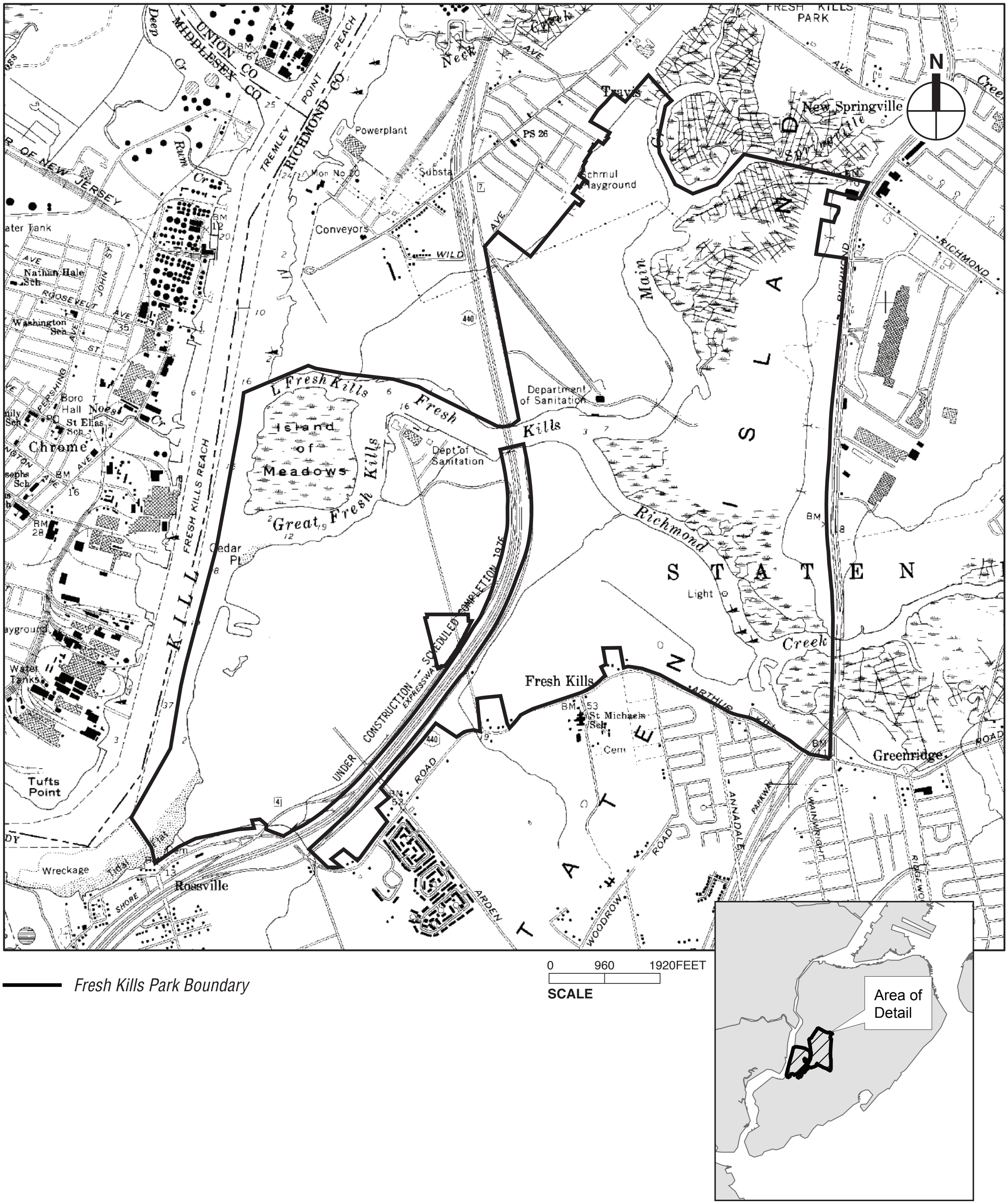
Much of the park road segments proposed in this option would be constructed in the same location as the existing DSNY Landfill Section 6/7 landfill haul roads. While the proposed park roads under this option would be wider than the existing haul roads, disturbances would mostly be limited to previously disturbed areas. However, the location of these roads near major wetlands on the north, west, and south edges of East Park, as well as the increased traffic that would be carried along these corridors, could lead to habitat fragmentation impacts if habitats are located upland of the roadway. Additionally, placement of traffic closer to water bodies and wetlands by this option, as compared with the proposed project, is likely to have a greater degradation impact to aquatic habitat at the perimeter of the site.

CONCLUSIONS

Certain elements of the proposed roads have the potential to result in significant adverse impacts to natural resources. For example, construction and operation of the proposed park roads to provide a new east-west connection between Richmond Avenue and the West Shore Expressway as well as to provide visitor access to major park facilities would result in significant adverse impacts to wetlands and aquatic resources due to filling, grading and shading, which requires wetland mitigation (i.e., creation, enhancement). The proposed wetland mitigation and enhancement project, presented in Chapter 23 “Impact Avoidance Measures and Mitigation.” Given the large amount of land available at Fresh Kills for wetland mitigation, these wetland impacts could be mitigated on an area basis by a ratio of more than 20 to 1 for tidal and freshwater wetlands. Operation of the proposed park roads also has the potential to result in indirect impacts to wildlife due to aspects of road operation such as noise and light pollution, as well as impairment of life-cycle requirements, habitat fragmentation and wildlife avoidance response, and the loss of wildlife individuals due to wildlife/vehicle collisions. Measures would be integrated into the design and operation of the park roads to minimize the potential for adverse impacts to aquatic and terrestrial biota (e.g., monitoring of wildlife/vehicle collisions, providing safe wildlife passages, and modifying roadside landscaping and maintenance, see also Chapter 23). Increased human presence within Fresh Kills Park also has the potential to impair suitability of the habitat restoration efforts for certain wildlife species and individuals. These effects, however, can be minimized through modification of proposed pathway locations and number of pathways to create large areas of contiguous habitat in certain locations that would have minimal human presence (see Chapter 23, “Impact Avoidance Measures and Mitigation”).

