

# **Draft Final Historical Site Assessment/Records Search Summary Report**

## **Gateway National Recreation Area, New York**

**Great Kills Park Site  
EDL #5NER1580**

**August 31, 2017**



**Revision Log:**

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NPS Federal Government Lead

Signature, Date

**By signing above, the signatory verifies that they understand and concur with the information and procedures, and recommendations presented herein.**



## Draft Final Historical Site Assessment/Records Search Summary Report

### Great Kills Park Site Gateway National Recreation Area, New York National Park Service

**Document Date:** August 31, 2017

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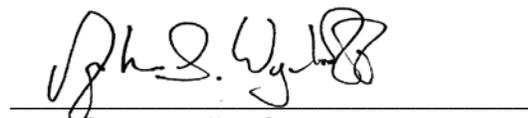
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## LIST OF ABBREVIATIONS AND ACRONYMS

APC	Air Pollution Control
APP	Accident Prevention Plan
AR	Administrative Record
AR&TDS	Archival Records and Targeted Data Search
ATSDR	Agency for Toxic Substances and Disease Registry
B	Bedrock Aquifer
BaA	Barren Sand
BiA/BiB	Bigapple
bgs	below ground surface
CaCO <sub>3</sub>	calcium carbonate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
City	City of New York
CIR	Criminal Incident Report
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
CST	Contaminated Sites Team
DOHMH	New York City Department of Health and Mental Hygiene
DOI	United States Department of the Interior
DWC	Domestic Waste Combustor
ESV	Ecological Screening Value
EE/CA	Engineering Evaluation and Cost Analysis
°F	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
GAO	U.S. Government Accountability Office
GKP	Great Kills Park
GMP	1979 General Management Plan
GMP/EIS	2014 Environmental Impact Statement and General Management Plan
GO	Governmental Organization
GOB	Gravesend and Oldmill
gpm	gallons per minute
GrA	Great Kills Gravelly Sand
GWS	Gamma Walkover Survey
HAD	Hooksan-Dune
HP	horsepower
HSA/RS	Historical Site Assessment/Records Search
IDW	investigation-derived waste
IPA	Ipswich-Pawcatuck Complex



IRA	Interim Response Action
ISCORS	Interagency Steering Committee on Radiation Standards
JaA	Jamaica Sand
JV	AECOM-Tidewater Joint Venture
LUW	land under water
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
mCi	milliCuries
MCL	maximum contaminant level
MDC	minimum detectable concentration
MGD	million gallons per day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MLLW	mean lower low water level
mR/hr	milliroentgens per hour
MSL	mean sea level
MWC	Municipal Waste Combustor
NaI	Sodium Iodide
NCP	National Contingency Plan
NGO	Non Governmental Organization
NJ	New Jersey
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NUREG	Nuclear Regulatory Commission Regulation
NR	Not Reported
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NSSS	National Sewage Sludge Survey
NWI	National Wetlands Inventory
NYPD	New York Police Department
NYSDEC	New York State Department of Environmental Conservation
OU	Operable Unit
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PCBs	polychlorinated biphenyls
pCi/g	picocuries per gram
POTW	publicly-owned treatment works
PP	Proposed Plan
RAP	Radiological Assistance Program
RC	Raritan Clay
RCC	Radium Chemical Company
RCP	reinforced concrete pipe
R/hr	Roentgens per hour



RI/FS	Remedial Investigation and Feasibility Study
ROD	Record of Decision
ROPC	radionuclides of potential concern
ROW	right-of-way
RSL	USEPA Regional Screening Level
SaA	Sandyhook Mucky
SI	Site Inspection
SRD	South Richmond Development District
SSHPP	Site Safety and Health Plan
SSSI CSRM	South Shore of Staten Island Coast Storm Risk Management Project
SSO	Site Safety Officer
SVOC	semi-volatile organic compound
TCRA	Time Critical Removal Action
TENORM	Technologically Enhanced Naturally Occurring Radioactive Materials
TEQ	toxicity equivalent
TNSSS	Targeted National Sewage Sludge Survey
UGA	Upper Glacial Aquifer
μCi	microCuries
μg/l	micrograms per liter
μR/hr	microRoentgens per hour
URL	Uniform Resource Locator
USACE	United States Army Corps of Engineers
USC&GS	United States Coast and Geodetic Survey
USDA	United States Department of Agriculture
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USPP	United States Park Police
USRC	U.S. Radium Corporation
UST	underground storage tank
USUL	Underground Sewer Utility Line
VOC	volatile organic compounds
WFMI	Wildland Fire Management Information System
WPCP	Water Pollution Control Plant
WWTP	Wastewater Treatment Plant
WWW	worldwide web
ZIP	Zone Improvement Plan



## 1. INTRODUCTION

The National Park Service (NPS) prepared this Historical Site Assessment/Records Search Summary Report (HSA/RS) for the Great Kills Park (GKP) Site, which is part of the 523-acre GKP located on Staten Island, New York. This report was prepared pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). GKP is managed by NPS as a part of the Staten Island Unit of the Gateway National Recreation Area (**Figure 1-1**). Radionuclides of potential concern (ROPCs) and contaminants of potential concern (COPCs) are present, as indicated by the results from previous investigations undertaken by NPS, within the waste filled area of GKP, known as the Site. The Site is defined as consisting of the waste filled area and any area where hazardous substances, pollutants, or contaminants disposed of at or released at or from the waste filled area have come to be located.

The 280-acre Site was divided into two Operable Units (OUs), which are shown in **Figure 1-2**. OU1 is a 43-acre parcel situated within and along the northeastern portion of GKP; OU2 includes all areas (approximately 237 acres) of the Site that are outside of OU1. In 2016, the NPS Contaminated Sites Team (CST) established OU1 and accelerated the investigation of this area to inform construction planning for the South Shore of Staten Island Coastal Storm Risk Management Project (SSSI CSRMP), which may be sited within or adjacent to OU1 (AECOM-Tidewater JV, 2017). OU1 consists of the former waste filled area and the sludge drying beds. OU2 consists of the waste filled area, the former Bay Terrace Incinerator, and the former Marine Unloading Plants. Both OU1 and OU2 are underlain by Underground Sewer Utility Lines (USULs) including a 30-inch diameter sanitary sewer and an 8-foot diameter interceptor (West Branch Interceptor, **Figure 1-3**). This HSA/RS addresses the entire Site, including OU1 and OU2.

### 1.1. INVESTIGATION OF THE SITE UNDER CERCLA AND NPS AUTHORITY

NPS is investigating the Site, including OU1 and OU2, pursuant to CERCLA. The President of the United States delegated response authority under Section 104 of CERCLA to the Secretary of the United States Department of the Interior (DOI) by Executive Order 12580, 52 Fed. Reg. 2923 (1987), as amended by Executive Order 13016, 61 Fed. Reg. 45871 (1996). The Secretary of Interior re-delegated CERCLA Section 104 authorities to NPS with respect to lands under NPS's jurisdiction, custody, or control. Pursuant to this authority, NPS is the CERCLA "lead agency" as defined in the National Contingency Plan (NCP), Title 40 of the Code of Federal Regulations (CFR) Part 300 for the Site.

As part of an Interagency Agreement between NPS and the U.S. Army Corps of Engineers (USACE), USACE is providing technical support to NPS. USACE, on behalf of NPS, contracted the AECOM-Tidewater Joint Venture (JV) (Contract No. W912DR-13-D-0016, Delivery Order 0003), to conduct a Remedial Investigation/Feasibility Study (RI/FS) with associated Proposed Plan(s) (PPs) and Record of Decision(s) (RODs) for the Site. This HSA/RS was prepared as part of the initial scoping phase for the remedial investigation at the Site.

### 1.2. PURPOSE OF HSA/RS

This HSA/RS was prepared in accordance with regulatory guidance including but not limited to: 1) the MARSSIM; 2) United States Environmental Protection Agency (USEPA) Guidance for Performing



Preliminary Assessments (PA) Under CERCLA (September 1991); and 3) NPS Preliminary Assessment Template (NPS, 2015). The objectives of this HSA/RS were to gather information regarding:

- Existing Site data including the results of any removal actions, remedial preliminary assessment, and site inspections;
- Past Site operations and waste disposal practices, including the disposal of incineration ash, wastewater treatment plant sludge, and waste fill at the Site;
- Type, depth, and aerial extent of waste present at the Site;
- Potential contaminants (radiological and non-radiological chemical contaminants); potentially contaminated areas (including initial classification of the Site as impacted or non-impacted); and potentially contaminated media, including surface soil, subsurface soil, groundwater, surface water, sediment, air, and subsurface structures; and
- Sources, nature of releases, exposure pathways, and exposure targets.<sup>1</sup>

### 1.3. HSA/RS APPROACH AND METHODS

The scope of this HSA/RS included: 1) conducting an Archival Records and Targeted Data Search (AR&TDS) for Governmental Organizations (GOs) (Federal, State, and local agencies) and Non-Governmental Organizations (NGOs) (historical societies, etc.) records; 2) compiling and evaluating information obtained from the AR&TDS; and 3) preparing this HSA/RS Summary Report presenting the approach and findings. In addition to the above, a reconnaissance visit and coordination meeting was conducted on July 28, 2015 to visually inspect the Site and review the status of the HSA/RS Task Plan. The Task Plan for conducting the HSA/RS work was finalized and issued on April 22, 2016. The following subsections provide additional information regarding the records and data searched, and compilation and evaluation of data and information, and HSA/RS reporting, and reconnaissance visit.

#### 1.3.1. Archival Records and Targeted Data Search

The HSA/RS included a structured and thorough AR&TDS of information from over 20 sources including GOs, and NGOs (**Table 1-1**). As part of the AR&TDS, the following tasks were conducted: 1) searched worldwide web (WWW); 2) prepared and submitted information requests to obtain documents from NPS and City of New York (City); 3) reviewed documents produced by NPS, City, and the USEPA; and 4) conducted research and document collection at GOs and NGOs. These included document searches and collections at the City (City Hall) Public Library, United States Library of Congress, and local historical societies including the Staten Historical Society and Staten Island Museum.

For each source identified, a thorough search was conducted of the source's website. Information for each file (including a PDF of the webpage in certain instances) downloaded from the WWW was recorded and linked in a data table maintained on the project SharePoint site. The information recorded included: 1) the document title, 2) the WWW Uniform Resource Locator (URL) for the document or file; 3) the date accessed; 4) the author of the document or file; 5) the document date; 6) a general description of the document or file, 7) comments (e.g., document relevance); and 8) applicability to the Site (e.g., past Site operations, waste disposal, nature and extent, and contaminants). This information for the 118 documents obtained from the WWW is presented in **Table 1-2**. All documents obtained from GOs and NGOs were

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<sup>1</sup> PA guidance (1991) defines a "target" as a physical or environmental receptor that is within the target distance limit for a particular pathway. Targets may include wells and surface water intakes supplying drinking water, fisheries, sensitive environments, and resources.



uploaded to the project SharePoint site using similar procedures used for the on-line (WWW) information. The information for 315 documents obtained from GOs and NGOs is presented in **Table 1-3**.

### **1.3.2. Site Reconnaissance Visit**

A site reconnaissance visit and HSA/RS coordination meeting was conducted on July 28, 2015 to visually observe GKP, the Site, and surrounding environs, kickoff the HSA/RS Task Plan, and collect information from NPS to support the HSA/RS.

As part of the site reconnaissance, a “windshield tour” of the GKP and Site was conducted. This included observing Site topography, drainage and surface features, the waste filled area (including areas where elevated levels of radioactivity were previously identified and removed), and the surrounding neighborhood. The tour involved (1) observing existing conditions in areas of GKP outside the Site boundary, including Crooke’s Point, GKP beach, Nichols Marina, NPS Education Field Station, Ranger Station, and maintenance facilities; and (2) observing conditions within the Site boundary, including Buffalo Street, Bulkhead Road, Sewerline/Wetland Road, the ball field area, the model airplane field, and the former sludge drying beds and adjacent wetland area.

The windshield tour around GKP (surrounding neighborhood) presented existing conditions along Hylan Boulevard and adjacent properties including the residential neighborhood along Chesterton Avenue, the wetlands in the Oakwood Beach Creek and OU1, and the Oakwood Beach Water Pollution Control Plant (WPCP).

After the site reconnaissance visit, participants conducted an HSA/RS coordination meeting at the NPS office at 210 New York Avenue, Staten Island, New York to discuss the status of the HSA/RS Task Plan. During the coordination meeting, the JV presented the status of efforts to complete the HSA/RS Task Plan, procedures for collecting and compiling information from the WWW, GOs, and NGOs, and the format for storing documents and data on the project SharePoint site. Documents were also requested from NPS including those contained in the Site Administrative Record (AR). Given the extensive AR (including previous environmental investigations conducted since 2005) and information to be obtained from GOs, NGOs, and WWW research, an extensive site reconnaissance was deemed not necessary.

### **1.3.3. HSA/RS Summary Report**

Following the introduction above, this HSA/RS Summary Report presents information regarding:

- Site Description, Previous Environmental Investigations, and History;
- Site Characteristics;
- Site Operations, Sources, and Potential Hazardous Substances;
- Site Exposure Pathway and Environmental Hazard Assessment; and
- Conclusions and Recommendations.



## 2. SITE DESCRIPTION AND HISTORY

The following provides information regarding: the Site location; previous Site environmental investigations; and Site history.

### 2.1. LOCATION AND SURROUNDINGS

GKP is located at the intersection of Buffalo Street and Hylan Boulevard, Staten Island, NY 10306 and is included within the Staten Island Unit of the Gateway National Recreation Area. GKP center coordinates are approximately 40°33'01.66" north latitude and 74°07'37.67" west longitude, while the coordinates for the entrance to GKP at Buffalo Street and Hylan Boulevard are 40°33'23.97" north latitude and 74°08'36.37" west longitude.

GKP consists of 523 acres of land centrally located on the east coast of Staten Island approximately equidistant between Fort Wadsworth (to the north) and Tottenville (to the south). Hylan Boulevard (for a distance of approximately 4,700 feet) borders GKP on the west-northwest. Fairlawn Avenue and Great Kills Harbor border GKP to the southwest and south. The Atlantic Ocean or Lower New York Bay and Raritan Bay border GKP to the south and east. An unnamed drainage channel, Oakwood Beach Creek, Oakwood Beach WPCP, wetlands, and a single family residential community (west side of Chesterton Avenue) border GKP on the north and northeast. The Site footprint occupies approximately 280 acres of GKP. Of the 280 acres, 47 acres are owned by the City (Tidewater, 2015). This 47 acre parcel is located on the north-northeast portion of GKP (**Figure 2-1**).

Currently at GKP, NPS maintains and operates several public recreational facilities including a beach center, hiking and biking trails, fishing areas, marina and boat launch ramp, and associated parking areas. A paved wheelchair-accessible multi-use path, adjacent to Buffalo Street, begins at the entrance to GKP and extends 1.5 miles to the beach center. The multi-use path is used for walking, jogging, biking, and roller skating. There are several grassy areas used for recreational purposes. There are hiking trails available in the southern portion (Crooke's Point) of the GKP and bird watching is available along the shoreline. Swimming beaches are located along the southeastern and southwestern portions of GKP, with swimming restricted to beaches located south of the bay side of Great Kills Harbor. Nichols Marina is located at the western side of GKP.

As a result of the discovery of radiological contamination in 2005 at the Site, NPS closed portions of GKP and ultimately restricted public access to the Site. The closed portion of the GKP generally coincides with the Site boundary and was historically used for environmental education, walking (trails), baseball and softball, other athletics, and model airplane flying. In 2013 and 2014, NPS installed four-foot tall fencing and installed three gates at access points. Warning signs stating "Danger Hazardous Area" were posted every 25 feet on the fence line to notify the public of potential risks associated with the Site. Areas of GKP southeast of Hylan Boulevard and north of Great Kills Harbor to a line approximately 1,000 feet south of Wetland Road are fenced, signed and identified on area maps as project Site area closed for safety.

### 2.2. PREVIOUS ENVIRONMENTAL INVESTIGATIONS AT THE SITE

This section presents information regarding previous environmental conducted at the Site. Most investigations were conducted after NPS was notified in 2005 regarding elevated radiation levels detected at the Site as part of the baseline radiological mapping effort conducted by the Counter Terrorism Bureau



of the New York City Police Department (NYPD) and the United States Department of Energy (USDOE) (U.S. Government Accountability Office [GAO]), 2006; Tidewater, 2015). Prior to 2005, in 1985, Sidney M. Johnson and Associates (Johnson, 1985), on behalf of NPS, issued a report related to its structural engineering analysis of the bathhouse, sewer, and impacts due to erosion. As part of this analysis, Johnson also conducted a field investigation to determine: 1) the limits of the waste fill; 2) the nature of the fill; and 3) the nature of leachate. The results of the 1985 field investigation are presented below followed by the environmental investigations that commenced in 2005.

### **2.2.1. Sidney M. Johnson and Associates 1985 Field Investigation**

As part of the field investigation, Johnson conducted a magnetometer survey and excavated 41 test pits. The magnetometer survey found an area with ferrous metal west of the NPS Education Field Station. Johnson identified the waste fill in the northwest quadrant of GKP, ranging in thickness from 8 feet to more than 15 feet thick. Johnson noted gray or red brown sand overlying the “black garbage fill”, and in some areas red brown inorganic clay at 6-inches to 12-inches thick overlying “brown garbage fill.” Johnson attributed the clay layer to the soil amendment efforts performed by the City. The “brown garbage fill” overlies the “black garbage fill” at all areas of the waste filled area except at the perimeter where sand is present. The presence of sand at the perimeter of the waste filled area is consistent with the City’s efforts to “armor” and surround the waste filled area with hydraulic fill (sand). Johnson stated “Overall the bulk of the fill has the appearance of highly decomposed or incinerated material.” Johnson found no drums, barrels, or evidence of toxic materials. Johnson noted a black semi-cemented soil underlies the waste fill and is composed of pre-existing material mixed with the waste fill and incinerator residue.

Johnson also collected four groundwater samples for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and metals analyses; and only detected low concentrations of toluene (maximum concentration 20.3 micrograms per liter [ $\mu\text{g}/\text{l}$ ]) and tetrachloroethylene (9.1  $\mu\text{g}/\text{l}$ ). The tap water Regional Screening Level (RSL) for toluene is 1,100  $\mu\text{g}/\text{l}$  and the Maximum Contaminant Level (MCL) is also 1,100  $\mu\text{g}/\text{l}$ . The tap water RSL for tetrachloroethylene is 11  $\mu\text{g}/\text{l}$  and the MCL is 5  $\mu\text{g}/\text{l}$ . All other analytes were either not detected or below their respective residential USEPA RSLs. Both toluene and tetrachloroethylene were detected in the equipment blank suggesting the sampling equipment may not have been properly decontaminated between sampling locations. With respect to the fill, Johnson collected three waste fill samples from depths of 6 feet to 8 feet and analyzed them for VOCs, SVOCs, pesticides, PCBs, and metals. The analytical results indicated VOCs, SVOCs, pesticides, and PCBs were not detected. Of the detected metals and inorganic elements, only antimony (35.2 milligrams per kilogram [ $\text{mg}/\text{kg}$ ] to 82  $\text{mg}/\text{kg}$ ), arsenic (6.34  $\text{mg}/\text{kg}$  to 7.83  $\text{mg}/\text{kg}$ ), and cyanide (4.28  $\text{mg}/\text{kg}$  to 24.8  $\text{mg}/\text{kg}$ ) were detected above their respective residential RSLs of 31  $\text{mg}/\text{kg}$ , 0.68  $\text{mg}/\text{kg}$ , and 23.0  $\text{mg}/\text{kg}$ .

### **2.2.2. Environmental Investigations and Response Actions Conducted Since 2005**

Between 2005 and 2017, a series of response actions were conducted on behalf of NPS to investigate the nature of the radiological contamination at the Site and to mitigate risk to human health and the environment. Many of the investigation reports cited below are included in the AR established by NPS for the Site. A chronological listing of previous investigations and activities is summarized below:

- On August 2, 2005, NYPD notified USEPA Region 2 that elevated gamma radiation levels were identified at the Site. NYPD reported that the highest radiation reading was 1.5 milliroentgens per



hour (mR/hr) located near a parking lot for the model airplane field. (Michael Baker, 2007, Appendix D: USEPA Region 2 Bullet-Great Kills Park Radiation Response Investigation).