Recognizing that the project has the potential to avoid natural resources impact as design progresses (e.g., habitat fragmentation) and would also mitigate the expected direct and indirect impacts of project elements such as road impacts on wetlands (e.g., filling), Chapter 23, “Impact Avoidance Measures and Mitigation,” contains a comprehensive approach to avoiding or minimizing project impacts to natural resources through design and mitigating impacts where necessary. ✷

4.16.09



Fresh Kills Park Project Site
USGS Basemap - Arthur Kill Quad

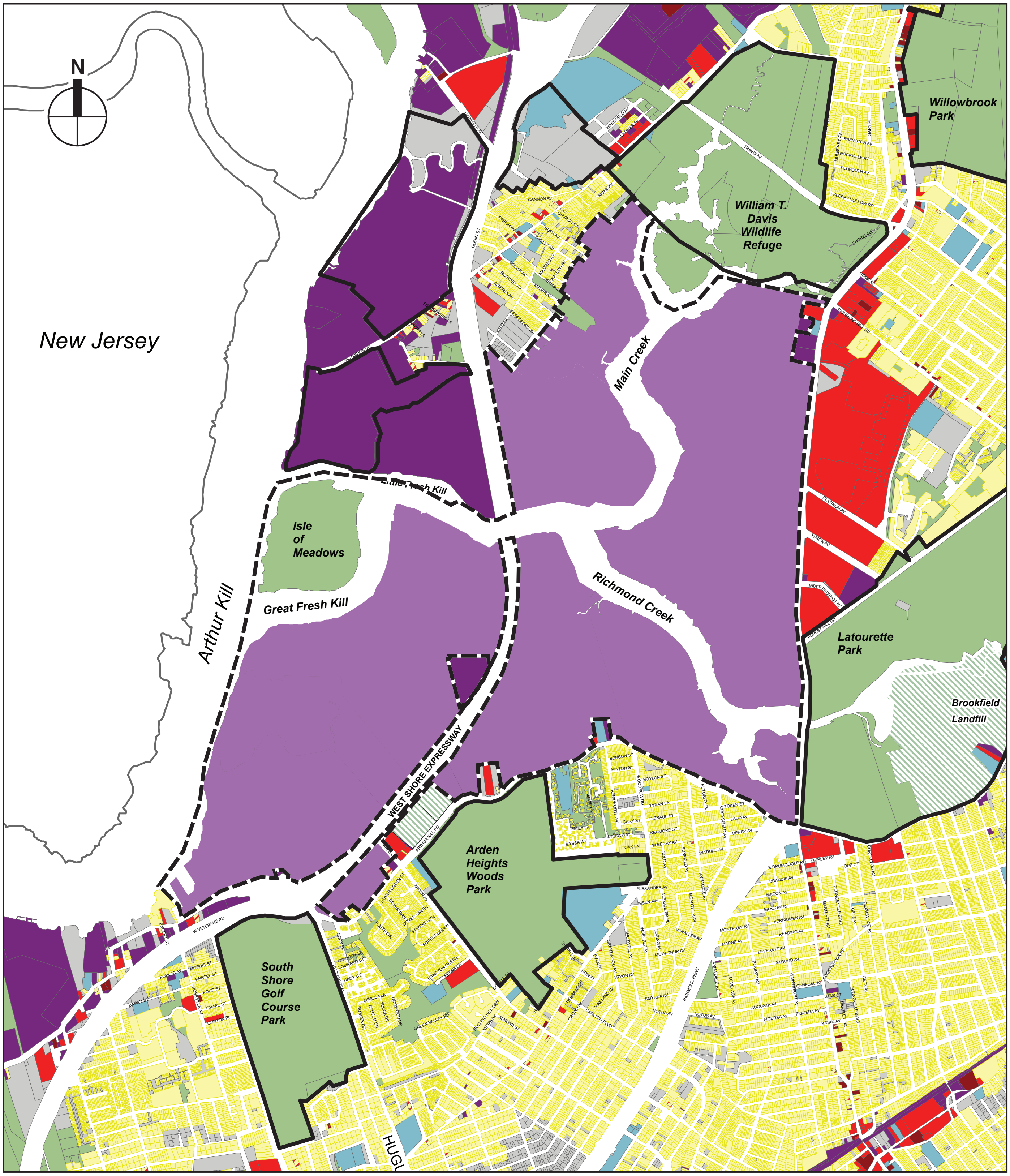
Figure 10-1

Fresh Kills Project Site
Current Aerial (2007)
Figure 10-2

Fresh Kills East Park Boundary

Project Site Current Aerial
Figure 10-2a

4.16.09

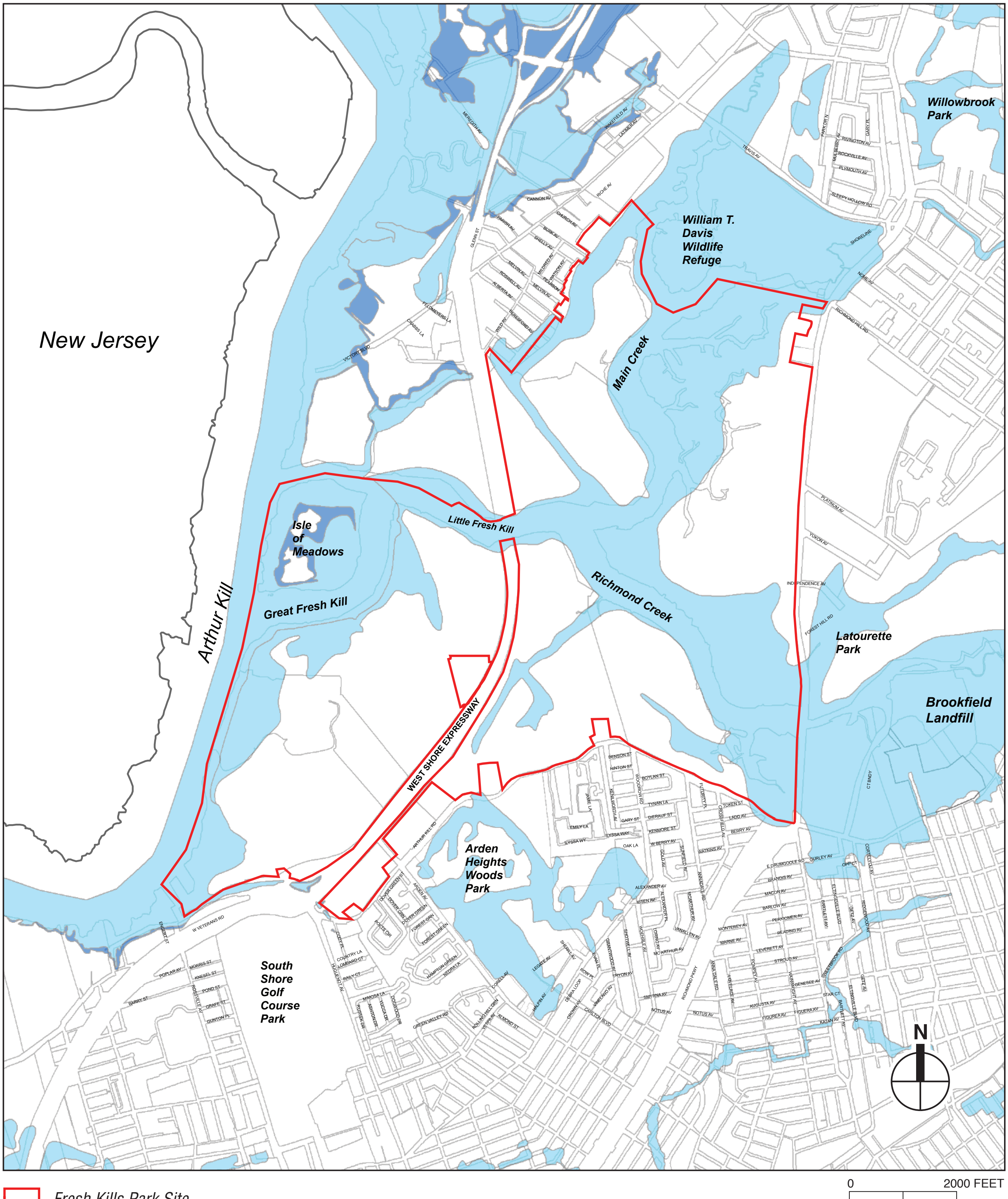


- Fresh Kills Park Boundary
- Secondary Study Area
- Industrial/DSNY Facilities
- Fresh Kills Project Area
- Residential
- Residential (with Ground-Floor Retail)
- Commercial
- Office
- Institutional
- Open Space
- Vacant Parcels
- Vacant Building
- Under Construction
- Open Space Under Construction

0 2000 4000 FEET
SCALE

Primary and Secondary Natural Resources Study Areas
Figure 10-3

4.16.09



Source: Federal Emergency Management Agency (FEMA)