- On August 3, 2005, USEPA conducted a ground radiological survey/assessment confirming that the “fire break” area had above-background, but relatively low-level, radiation readings. This survey also identified the source of the readings as radium-226. NPS further restricted access to the area by erecting a fence and allowing the area to re-vegetate (Michael Baker, 2007; Tidewater, 2015).
- In November 2006, NPS initiated a CERCLA response action and contracted Michael Baker Jr., to prepare a PA for potential radiological contamination at the Site (Tidewater, 2015).
- On March 6, 2007, while the PA was in progress, a brush fire occurred at the Site (Michael Baker, 2007). Following the fire, NPS surveyed the burned area on March 15, 2007 and detected elevated radiation readings (Michael Baker, 2007; Tidewater, 2015). NYPD was notified and responded with USDOE Radiological Assistance Program (RAP) team. The highest gamma reading obtained by the RAP team was 0.2 mR/hr (Michael Baker, 2007). On March 21, 2007, the City Department of Health and Mental Hygiene (DOHMH) conducted a survey and identified “a hot spot just off the road leading to the model airplane field. Readings at contact at the grass were 10 mR/hr and 0.5 mR/hr at 1 meter over the spot. Natural background readings for the area are 0.01 mR/hr.” (March 22, 2007, Letter from Gene Miskin, Director, Office of Radiological Health DOHMH to Dave Avrin, NPS. Included as Appendix E in Michael Baker, 2007).
- On March 30 and April 3, 2007, DOHMH conducted a limited radiological gamma survey of the public access areas including ball fields 1 through 5 and associated parking lot, as well as the model airplane field and parking lot, fishing area (Harbor Beach) and access road, hiking trail, Sewerline Road<sup>2</sup>, Fire Road and the main park access road (Buffalo Street). The survey confirmed the location of three previously identified areas and identified two additional areas: south of ball field 1 and east of the model airplane field parking lot. DOHMH concluded that while the detected radiation levels were many times above background, the levels were reduced to background three feet from the source. DOHMH recommended that a radiological contaminant assessment be conducted at the Site (Michael Baker, 2007). As a result of DOHMH findings, NPS installed additional fencing to isolate the identified areas (Tidewater, 2015).
- On May 25, 2007, the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) completed a Health Consultation and its evaluation of potential hazards to public health posed by the radiological contamination at GKP. USEPA requested ATSDR develop a public health statement based on existing data. ATSDR concluded that the areas posed an “Indeterminate Public Health Hazard.” ATSDR referred to its conclusions regarding past radiation exposures (for the areas of concern) as indeterminate because the conclusions were based on limited data and analyses. ATSDR also reported that past exposures were not expected to be a health hazard because the radioactivity readings “dropped” significantly three feet away from the peak readings, it was unlikely that anyone would remain on any of the identified hot spots for an extended period of time (i.e., three hours or more), and the elevated readings were limited to five distinct areas (ATSDR, 2007 and Tidewater, 2015).

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<sup>2</sup> Sewerline Road is referred to by NPS as Wetland Road. Wetland Road and Sewerline Road are the same.



- In August 2007, Michael Baker, Jr. Inc., on behalf of NPS completed and issued its PA report. The PA concluded the radiological contamination at the Site appeared to be concentrated in five locations and is comprised of radium-226 and its decay products. It further concluded that the radiological contaminants identified were not likely to pose an immediate health risk to park users because NPS closed public access to the five suspect areas with fencing. The PA recommended the identified contaminated radiological material be removed and disposed of, with follow-up confirmatory screening, and any future detections of radiological contamination be handled in a similar fashion (Michael Baker, 2007; Tidewater, 2015).
- In January 2009, Cabrera Services on behalf of NPS conducted an Interim Response Action (IRA) consisting of additional radiological surveys and removal of radiological materials. The IRA identified a total of fourteen hot spots. Seven of these hot spots were in the five areas previously identified and discussed above. The other seven areas were locations that had not been previously identified. Of the 14 areas, seven hot spots were prioritized for removal based on public accessibility and detected readings (e.g., highly accessible areas with the highest readings were prioritized over less accessible areas and/or those with lower readings). During excavation, two radium sources (e.g., and brachytherapy needle and tube) were recovered. As part of the IRA, a total of four drums of material were removed from the Site and disposed of at permitted and licensed facilities. One drum containing the two radium sources was disposed of at the U.S. Ecology facility (State of Washington Radioactive Materials License WN-I01902) in Richland, Washington. The three drums containing investigation-derived waste (IDW) were disposed at the Energy Solutions facility (State of Utah Radioactive Material License UT 2300249) in Clive, Utah. Cabrera Services completed the IRA and issued its report in November 2010 (Cabrera Services, 2010; and Tidewater, 2015). As a result of the discovery of the additional hot spots and the subsequent removal of two radium sources, NPS put up barricades and signs to close off access to Wetland Road, the ballfields and Model Airplane field and stopped issuing permits for these activities.
- On October 14, 2010, NPS issued an Approval Memorandum to conduct an Engineering Evaluation and Cost Analysis (EE/CA) at the Site to evaluate non-time critical removal action alternatives (Tidewater, 2015).
- On February 2, 2012, NPS conducted fire protection activities, including cutting back vegetation in the area south of Wetland Road and east of Buffalo Street. The area was subsequently checked for radiation and three distinct hot spots were identified. Testing of the area by USACE confirmed the elevated readings and located a fourth elevated reading within the same area. The source of the radioactivity was identified as radium-226 (Tidewater, 2015).
- During June through August 2012, USACE at the request of NPS conducted a gamma walk-over survey (GWS) and dose rate survey of four additional areas including: 1) the multi-use path along Buffalo Street; 2) the trails around the Education Field Station; 3) Bulkhead Road; and 4) the Bulkhead Road fishing area. The results of GWS and dose rate survey confirmed the absence of radiation hazards in the near surface soil (USACE, 2012).
- On July 31, 2012, NPS Northeast Regional Director signed an Action Memorandum approving the decision to conduct a time critical removal action (TCRA) at the Site. The EE/CA, initiated per NPS on October 14, 2010, Approval Memorandum was put on hold to expedite the TCRA



and the identification and removal of radioactive contamination which posed an immediate risk to human health and the environment (Tidewater, 2015).

- In June 2015, Tidewater, Inc. on behalf of NPS issued the Final Great Kills Park TCRA Completion Report. Activities conducted as part of the TCRA involved clearing of brush, trees, and Phragmites; installing security fencing along the perimeter of the waste filled area to prevent access; conducting drive-over and walk-over gamma surveys; installing 51 borings to delineate waste filled area; conducting a radiation dose assessment for firefighters, park rangers/law enforcement officers, maintenance workers, nearby residents, and trespassers; and the excavation and removal of 37 source areas including five areas that exceeded 2 mR/hr. As a result of the TCRA, 25 drums of waste were generated, transported, and disposed of at permitted and licensed facilities. 24 of the 25 drums were disposed of at the U.S. Ecology facility in Grand View, Idaho and one drum was disposed of at the Energy Solutions facility in Clive, Utah (Tidewater, 2015).
- In April 2016 through October 2016, NPS conducted a two-phased environmental investigation of the OU1 43-acre area to further characterize Site-related contamination and to inform planning for the SSSI CSRM Project. Environmental media within OU1 were investigated for the presence of VOCs, SVOCs, PCBs, metals including mercury, herbicides, pesticides, dioxins/furans, and radionuclides. The OU1 environmental investigation included installing borings and tests pits; collecting and analyzing surface and subsurface soil samples; installing and sampling temporary and permanent groundwater monitoring wells; conducting a tidal study and aquifer slug tests; conducting GWS of OU1 areas and dose rate measurements of radiological anomalies; and sampling and analysis of sediment and surface water samples collected from Oakwood Beach Creek. The OU1 environmental investigation determined that metals, polycyclic aromatic hydrocarbons (PAHs), PCBs, dioxins/furans, and radionuclides were associated with waste fill and sewage sludge at levels that exceeded background and project screening benchmarks. The OU1 environmental investigation also confirmed that radiological artifacts are incidentally contained in waste fill and possibly in the sewage sludge, and that damaged radiological artifacts can result in isolated releases of radionuclides to adjacent soil (AECOM-Tidewater JV, 2017).

### 2.3. SITE HISTORY

This section presents the history of the Site and its surrounding environs. The information regarding the Site history was developed from an analysis of historic maps, historical aerial photographs, historic topographic maps, park plans and designs, and cited literature (**Table 2-1**).

The Site history enumerated in the subsections below covers the following periods and activities:

- Late 1600s to Early 1900s: James Brown and John J. Crooke
- 1900 to 1925: Crooke's Point Erosion
- 1925 to 1943: Marine Park, Land Acquisition, Bay Terrace Incinerator, Oakwood Truck Fill and Bulkhead
- 1944 to 1948: Marine Unloading Plant and Landfill
- 1949 to 1960: Great Kills Park Opening, Oakwood Beach WPCP, and Soil Amendment
- 1961 to 1972: Athletic Field, GKP Re-graded, Gateway National Recreation Area Established



- 1974 to Present: City Conveys GKP to NPS, Oakwood Beach WPCP Upgrade and GKP Development

### 2.3.1. History Prior to Property Conveyance to the United States

The following section provides a summary of Site history prior to the conveyance of GKP to the United States to be managed by NPS.

#### 2.3.1.1. Late 1600s to Early 1900s: James Brown and Jeremy Crooke

Information regarding GKP property and its inhabitants during the period from the early 1600s to the early 1900s is limited. The town of Great Kills, formerly known as Cairedon, Newtown, and Giffords was present on maps starting in the late 1860s. The adjacent town of Oakwood was established in 1890.