Fresh Kills Park Site

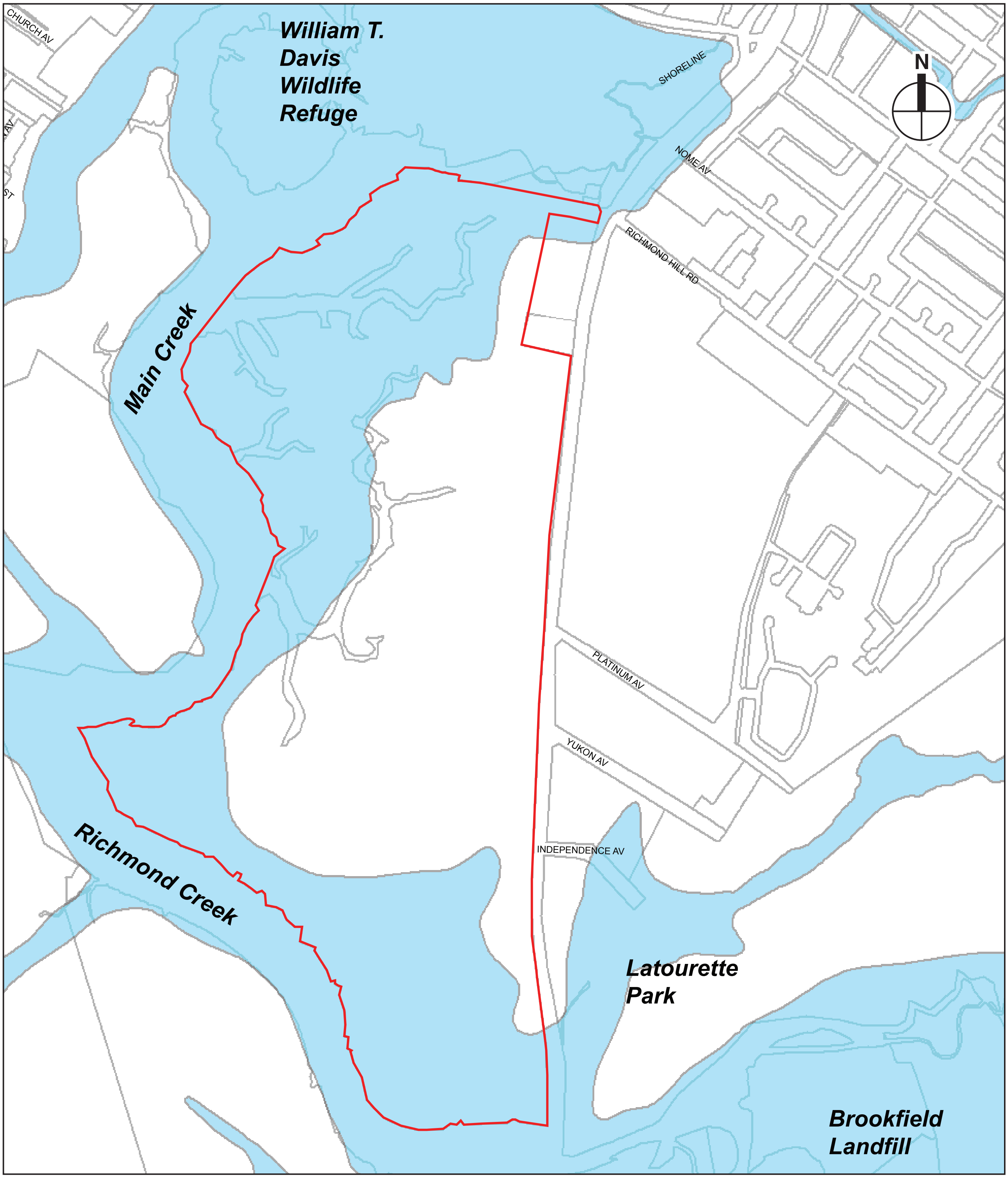
FEMA Flood Plains

Inside 100-Year Floodplain

Inside 500-Year Floodplain

Floodplains

Figure 10-4



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Source: Federal Emergency Management Agency (FEMA)