**Figures 2-2, 2-3 and 2-4** provide Site map information for 1887, 1894, and 1898 respectively.

An August 1939 Staten Island Institute of Arts and Sciences Museum Bulletin reports: 1) a French map of the grant (of land) to Guyon (an early French settler) in 1675 named the land [Crooke's Point area] "Pointe de Sable;" 2) a 1797 map prepared by Conner and Sprong labeled Crooke's Point as a "Beach of Sand;" 3) an 1850 map prepared by Dripp and an 1853 map prepared by Butler indicated Crooke's Point was occupied by James Brown Shipyard and referred to the area as "Brown's Point." In the 1850s there were two documented structures on Crooke's Point. These structures were James Brown's house and shipyard, and a structure occupied by a fisherman (Baugher-Perlin et al, 1980).

John Jeremy Crooke reportedly purchased the property in 1865 (Staten Island Museum Bulletin, August, 1939). John J. Crooke, purchased the peninsula (150 acres) (a.k.a. Crooke's Point) as well as an 144 to 173 acre parcel that extended from the Staten Island Railroad eastward to Great Kills Harbor (1887, J.B. Beers & Co., and 1894 I.A. Lefevre) (**Figure 2-2** and **Figure 2-3**). Mr. Crooke is notable because he was the owner of most of the land that comprised what is today GKP, and "Crooke's Point" takes its name from John J. Crooke. Mr. Crooke lived from 1824 to 1911 and was an engineer, physical and natural scientist, industrialist, miner, essayist, poet, businessman, photographer, and inventor.

The 1874, 1887, and 1894 Staten Island atlases indicate the area within and around GKP was owned by several landowners including Mr. Crooke, with only a few scattered structures (presumed to be residential). The Crooke Property, north and west of South Side Boulevard (a.k.a., Hylan Boulevard) was known as Liberty Hall. The 1894 atlas shows a road network for the town of Brendan. Emmet Avenue is the northern-most street within the proposed grid. The GKP property (at the time) and Site was largely vacant and comprised of wetlands and associated drainages (Bass Creek, Mill Pond Creek, Flat Creek, Lockmans Creek, and Duck Creek) that drained to Great Kills Harbor (**Figure 2-3**). GKP land uses at the time included farming and the growing of salt hay.

#### 2.3.1.2. 1900 to 1925: Crooke's Point and Erosion

**Figures 2-5, 2-6 and 2-7** provide Site map information for 1917 and 1925. Between 1894 and 1902, Crooke's Point and associated wetlands adjacent to Great Kills Harbor underwent significant erosion and loss of land (Staten Island Museum Bulletin, 1939, and G.W. Bromley and Co., 1917, **Figure 2-5**). The erosion and loss of land was attributed to the dredging of the Ambrose Channel (lower New York Bay) and the resultant change in tidal and wave action along the Staten Island shoreline and Crooke's Point (Balch, 1923). Balch reported that Crooke's Point began to scour away within a few years after dredging of the channel. Crooke's Point was initially comprised of 180 acres, but as a result of the erosion was reduced to a 30-acre island (Balch, 1923; G.W. Bromley and Co., 1917). The 1917 atlas (**Figure 2-5**)



shows continued development around the Site including the town of Oakwood is present; the town of Brendan is renamed Whitlock and the street grid is dashed (inferring future presence); and Kissam and Ocean Avenues (Oakwood Beach) have been constructed.

### 2.3.1.3. 1925 to 1944: Marine Park Plan, Land Acquisition, Bay Terrace Incinerator, Oakwood Truck Fill, and Bulkhead

**Figures 2-8, 2-9, 2-10, 2-11, 2-12, and 2-13** provide Site map and aerial photography information from 1926 to 1940. The land plan for the Marine Park originated in 1925. In 1926, the City constructed the Bay Terrace Burner House and Incinerator (Sanborn, 1937) (**Figure 2-12**). The incinerator was formerly described as being located east of Hylan Boulevard and south of Baldwin Avenue (Block 5065 Lots 98 and 100) on an irregularly shaped area consisting of 14.9 acres (New York City, 1948). Between 1929 and 1930, the City acquired 18 parcels involving over 290 acres of upland. The State of New York granted 445 acres in 1932 and 83 acres in 1934, for a total of approximately 529 acres of land under water (LUW), to the City. In 1934, the New York City Department of Sanitation Oakwood Truck Fill commenced operations (New York City Department of Parks Press Release, 1949) and these operations received refuse from sanitation trucks that serviced Staten Island. The exact location of the Oakwood Truck Fill is unknown; however, it is believed to be co-located on Site with the Bay Terrace Garage and Incinerator.

In 1936, the City acquired 94 acres of property (upland) by condemnation (New York City Department of Parks, Public Notice Purchase Private Property, October 25, 1935 and New York City Board of Estimate and Apportionment, July 15, 1936, Record Map of Great Kills Park, R-16, 1982). In 1940, the State of New York granted an additional 411 acres of LUW to the City. The 411 acre grant required the land be improved for the proposed public park within 5 years (New York State Report of Attorney General, November 26, 1940 re: Application of the City New York). The complete Marine Park area was bounded by Fairlawn Avenue (on the southwest to west), Hylan Boulevard (on the northwest to north), and Emmet Avenue (on the north to the northeast, **Figure 2-8**).

Detailed topographic maps issued by the New York City Department of Parks in 1935 and 1936 indicate Mansion and Grattan Avenues and Bach Street were constructed on what became park land and now Site, and are mapped east of Hylan Boulevard. The 1935-1936 topographic maps also show several structures (likely residential) adjacent to Hylan Boulevard (on the upland, **Figures 2-10 and 2-11**); a sanitary sewer and easement beneath Mansion and Grattan Avenues, Bach Street, and Emmet Avenue (New York City Department of Parks, 1935 and 1936); a gas pump located near the street entrance for the Bay Terrace Incinerator and Garage; a gas pump near what is today Buffalo Street; and an extensive drainage ditch network indicating efforts to drain the Site wetlands adjacent to Great Kills Harbor.

In 1933, a 400 foot-long section of steel bulkhead was constructed near the present day Nichols Marina (Dallas, 2013 and New York City Department of Parks, 1933). In 1935, the steel bulkhead was extended in both directions, with the southern end extending around the tip of Crooke's Point (off Site) and the northern end extending (on Site) toward Oakwood Beach for a total length of 5,500 feet (New York City Department of Parks, 1935a, **Figure 2-9**).

Filling of the eroded area between Crooke's Point (island) (off Site) to the mainland (on Site) at Oakwood using hydraulic fill east of the bulkhead started in late 1934 and continued through 1935, and ultimately the previously eroded area was filled (New York City Department of Parks, 1935b, Baker and Honig 1982). By the end of 1939, over 322,019 cubic yards of hydraulic fill (sourced from the sand that was



eroded during the late 1890s and early 1900s) were dredged from Great Kills Harbor and placed along the bulkhead creating a harbor and new land (**Figure 2-13**) (Dallas, 2013). In 1943, a timber bulkhead was built along the northern shore of Great Kills Harbor, extending 2,841 feet from the existing steel bulkhead to the property line at Fairlawn Avenue (New York City Department of Parks, 1943). The designs for Marine Unloading facilities were prepared and included significant pilings along the bulkhead to support the foundations for the unloading stations (Section 2.3.1.4. and 4.1.3. below).

In addition to the hydraulic fill, the 1935 and 1936 New York City Department of Parks topographic maps for the Marine Park indicate fill (likely including incinerator residue from the Bay Terrace Incinerator and refuse from the Oakwood Truck Fill) was disposed of in the vicinity of the Bay Terrace Incinerator (i.e., within the current boundary of the Site). The Bay Terrace Incinerator was reportedly abandoned on or before 1941 (New York City Department of Parks, Press Release, 1941). The Oakwood Truck Fill ceased operations in 1948 (New York City Department of Parks Press Release, 1949).

#### **2.3.1.4. 1944 to 1948: Waste Fill, Marine Unloading, and Landfill Operations**

**Figures 2-14 and 2-15** provide Site map and aerial photography information from 1947 to 1949. Starting in 1944 to 1949, the City operated the Marine Unloading Plants (on Site) comprised of the Lambert and Wellman Unloading Stations (New York City Department of Parks, 1943), and an outbuilding for maintenance and equipment storage and landfill (**Figure 2-15**). Section 4.1.3 provides additional detail regarding the Marine Unloading and Landfill operations. During 1944 through 1948, low lying wetland areas (within the acquired property) and LUW were covered with over 15.1 million cubic yards of waste fill. The New York City Department of Sanitation's operations including Marine Unloading Plant and Landfill are described in the New York City Department of Park's Annual Reports issued from 1946 through 1949, as well as in the New York City Department of Sanitation Annual Reports from 1946 through 1949.<sup>3</sup>

In 1945, in anticipation of filling the area (on Site) east of Hylan Boulevard, the City developed plans to reconstruct the existing manholes for the sanitary sewer located beneath both Mansion and Gratten Avenues and Bach Street described above. The reconstruction effort involved raising the elevations of the existing manholes by installing manhole extensions (in some cases over ten feet) to prevent the manholes from being buried by the waste fill.

#### **2.3.1.5. 1949 to 1960: GKP Opening, Oakwood Beach WPCP, and Soil Amendment**

Figures 2-15, 2-16, 2-17, 2-18, and 2-19 provide Site map and or aerial photography information for 1949, 1951, 1954, 1955 and 1956. GKP opened on a limited basis (bathing beach) in 1949 (Moses, 1949). The 1949 aerial photograph (Figure 2-15) shows the Site completely filled and graded including Buffalo Street and Beach Parking, and the three constructed drainage channels: 1) Northwest to Southeast (Buffalo Street) Drainage Channel; 2) the Northeast to Southwest (Hylan Boulevard) Drainage Channel; and 3) Unnamed Northeast to Southwest Drainage Channel. The 1949 aerial photograph also shows the locations of the two former unloading stations and the barge mooring platform and the location (near what is today Fairlawn Avenue) of an outbuilding used for maintenance and equipment storage for the unloading and landfill operations; all of these former operations are within the boundary of the Site. The

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<sup>3</sup> Annual reports were not issued during the World War II years from 1940 through 1945.



1951 aerial photograph (Figure 2-16) shows: 1) the beach parking lot (for approximately 650 cars) and Buffalo Street are paved; 2) the beach bathhouse and concessions facilities are present; and 3) the interior of the Site is sparsely vegetated.

During 1954 to 1955, the Oakwood Beach WPCP was constructed east of the Site boundary and commenced operations in 1956. Information regarding the Oakwood Beach WPCP operations is summarized in Section 4.1.2. Between early 1955 and late 1959, 213,000 cubic yards of clay and 285,000 cubic yards of sewage sludge were mixed together to create topsoil (Wrenn, 1975) and used to facilitate vegetative growth over the Site's waste filled area. In 1958, the New York City Department of Parks issued contract drawings for the construction of an athletic field including a baseball field, softball field, and football field with running track and associated facilities (pole vault and high jump areas).

The athletic field plans specified that where excavation exposed waste fill (i.e., within the Site boundary), the fill would be removed to a depth of 6-inches below subgrade for seeded and paved areas, and 18-inches in areas with curbs, drainage pipes and drainage structures, and then backfilled with clean material. Certain ball field areas (e.g., infield areas) were also "skinned," and sodded, and other areas (e.g., outfield) were surfaced with top soil and seeded. The design drawings show an under-drain system (beneath and adjacent to athletic fields) with a network of surface water catch basins connected via corrugated pipe, with a discharge to the Northeast to Southwest (Hylan Boulevard) Drainage Channel that drains into Great Kills Harbor at Fairlawn Avenue.

#### **2.3.1.6. 1961 to 1972: Athletic Fields, Site Re-grading, Sludge Drying Beds and Gateway National Recreation Area Enabling Legislation**

**Figures 2-20, 2-21, 2-22, and 2-23** provide Site map and or aerial photography information for 1961 to 1966. The 1961 aerial photograph (**Figure 2-20**) confirms the presence of the constructed softball field, baseball field, running-track oval and football field within the Site boundary. The 1961 aerial photo also indicates increasing vegetation across the Site. The 1966 aerial photograph (**Figure 2-21**) shows the entire Site has been re-graded including the former Unnamed Northeast to Southwest Drainage Channel appears to be filled and is no longer present; and there is a linear road or trail present in the location of what is known today as "Sewerline and or Wetland Road." The 1966 aerial photograph also shows significant development of residential communities adjacent to the Site and north of Hylan Boulevard and Buffalo Street (in the vicinity of Chesterton Avenue).

The 1966 historical topographic 7.5 minute quadrangle map (The Narrows) shows the sludge drying beds (on Site) west of the Oakwood Beach WPCP (**Figure 2-22**). The 1966 topographic map also confirms that the Unnamed Northeast to Southwest Drainage Channel near the beach is no longer present (likely filled in).

In 1969, Greeley and Hansen issued its preliminary investigation for upgrading the Oakwood Beach WPCP from 15 million gallons per day (MGD) to 40 MGD with enlargement to an ultimate capacity of an average of 80 MGD. The upgrade also included installing a new outfall for discharge in the Lower New York Bay and a 10-inch diameter sludge force main adjacent to the West Branch Interceptor.

The 1975 aerial photograph indicates three additional ball fields (for a total of five fields) are present on the Site, suggesting that these three additional fields were constructed between 1966 and 1975, but the exact dates of construction are unknown.



### 2.3.2. Oakwood WPCP Upgrade

The 1975 aerial photograph also shows the presence of the sludge drying beds related to the Oakwood Beach WPCP in the northeast central portion of the Site. The Oakwood Beach WPCP initiated an upgrade of its facilities in the mid-1970s. The Oakwood Beach WPCP sludge drying beds, while shown in the 1975 aerial, are shaded on the 1981 7.5 Topographic Quadrangle Map (**Figure 2-25**) indicating that the sludge drying beds were no longer in service.

### 2.3.3. Site History After Property Conveyance to the United States

The following section provides a summary of Site history after the conveyance of GKP to the United States. **Figures 2-24, 2-25, 2-26, 2-27, 2-28, 2-29, and 2-30** provide Site map and or aerial photography information during the time period after the property was conveyed, including 1975, 1981, 1984, 1991, 2006, 2009, and 2011, respectively.

On October 27, 1972, the United States Congress approved Public Law 92-592 (a.k.a. Enabling Legislation) that established the Gateway National Recreation Area. This statute in part defined and established the Gateway National Recreation Area and authorized the Secretary of Interior to acquire certain lands and water, administer the Recreation Area, enter cooperative agreements with the states of New York and New Jersey, inventory and evaluate Recreation Area sites and structures (among other responsibilities), and approved the appropriation of money for the acquisition (\$12.1 million) and development (\$92.8 million) of the Recreation Area. The Enabling Legislation created the Gateway National Recreation Area “to preserve and protect for the use and enjoyment of present and future generations an area possessing outstanding natural and recreational features.”

On March 1, 1974, the City conveyed via deed to the United States of America for the use and development by NPS, approximately 16,665 acres within the Recreation Area including GKP (1,198.9 acres). The deed excluded 47.7 acres (located along the northeast section of the GKP) that was retained by the City and remains owned by the City today. The deed allowed the City certain rights relating to improvements to the Oakwood Beach WPCP and easements and other rights for the construction, operation, maintenance, repair and reconstruction of any municipal facility and also contained a provision that stated the conveyed property “shall revert to the City if not suitably developed as a national recreation area.” The deed was amended on October 14, 1977 to address two provisions in the 1974 deed involving: 1) airport, jetport or related facilities; and 2) “in the event that lands so ceded, granted, and conveyed cease to be used for the purposes of the national park system or are used for any use inconsistent with such purposes, such lands shall revert to the State of New York or City of New York as the case may be....”

Between 1974 and 1979, NPS collected and evaluated data regarding the resources of the Gateway National Recreation Area, including those at the GKP and Site. NPS subsequently issued the General Management Plan (GMP) for the Gateway National Recreation Area in August 1979, which outlined the management of the Gateway National Recreation Area in accordance with the 1916 Organic Act and 1972 Enabling Legislation.

Available records show that a majority of redevelopment and construction conducted by NPS at the GKP were performed outside of the Site boundary. The trail and road network and general park configuration shown in the 1975 photograph presented in **Figure 2-24** is generally consistent with the existing trail and road network currently present on Site. The available information indicates that the following activities were performed by NPS within the Site boundary:



- Sidney M. Johnson and Associates performed a field investigation that evaluated the waste fill within the Site boundary. As part of the investigation, 41 tests pits were excavated within and adjacent to the Site, which were documented in a summary report issued in 1985 (Sidney M. Johnson and Associates. 1985). Section 2.2.1 provides a summary of this investigation.
- In the late 1980s, NPS rehabilitated 2,840 feet of the existing timber bulkhead adjacent to Bulkhead Road because the bulkhead had buckled at several locations and several tie-back rods had corroded and failed (Dallas, 2013).
- In the late 1990s, NPS installed a promenade north of the marina along Great Kills Harbor (just north of Nichols Marina) and the southwestern edge of OU2 (NPS. 1999).
- Aerial photographs suggest that the portion of Buffalo Street within the site boundary was repaved several times since the mid-1970s, most recently in 2012 (after Hurricane Sandy).

In addition to the investigations and construction activities discussed above, NPS performed ongoing maintenance of recreation areas, trails, and buildings throughout GKP, including within the Site boundary. A majority of maintenance activities were routine in nature and did not involve significant construction or alteration of property. Starting in 2005, portions of the Site were closed for public access and in 2009 NPS restricted access to the entire Site due to the confirmed presence of elevated radioactivity. A strip of land between the bulkhead to Great Kills Harbor and Bulkhead Road from the boat ramp, along the promenade and bulkhead fishing area was reopened in 2012.

In 2014, NPS issued a General Management Plan and Environmental Impact Statement (GMP/EIS) for the Gateway National Recreation Area, which includes GKP. Based on the 2014 GMP/EIS, a majority of the Site is within the area of GKP considered to be a Recreation Zone (**Figure 2-31**). The 2014 GMP/EIS indicates that these areas would be used for nature-themed recreation and camping opportunities and flexible open spaces to accommodate other uses including picnicking, school groups, discovery zones, and other unstructured recreational activities.



### 3. SITE CHARACTERISTICS

The following section and subsections provide information regarding Site features including topography, land-use, geology, hydrogeology, wetlands, vegetation and wildlife, cultural resources, and climate.

#### 3.1. TOPOGRAPHY

The Site is fairly level with elevations ranging from sea level to approximately 35 feet above sea level in the northern portion (waste filled area) of the Site. Generally, GKP slopes from the entrance of the park, in the northern corner of the Site, towards the coastline in the south and southeast (United States Geological Survey [USGS], 1981). The highest elevation occurs in the north central portion of the Site where the waste fill is thickest.

#### 3.2. SURROUNDING LAND-USE AND DEMOGRAPHICS

GKP is located within Richmond County in the Borough of Staten Island. Staten Island is approximately 58 square miles. Based on the 2010 Census, Richmond County had a population of 468,730 with none of that population living within GKP. The population living within 1 mile of the Site is approximately 39,900 with 3,600 under the age of six (ATSDR, 2007). The 2010 census tract data for the four census tracts that occupy the area immediately adjacent to GKP was evaluated to assess population adjacent to the GKP. The data from the four census tracts are summarized in **Table 3-1**. The total number of residents (in 2010) within the four tracts was 17,699 ([maps.nyc.gov/census](http://maps.nyc.gov/census)).

Based on zoning maps from New York City Department of Zoning, GKP is situated within the low density residential planning zone and is designated as a park. The surrounding land use includes a mixture of residential, commercial, and manufacturing. Commercial-use properties are located adjacent to the western boundary of the Site along the northern shore of Great Kills Harbor. The manufacturing zone includes the area occupied by the Oakwood Beach WPCP. The remaining area surrounding GKP is zoned for residential use.