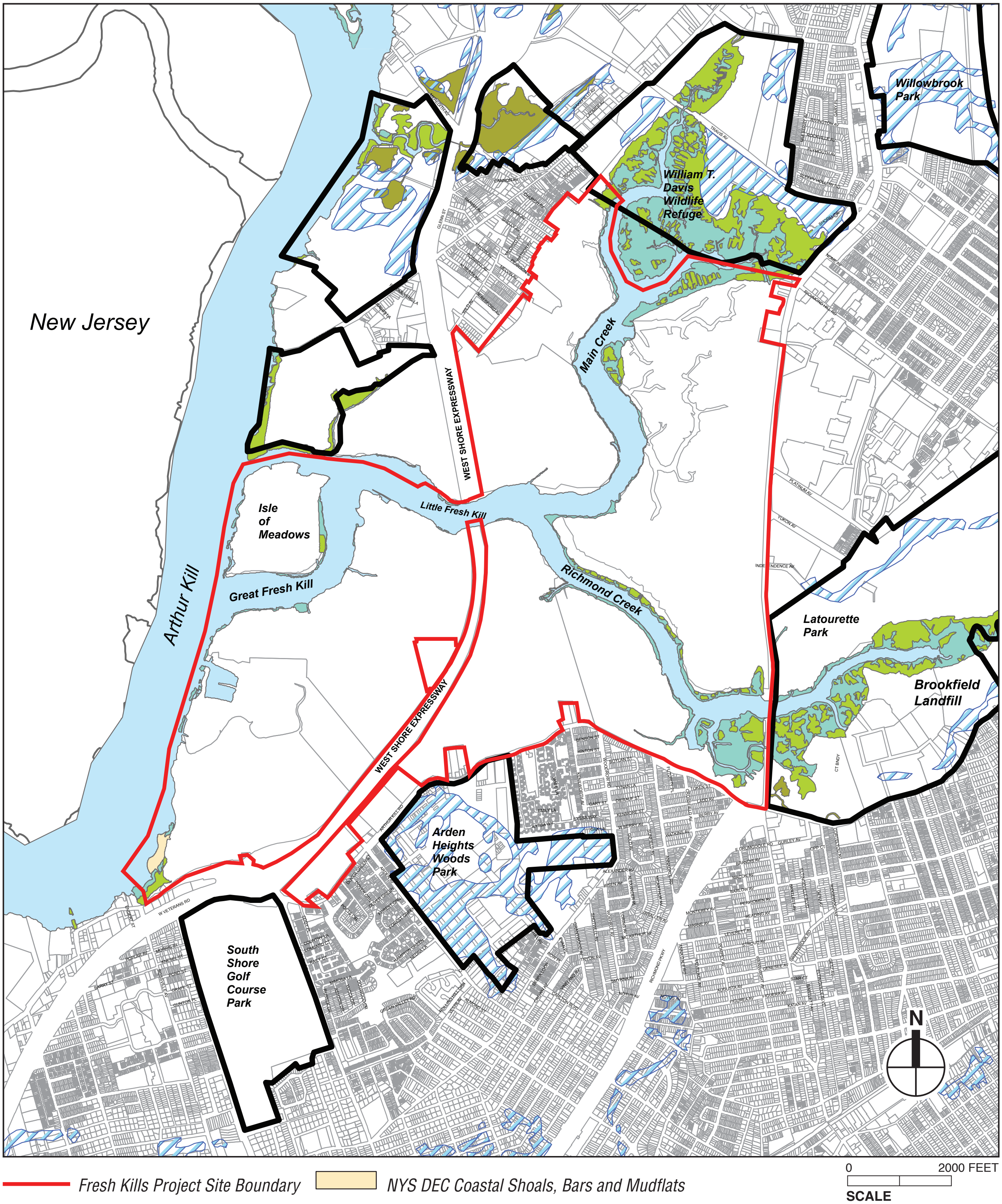
Fresh Kills Park Site

FEMA Flood Plains

Inside 100-Year Floodplain

Inside 500-Year Floodplain

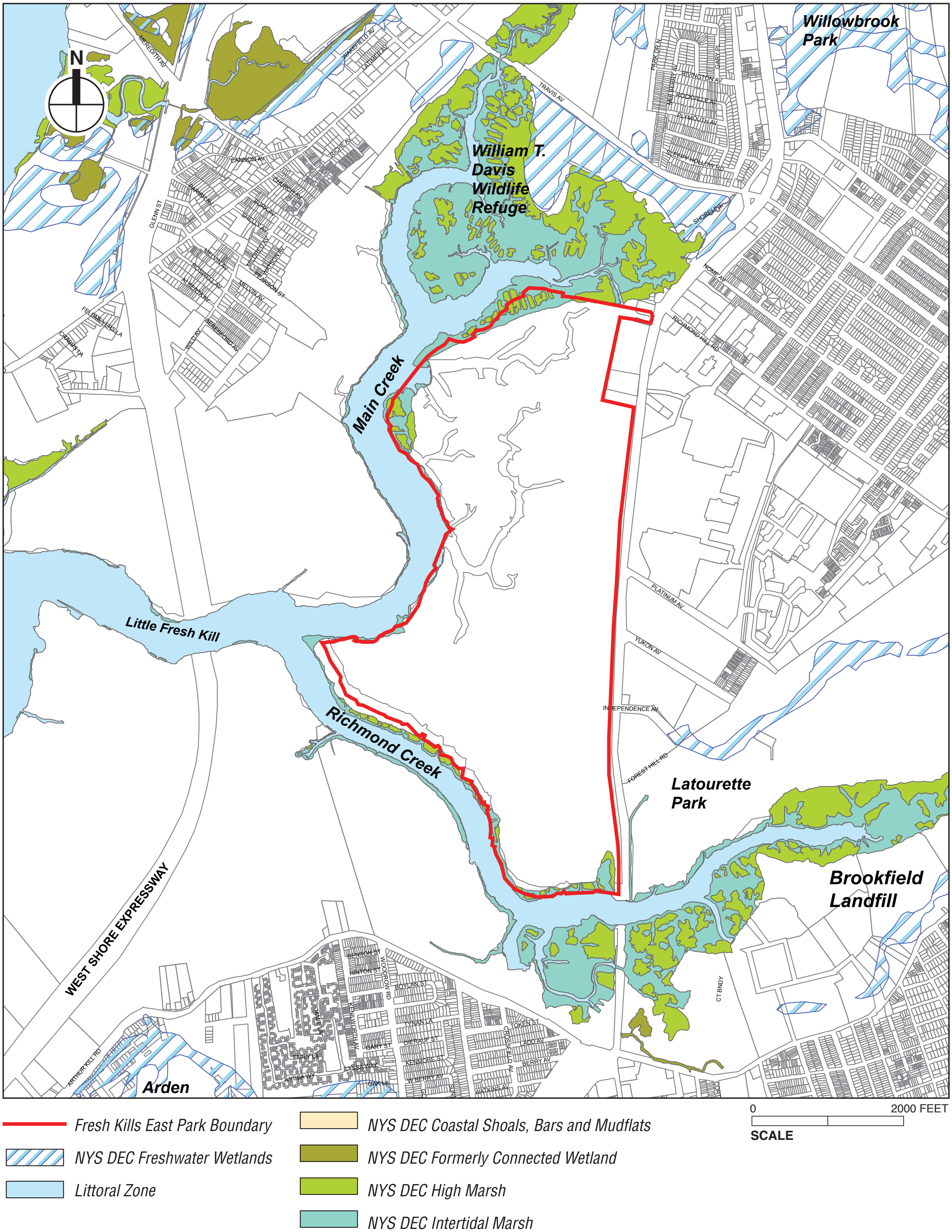
Project Site Floodplains
Figure 10-4a



NYSDEC-mapped Wetlands

Figure 10-5

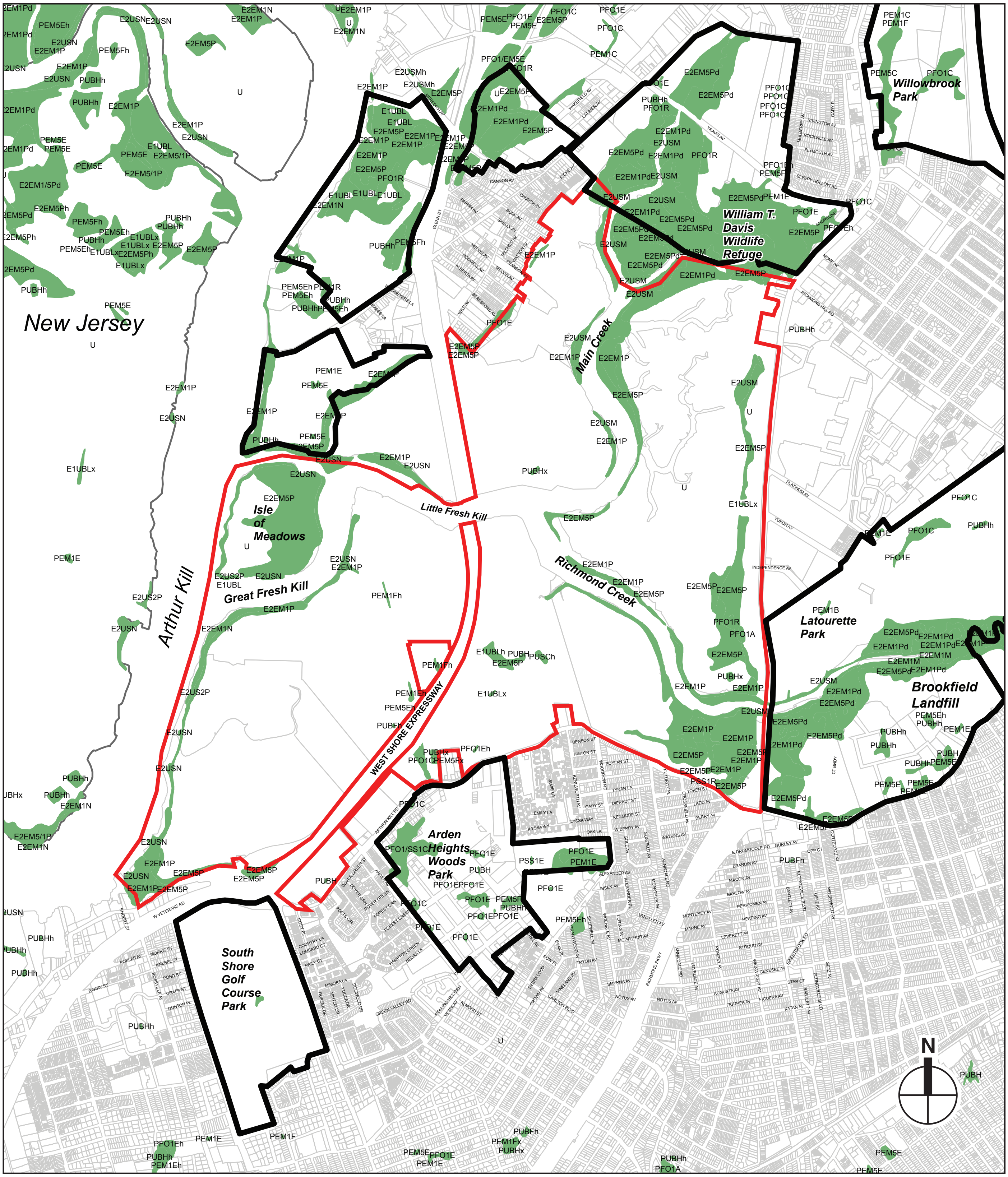
6.4.09



NYSDEC-mapped Wetlands: Project Site

Figure 10-5a

4.16.09



0 2000 FEET
SCALE

Fresh Kills Park Boundary

Secondary Study Area Boundary

NWI Wetlands

NWI-mapped Wetland Areas
Figure 10-6

6.4.09

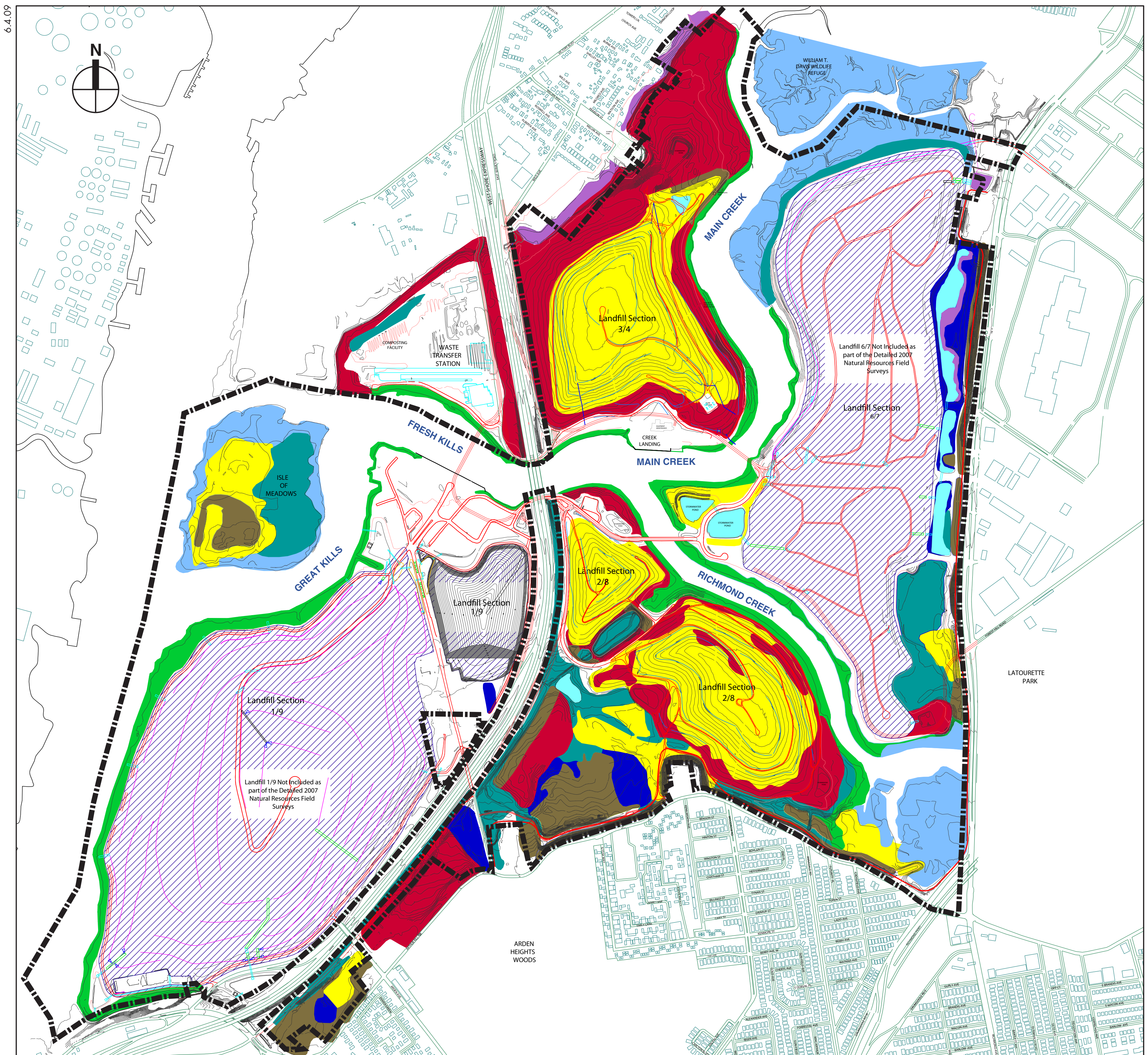
Fresh Kills East Park Boundary

NWI Wetlands

0 2000 FEET

SCALE

NWI-mapped Wetlands:
East Park Project Site
Figure 10-6a