A majority of the adjacent residential areas are zoned “R3-1” and “R3-2.” The “R3-1” zoning district denotes the lowest density and allows for semi-detached one or two family residences as well as detached homes. The “R3-2” zoning allows higher density and includes a greater variety of housing including low-rise attached houses, multifamily apartment houses, detached single family houses, and attached single family houses. Lot width requirements for “R3-1” and “R3-2” are 40 feet for a detached house and 18 feet for an attached house. The residential zoning (“R3-1” and “R3-2”) also allows for community facilities which include but are not limited to colleges and universities, libraries, museums, churches, nursing homes, child-care facilities, schools, health care facilities, and community centers.

The adjacent commercial property is zoned as “C3A” which denotes the area is zoned for waterfront recreational activities. In addition to general boating facilities, permitted activities include aquatic sport equipment sales, bicycle shops, and ice cream stores. The Oakwood Beach WPCP parcel is zoned “M3-1” which denotes heavy industry which generates noise, traffic, and pollutants. This zoning designation is generally used for power plants, solid waste transfer facilities, recycling plants, and fuel supply depots.

Areas south and west of GKP are located within the Special South Richmond Development District (SRD). This district is a Special Purpose District which limits and directs development within the district. The SRD was established in 1975 to guide the development of the southern part of Staten Island to ensure



that public infrastructure kept pace with new development. Associated land use restrictions within the SRD include tree preservation, planting requirements, limiting changes to topography, building height limits, building setback limits, and the designation of open spaces.

The surrounding land use including the identification of residential communities, schools, day care facilities, parks, and cemeteries was evaluated within the area encompassed and bounded by Richmond Avenue (to the south and west), Arthur Kill Road (to the west and north), Richmond Road (to the north) and New Dorp Lane (to the north and northeast, [maps.nyc.gov/doitt/nycitymap/](https://maps.nyc.gov/doitt/nycitymap/)). This area encompasses an approximate 1.5 to 2 mile radius around GKP and includes the Eltingville (west-southwest), Great Kills (west), Bay Terrace (north), Oakwood Heights (north), and Oakwood Beach (north-northeast) neighborhoods. This is the approximate population that lives within 1,000 to 2,000 feet of the GKP boundary.

Residential communities present within 200 feet of the Site include communities: 1) west of Fairlawn Avenue, 2) north of Hylan Boulevard, and 3) north and east of the Site along Chesterton Avenue and north of the Oakwood Beach WPCP. With respect to residents near Fairlawn Avenue and Hylan Boulevard, there is an intervening drainage channel and Fairlawn Avenue, a two lane asphalt road between the Site and the community; and the residential community north of Hylan Boulevard is topographically higher and upgradient of the Site and separated from the Site by Hylan Boulevard, a six lane major thoroughfare.

Within one to two miles of the Site, there are 19 schools including preschools and pre-kindergarten, primary schools (grades 1-5), intermediate schools (grades 6 through 8), and high schools (grades 9 through 12) serving over 7,642 students ([www.schools.nyc.gov](http://www.schools.nyc.gov)). There are approximately 15 day care providers located near (within 1.5 mile radius) GKP (**Tables 3-2 and 3-3**). There are no schools located within 200 feet of the Site boundary. The closest school to the Site is Public School 053 Bay Terrace - The Barbara Esselborn School at 330 Durant Avenue, Staten Island. The school is located over 288 feet to the north and upgradient from the Site. This school includes grades from pre-kindergarten through 5<sup>th</sup> grade and has approximately 780 students.

In addition, there are four cemeteries (acreage unknown); six parks occupying 691.24 acres; and three playgrounds occupying 10.15 acres. These include the following:

- **Cemeteries:** 1) Ocean View Cemetery, less than 1.0 mile northwest; 2) United Hebrew Cemetery 1.0 Mile north; 3) Mt. Richmond Cemetery, less than 1.5 miles north; and 4) Frederick Douglass Memorial Park Cemetery, less than 0.5 mile north;
- **Parks:** 1) Siedenburg Park, less than 1.0 mile west, 22.88 acres; 2) King Fisher Park, less than 1.5 miles northwest, 23.01 acres; 3) Seaside Wild Nature Park, less than 0.25 mile south, 20.91 acres; 4) Crescent Beach Park, less than 0.5 mile south, 110.96 acres; 5) Great Kills Park, less than 0.2 mile north to northeast, 315 acres, and 6) Willowbrook Parkway, less than 0.1 mile to north, 198.48 acres; and
- **Playgrounds:** 1) Dugan Playground, less than 0.5 mile northeast, 3.33 acres, 2) Clawson Playground, less than 0.1 mile north, 3.59 acres; and 3) Greencroft Playground, less than 0.1 mile north, 3.23 acres.



### 3.3. GEOLOGY

This section provides information regarding the regional geology followed by the Site geology. The regional geology is “framed” within the context of the Atlantic Coastal Plain Physiographic Province. A Physiographic Province is defined as a region having a similar geologic structure, climate, a unified geomorphic history (landscape evolution), and is different from surrounding regions. The following sections describe the Atlantic Coastal Plain Physiographic Province as well as its geology, including the underlying unconsolidated surficial deposits and deeper bedrock formations. Formations and/or groups are rock units that have lithologic characteristics (e.g., color, mineralogic composition, grain size, etc.) that make them distinct and mappable from region to region. The lithologic character of the formations is directly related to the rock’s origin. Finally, the underlying geology influences the makeup and character of the Site’s soil, hydrogeology, and other physical characteristics described below.

GKP is located within the Atlantic Coastal Plain Physiographic Province. The Atlantic Coastal Plain Physiographic Province extends along the east coast from the State of New York southward to and including the State of Florida. Regionally, the Atlantic Coastal Plain Physiographic Province is bordered to the north and west by the Piedmont Physiographic Province and on the south and east by the Atlantic Ocean. The northern Atlantic Coastal Plain is underlain by a wedge of unconsolidated sediments that generally thicken and dip to the east. The sedimentary rocks lie unconformably (erosional contact) on top of metamorphic, igneous, and consolidated sedimentary rocks. The metamorphic, igneous, and consolidated sedimentary rocks outcrop to the west (up-dip) and underlie the Piedmont Physiographic Province. The Coastal Plain sedimentary formations range in age from Jurassic (135 to 195 million years ago) to Holocene (10,000 years ago to the present). The following subsections describe the regional surficial and bedrock geology (**Table 3-4**).

#### 3.3.1. Regional Surficial Geology

The surficial and shallow geology of the Atlantic Coastal Plain Physiographic Province within Staten Island is comprised of areas underlain by artificial fill followed by thin discontinuous Holocene (shore and near shore) deposits and the more significant (laterally extensive and thicker) Upper Pleistocene (glacial, 10,000 to 2-3 million years ago) deposits (**Figure 3-1**). The glacial deposits unconformably overlie (erosional contact) the Upper Cretaceous (65 to 88 million years ago) Raritan Formation.

The artificial fill is present in major, former wetland areas of Staten Island that were filled with “sanitary fill” obtained from Staten Island and other boroughs of the City (Soren, 1988)<sup>4</sup>. These areas include the waste filled area at the Site, and the Fresh Kills Park (and landfill) area between Bloomfield and Rossville (adjacent to the Arthur Kill located to the west of GKP), and the area of Ocean Breeze Park, (located to the north of GKP and south of Fort Wadsworth). The thickness of the artificial fill varies greatly and in some instances is greater than 30 feet thick (Soren, 1988).

The thin (generally less than 10 feet thick) Holocene deposit consist of light brown to tan sand associated with beach deposit (shore) to dark gray, plastic, organic silty-clay to clayey-silt associated with marsh and estuarine deposits (near shore). The Holocene deposit unconformably (erosional contact) overlies the Pleistocene glacial deposit.

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<sup>4</sup> “Sanitary fill” is a term used by Soren and is waste from the City’s sanitation operations including refuse collection and incinerators that was used as “artificial fill” in wetland areas.



The Upper Pleistocene glacial deposits lie unconformably on top of the unconsolidated Upper Cretaceous Raritan Formation and consolidated bedrock units. The glacial deposits comprise a northeast-southwest (e.g., strike) outcrop belt of outwash, terminal-moraine, and ground moraine reflecting the origin (water deposited versus ice deposited) of the deposit and the position of the glacial ice front.

The glacial outwash deposit consists mainly of stratified fine to coarse sand and gravel deposited by melt water from the receding front of the glacier. The glacial outwash deposit underlies the low-level areas of eastern Staten Island from Amboy and Richmond Roads to GKP (Soren, 1988). The maximum known thickness for the glacial outwash deposit is approximately 95 feet (Rosenberg, 2013) in the vicinity of the towns of New Dorp and Arochar (located north-northeast of GKP). The terminal-moraine consists of poorly sorted sand, gravel, cobbles, and boulders in a clay silt matrix. The larger clasts (gravel, cobbles and boulders) were derived (via erosion and reworking by ice and water) from underlying bedrock. The terminal moraine underlies the “string of hills” extending south from Fort Wadsworth to Todt Hill to Annadale to Tottenville. Todt Hill is 409 feet above sea level and one of the highest points on the Atlantic Coast south of Maine (Perlmutter, 1953). The terminal moraine is thicker (over 200 feet thick) in the north and thins to 75 feet thick in south. The ground moraine is a reddish-brown clayey till (having a clay-silt matrix) and clasts derived from the Upper Triassic and Lower Jurassic shale and sandstone. The ground moraine is thinner in the north where the moraine overlies bedrock underlying the higher elevations (Todt Hill) of Staten Island and thickens to the south where it is over 150 feet thick (Rosenberg, 2013).

The Upper Cretaceous Raritan Formation unconformably underlies the glacial deposits from the central portion of Staten Island, extending from Fort Wadsworth southwestward to Fresh Kills Park. The Raritan Formation consists of a stratified white, light to dark gray and red, beds and lenses of clay, silt, and sand with common zones of lignite and pyrite. The Raritan Formation outcrops in a few isolated locations in southwestern Staten Island (near Charleston) and thickens to the east, south and southwest to over 400 feet thick. The Raritan Formation is comprised of two members (where it is divided): 1) the Raritan Clay (upper, thicker unit); and 2) underlying Lower Sand Unit (a.k.a. Lloyd Sand Member, **Figure 3-2**). The Raritan Clay overlies the Lower Sand and is more extensive covering an area from Fresh Kills to Fort Wadsworth, and extends to the southeast and east. The Raritan Clay increases in thickness to over 100 to 300 feet thick at the coast line (Rosenberg, 2013). The Lower Sand Unit, where present, consists of a varicolored gray, white and red, fine to coarse sand, and is present in the subsurface south of Rossville to Great Kills to Tottenville.

### 3.3.2. Regional Bedrock Geology

Staten Island bedrock geology consists of igneous, metamorphic, and sedimentary rocks that range from Upper Proterozoic (oldest) to Lower Jurassic (youngest, **Figure 3-3**). The four bedrock units consist of (oldest to youngest), the Staten Island Serpentine, the Manhattan Schist, the Newark Supergroup, and the Palisade Diabase. The Staten Island Serpentine is a greenish-brown metamorphic ultramafic (comprised of dark ferromagnesian minerals) crystalline rock. The Staten Island Serpentine lies beneath the northeast and central portions of Staten Island in the vicinity of Todt Hill. The Manhattan Schist is a dark-gray micaceous metamorphic rock that is complexly folded and faulted. The Manhattan Schist underlies (it does not outcrop on the island) the western portion of Staten Island from St. George-Stapleton to Huguenot. The Manhattan Schist unconformably underlies (erosional contact) the Newark Supergroup, an Upper Triassic to Lower Jurassic sequence of consolidated sedimentary rocks consisting of reddish brown medium to coarse sandstone and shale (Rosenberg, 2013). The reddish brown interbedded sandstone and



shale (Newark Supergroup) underlies the western portion of Staten Island in an outcrop belt that extends (e.g., strike) northeast to southwest. The Newark Supergroup is intruded by the sheet-like Palisade Diabase; a massive, intrusive dark gray sill (tabular intrusion that parallels the planar structure of surrounding sandstone-shale bedrock) that underlies the level and low areas of the western portion of Staten Island (Soren, 1988).

### 3.3.3. Site Geology and Soil

The surficial geology of the Site primarily consists of artificial fill comprised of hydraulic fill and waste fill (with sewage sludge) overlying the Holocene deposit comprised of dark gray silty clay to clayey silt with sand lenses, overlying the glacial outwash and till deposits. These surficial units are underlain by the Raritan Formation, the Staten Island Serpentine, and Manhattan Schist. These Site-specific geologic units (including their character and distribution) are described more fully below.

### 3.3.4. Hydraulic Fill

The hydraulic fill consists of sediment (graded sand) dredged by the City and USACE from Great Kills Harbor (anchorage area) and channels (New York City Department of Parks, 1943 a, b, c). USACE dredged different locations (channel and anchorage [a.k.a. harbor]) and installed the hydraulic fill from 1934 through 1951. The dredging was conducted as part of the Great Kills Harbor Federal Navigation Project that was adopted in 1927 and modified in 1938. The hydraulic fill was installed in an area that extended from Crooke's Point east-northeast parallel and along what is today GKP beach and the bulkhead, and expanded into the Site as the bulkhead curves to the north-northwest for approximately 2,000 feet. The hydraulic fill then extends parallel to the beach to the boundary of the City Property to the north-northeast (**Figure 3-4**). A portion of the hydraulic fill was also installed in a "curvilinear" narrow band beneath what is today the GKP utility corridor/Buffalo Street toward Hylan Boulevard (New York City Department of Parks, 1947 a, b, c). The hydraulic fill was placed in these areas to provide firm foundations for improvements including beach, boardwalk, bathhouse, game areas, parking fields, picnic groves, roadways, walks and landscaped areas (New York City Department of Parks, 1947d). The hydraulic fill ranges in thickness from 5 feet to 25 feet (typically 15 feet thick, Mueser Rutledge Consulting Engineers, 1991; French & Parrello Associates, PA.1993, and French & Parrello Associates, PA. 1998).

**Table 3-5** summarizes the location of where USACE obtained the hydraulic fill, the dredging time period, and amount. Over 1.5 million cubic yards of hydraulic fill were placed by USACE along the beach, bulkhead, and utility corridor between 1934 and 1948 (14 years). In addition, the City issued a contract to Standard Dredging Corporation in 1947 for dredging to fill the beach area and the park frontage on Great Kills Harbor with about 3.5 million cubic yards (New York City Department of Parks, 1947d). In 1951, additional fill was installed on the beach to improve swimming conditions at both high and low tides (New York City Department of Parks, 1949). This "City" dredge amount appears to be in addition to the 1.5 million cubic yards (shown in **Table 3-5**) dredged by USACE. USACE and the City therefore filled GKP with over 5.0 million cubic yards of hydraulic fill. **Table 3-5** does not include City dredge amounts or USACE dredging events that occurred in 1962 involving 27,000 cubic yards and 2002-2003 involving 136,428 cubic yards because it is unknown where the 1962 dredge volume was managed, while the 2002-2003 dredge volume was used for beach replenishment along Great Kills Beach.



### 3.3.5. Waste Fill

In addition to the hydraulic fill, the Site was also filled with over 15.1 million cubic yards of waste fill. **Table 3-6** summarizes information regarding waste fill volumes managed at the Site. The waste fill consists of brown to black fill (highly decomposed) comprised of incinerator residue (cinder-like material), coal ash, and refuse containing organic material with scattered glass, metal, rubber, and wood debris (Johnson, 1985 and New York City Department of Sanitation, 1941).<sup>5</sup> **Table 3-7** provides information characterizing the likely composition of waste fill. Waste fill underlies the Site, having the highest elevation at or about 35 feet above mean sea level (USGS, 1981 Arthur Kill, New York, 7.5 Minute Quadrangle Topographic Map, **Figure 1-2**). The waste fill extends approximately to the drainage channel that parallels Hylan Boulevard - principally in the northwest quadrant of GKP (Johnson, 1985). Waste fill was also installed north-northeast of Buffalo Street, extending approximately to the City property boundary (or what was known at the time as Emmet Avenue) with the residential community to the north and east. The southern extent of the waste fill appears to be north of the unnamed northeast to southwest drainage ditch that extends from the wetland area northwest of Oakwood WPCP to Great Kills Harbor (U.S. Coast and Geodetic Survey (USC&GS), 1949, **Figure 3-5**).

### 3.3.6. Sewage Sludge – Artificial Top Soil

From 1955 to 1959, approximately 213,000 cubic yards of clay were mixed with 285,000 cubic yards of sewage sludge and used to amend the surface of the waste fill area (Wrenn, 1975). The purpose of the clay and sewage sludge mixture was to enhance vegetative growth on top of the waste fill area. The New York City Department of Parks conducted a study regarding the costs of using “artificial top soil” made using sludge versus natural soil and found that the sludge amended soil could be produced in place, and was more cost effective at \$1,600 per acre versus \$4,500 per acre for the purchase of natural soil (Scanlon, 1957). Information regarding the source and potential composition including hazardous substances contained within the sewage sludge is presented in Section 4.2.2.

### 3.3.7. Holocene Deposit and Coastal Processes

Both the hydraulic fill and waste fill were installed on top of the underlying marsh and creek drainages. The four former drainages that were filled were named, from southeast to northwest, Mill Pond Creek, Flat Creek, Lockmans Creek, and Duck Creek (**Figure 3-66**). The Holocene marsh and creek deposits consist of dark gray silty clay to clayey silt with organic zones (peat) and sand lenses. The thickness of the dark gray clayey silt to silty clay ranges from 2 feet to 17.5 feet thick; however, it is fairly uniform across the Site with an average thickness of 7 feet. The dark gray clay-silt occurs at a depth of 5 to 25 feet below the ground surface with an average depth of 15 feet below ground surface (bgs) (French & Parrello Associates, PA. 1993). The clay-silt layer is associated with the former marsh deposits. The discontinuous sand seams and lenses within the more continuous clay-silt layer are associated with the former Holocene-creek channels and open water deposits. The approximate and northern lateral extent of the Holocene marsh deposit is shown in **Figure 2-10 and 2-11**. The lateral extent occurs at the former break in slope (now buried) between the Glacial till deposit that underlies Hylan Boulevard and the upland to the north and west.

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<sup>5</sup> In 1941, the City issued a detailed survey of landfill characteristics and waste managed by City’s Department of Sanitation. These same sanitation operations managed waste at the Oakwood Truck Fill and Great Kills landfill. As part of the 1941 Survey, the City investigated the composition of waste material including the distribution of food refuse, paper, wood, metal, glass, ashes and miscellaneous materials (see Section 4.2.1).



There is a laterally extensive peat located south of Oakwood Beach WPCP that extends from beneath the beach deposit eastward towards and into the ocean (shallow surf zone) along the shoreline and south towards the location of the former Beach Facility.

Several beach replenishment projects, as well as constructed shore structures along the Staten Island coastline from Fort Wadsworth to Miller Field to GKP, have altered the longshore drift and sediment supply. In the vicinity of GKP, the longshore sediment transport direction is from northeast to southwest. The series of groins located north of GKP and the Oakwood Beach outfall pipe have restricted sediment supply to GKP, and there is an erosional area (with negative sediment supply) south of the Oakwood WPCP as well as a depositional area at Crooke's Point (NPS, 2014).

### **3.3.8. Pleistocene Glacial Outwash and Till Deposits**

Underlying the Holocene deposit is the Pleistocene glacial outwash deposit. The glacial outwash deposit consists of dark red to brown stratified fine to coarse sand and gravel deposited by melt water from the receding front of the glacier. Mueser Rutledge Consulting Engineers (1991) installed 34 borings, of which 28 penetrated the top of the glacial outwash deposit, and 11 borings completely penetrated through the glacial outwash deposit into the underlying Raritan Formation (**Figure 3-7**). Similarly, 14 of 24 borings installed by French & Parrello Associates, PA penetrated the Holocene deposit into the underlying glacial outwash deposit. Based on these borings, the top of the glacial outwash deposit ranges in depth from 13 feet bgs to 28.5 feet bgs, but typically is present at 21.7 feet bgs. The uneven contact between the overlying Holocene deposit and the underlying glacial outwash deposit reflects the erosional nature of the contact. Similarly the glacial outwash deposit ranges in thickness from 16 to 22.5 feet, and the bottom of the outwash deposit (or top of the Raritan Formation) occurs at 35 to 50 feet bgs. The depth of the outwash-Raritan Formation contact is consistent with the depth to the Raritan Formation as shown on Plate 3 Configuration of the Surface of the Raritan Formation on Staten Island, prepared by Soren (1988) (**Figure 3-7**).