Legend

Habitat Types

- Spartina -dominated
- Mixed marsh
- Phragmites -dominated Emergent/Scrub Shrub
- Palustrine emergent/forested
- Palustrine forested
- Open water/Stormwater Basins
- Phragmites /Mugwort-dominated
- Maturing Woodland
- Grass/Forb Dominated
- Areas Were Not Included as part of the Detailed 2007 Natural Resources Surveys (under landfill closure construction)
- Developed Areas (within the Primary Study Area)
- MAIN CREEK — Tidal Waterways

Notes:

1. Revised from AES 2003 and SCS Engineers 1991 based on field surveys performed by AKRF, Inc. (May and October 2007).

2. Field surveys were performed in May and October 2007 as outlined in the Natural Resources Field Survey Plan (AKRF 2007) and Fall 2007 Addendum, and focused on locations proposed as part of the 2016 Projects of the overall Fresh Kills Park Project.

3. In certain areas, mapped habitats contain smaller portions of other habitats. For example, the area north of Landfill Section 3/4 mapped as *Phragmites*/ Mugwort-dominated contains smaller amounts of Maturing Woodlands that are not represented on this drawing. Also, the areas mapped as Palustrine Forested wetland adajacent to the eastern edge of Landfill Section 6/7 contain smaller isolated areas of *Phragmites* -dominated Emergent/Scrub-Shrub wetlands in addition to large open water areas.

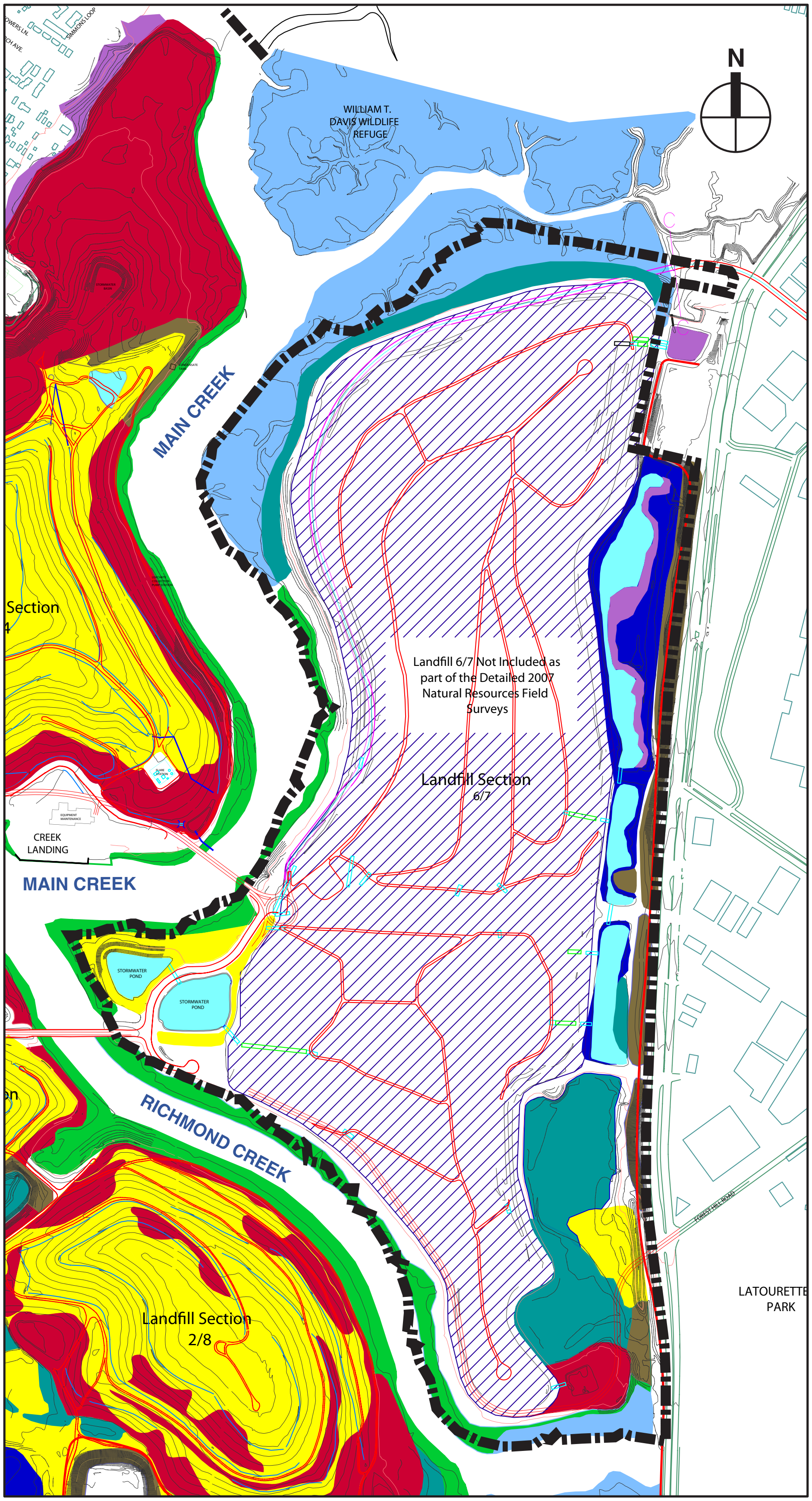
4. Landfill Section 6/7 was not investigated as part of the detailed survey because of ongoing active landfill operations. However, based on areas visible from accessible roads and adjacent areas, much of the vegetated portions of Landfill Section 6/7 would be classified as Grass/Forb Dominated.

5. Landfill Section 1/9 was not included as part of the detailed Natural Resources Survey performed in May 2007; however, this area appeared to be Grass/Forb Dominated, with areas of unvegetated cover in addition to large areas of *Phragmites* /Mugwort dominated communities.

6. For additional locations of stormwater basins see Figure 13-1.

0 1200 FEET
SCALE

General Land Cover Classification
Fresh Kills East Park
Figure 10-7



Legend

Habitat Types

- Spartina -dominated
- Mixed marsh
- Phragmites-dominated Emergent/Scrub Shrub
- Palustrine emergent/forested
- Palustrine forested
- Open water/Stormwater Basins [1]
- Phragmites /Mugwort-dominated
- Maturing Woodland
- Grass/Forb Dominated
- Areas Were Not Included as part of the Detailed 2007 Natural Resources Surveys (under landfill closure construction)
- Developed Areas (within the Primary Study Area)
- MAIN CREEK — Tidal Waterways

1 See Figure 13-7 for the locations of stormwater basins

NOTE: See Figure 10-7

6.4.09

Project Site Habitats

Figure 10-7a

View north towards open water area located along the eastern edge of East Park (Landfill Section 6/7) **1**

View north along the wetland alongside open water area in East Park (Landfill Section 6/7) **2**

East Park Wetlands and Drainage Basins

Figure 10-8

Upland area along berm alongside Richmond Avenue **3**

Phragmites-dominated wetland area in East Park **4**

East Park Richmond Avenue Berm

Figure 10-9

Upper reach of Main Creek north of East Park (Landfill Section 6/7) **5**

View of *Spartina*-dominated wetland north of East Park (Landfill Section 6/7) **6**

East Park Habitat:
Main Creek Wetlands
(East Shore)

Figure 10-10

Landfill Closure Construction at
Landfill Section 6/7
Figure 10-11