The glacial till deposit consisting of dark red-brown poorly sorted gravel and sand in a clay silt matrix is limited in aerial extent at the Site and is present underlying Hylan Boulevard and the former upland area (now buried) adjacent to Hylan Boulevard. The till is compact, dense (owing to ice-deposited origin) and overlies the glacial outwash. Site geotechnical investigations cited above did not penetrate the till deposit. The background borings for the OU1 environmental investigation penetrated and confirmed the presence of the till deposit on Site adjacent to Hylan Boulevard.

### **3.3.9. Cretaceous Raritan Formation**

Based on the 11 borings installed by Mueser Rutledge Consulting Engineers that penetrated the Raritan Formation, the upper Raritan Formation beneath the Site consists of a varicolored interbedded brown to tan to light gray to white medium to fine sand (with a trace of silt) and clayey silt (with mica), and occurs at an approximate depth ranging from 35 to 50 feet bgs. During drilling using hollow-stem augers and split-spoon samplers, the total number of blow counts (per two feet) increased when the top contact of the Raritan Formation was encountered. This reflects its compact and finer-grained nature than the overlying outwash deposit. One OU1 environmental investigation boring (OU1-3MW-7-I) advanced to a depth of approximately 55 feet encountered the top of the Raritan Formation at 52 feet bgs.

#### **3.3.10. Bedrock Formations**

Beneath the Raritan Formation is the Staten Island Serpentine which occurs at an approximate depth of 250 to 270 feet bgs, followed by the Manhattan Schist which occurs at a depth of 260 to 370 feet bgs



(Perlmutter, 1953, Soren, 1988, and Rosenberg, 2013). There are 3 deep boreholes (R56, R63, and R84) with two wells (R63 and R84) located near GKP (Perlmutter, 1953). The borehole and well information is summarized in **Table 3-8**.

### 3.3.11. Soil

A custom soil map and soil resource report for GKP and the Site was downloaded using the Web Soil Survey and data produced by the National Cooperative Soil Survey, which is operated by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) (see <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>, **Figure 3-8**). Soil is defined as the natural medium for growth of plants, and a term used in soil classification for the collection of natural, earthy materials at the Earth's surface in place modified or even made by man, containing living matter, and supporting or capable of supporting plants out-of-doors. The lower limit (of a soil) is normally the common rooting depth of native perennial plants.

**Table 3-9** summarizes the soil units identified at GKP and the Site. The table also includes information regarding the soil parent material, as well as the approximate Site acreage underlain by the soil unit/complex and the drainage class for the soil. The parent material (unconsolidated material upon which the soil has developed) is critical to identifying the soils associated with underlying fill, versus soil developed on native geologic deposits. **Table 3-9** correlates the identified Site soil units with both the hydraulic fill and waste fill. **Figure 3-8** shows the mapped soil units underlying the Site. The mapped location of soil units developed on "hydraulic fill" parent material include Barren Sand (BaA), Bigapple (BiA), Bigapple (BiB), and Jamaica sand (JaA), and are consistent with the history and known presence of hydraulic fill beneath Crooke's Point, the GKP Beach area, and the area underlying the utility corridor beneath Buffalo Street. Similarly, the mapped location of soil units developed on the waste filled area are consistent with the history and known presence of waste fill outlined within the TCRA boundary. Soil units associated with the beach dune (Hooksan-Dune [HAD]) and tidal wetlands (Sandyhook mucky [SaA], Ipswich –Pawcatuck complex [IPA]) are important because these soil types underlie areas that have not been filled, are not developed, or have not been occupied by past Site activities or development. The Ipswich – Pawcatuck complex is a soil that is representative of the Site soil prior to filling, and is a soil complex developed on a tidal wetland.

## 3.4. HYDROGEOLOGY

This section presents information regarding regional and Site-specific hydrogeology, including the association between geology, groundwater flow (quantity and quality), groundwater use, and the occurrence of surface water.

### 3.4.1. Regional Hydrogeology

"Fresh" groundwater beneath Staten Island occurs in both the bedrock and unconsolidated deposits under both unconfined and confined conditions (Soren, 1988). The freshwater lens beneath Staten Island is surrounded at depth on all sides by saline groundwater (Perlmutter, 1953) associated with saltwater intrusion from the Lower New York Bay and Raritan Bay to the south, the Arthur Kill to the west and the Van Kull Kill and Narrows to the north and east (Soren, 1988). The average ocean tide ranges from 4.3 feet at Fort Wadsworth to 5.3 feet at Tottenville (New York City Department of Water Resources, 1969). The shallow, surficial unconfined groundwater table adjacent to the coastal margin fluctuates with the tide along with the saltwater/freshwater interface.



The following subsections present information regarding: the occurrence of groundwater within the regional hydrologic units (e.g., the Upper Glacial Aquifer [UGA], the Raritan Clay [RC], and Bedrock [B] Aquifer Units [Rosenberg, 2013], **Figure 3-2**); the nature of the shallow regional groundwater table, the occurrence of surface water, and flow direction (basin and divide); the use of groundwater (both historical and present day); and regional groundwater quality.

### 3.4.2. Regional Groundwater Occurrence

Groundwater within the deep red-brown colored Pleistocene terminal and ground moraine (till) deposits occurs in unconfined to confined conditions and is dependent on the existence of clay and silt layers overlying more permeable layers of sand and gravel. The hydraulic conductivity is highly variable within the moraine deposits. The hydraulic conductivities for the Staten Island aquifer units are presented in **Table 3-10**. The sandy till is known to produce 10 to 1,500 gallons per minute (gpm) (Soren, 1988). The groundwater within the highly permeable glacial outwash is typically unconfined and the hydraulic conductivity is shown in **Table 3-10**. The glacial outwash deposit has a specific capacity ranging from 50 to 100 gallons per minute (gpm) per foot of drawdown (Soren, 1988).

Soren (1988) reported that four wells located near Tottenville and Huguenot (south-central Staten Island), ranging from 150 to 229 feet deep, produced groundwater from the Raritan Formation (likely the lower Lloyd Sand Member) and had reported yields ranging from 140 gpm to 200 gpm.

Soren (1988) also reported that there were no groundwater yield data for the Newark Supergroup. Since these rock units, as well as the Palisade Diabase, are not present (at the surface or in the subsurface) in the vicinity of the Site, the associated hydrologic information (while limited) is not presented.

There are no wells on Staten Island screened in the Manhattan Schist, but there are wells in the Borough of Manhattan and these wells have reported yields of 10 to 25 gpm with specific capacities ranging from 0.11 to 0.23 gpm per foot of drawdown. Soren (1988) reported the Manhattan Schist can supply small quantities of groundwater, but its depth and proximity to saline groundwater preclude its use for groundwater supply on Staten Island. Perlmutter reported that five wells penetrated the Staten Island Serpentine and had yields ranging from 0.5 to 14 gpm with an average yield of 5 gpm. The depth of the five wells ranged from 148 to 600 feet.

### 3.4.3. Shallow Groundwater and Surface Water Occurrence

A composite shallow groundwater table contour map of Staten Island shows two ground water mounds (potentiometric surface highs, **Figure 3-9**). The first mound is centered around Todt Hill and ranges in elevation from 100 feet above mean sea level (MSL) to 350 feet above MSL. A second mound is centered around Huguenot and ranges in elevation from 50 feet above MSL to 100 feet above MSL (Soren, 1988 – Plate 4). Soren mapped a groundwater divide extending from the southeast at Tottenville through the town of Great Kills to the northeast to Tompkinsville. The divide is approximately 1 mile west of GKP, and groundwater generally drains perpendicularly from the divide to either the south to southeast (in the vicinity of the Site) or to the north-northwest -- north of the divide.

The streams, ponds, and groundwater of Staten Island derive their water almost entirely from precipitation (Soren, 1988). Stream flow during dry periods is maintained by groundwater discharge into their channels (Soren, 1988). Soren speculated that minor amounts of water enter the groundwater system through leaking water mains and sewers (exfiltration) (Soren, 1988). A 1969 report prepared by the New York City Environmental Protection Administration, Department of Water Resources, Bureau of Water



Pollution Control indicated the Oakwood Beach WPCP total sewer tributary area was 23,000 acres<sup>6</sup> and “many of the old sewers in the Oakwood Beach area are below the groundwater level and have infiltration rates (New York City, 1969).” New York City estimated the infiltration rate to range from 2.0 MGD for dry to normal year and 4.0 MGD for a wet year (New York City, 1969). The estimated range in infiltration rates results in a per acre infiltration rate of 86 gallons per day per acre to 173 gallons per day per acre.

#### 3.4.4. Groundwater Use: Historic to Present Day

The only formation to produce commercially viable amounts of water (on Staten Island) is the Raritan Formation in the vicinity of Huguenot and Tottenville in southern Staten Island (Soren, 1988). All residential potable water is sourced from the municipal system which is operated by the New York City Department of Environmental Protection’s Bureau of Water Supply. The water is supplied by reservoirs located in Westchester County, Putnam County, and Ulster County, New York.

A 1910 Sanborn Map Sheet for the Borough of Richmond indicates at that time most of the potable water works supplying Staten Island (population of 90,000) were owned by the City and produced water from nine water supply pumping stations. The pumping station at Tottenville had three pumps and a combined capacity of 5,250,000 gallons and supplied water to southern Staten Island including the town of Great Kills. During 1917 to 1970, 67 percent to 96 percent (increasing over time) of the water supplied to Staten Island was provided by the City’s surface reservoir system described above. The remaining balance was supplied by several municipally owned wells on Staten Island. Since 1971, the New York State surface reservoir system has provided all of the public water supply for Staten Island.

While Staten Island groundwater is not used as a potable water supply, it is used as a source for other activities which may include irrigation, swimming pools, and automobile cleaning (e.g., carwash). These uses are restricted from using municipal supplied water (Soren, 1988).

Two sources of information were consulted regarding water withdrawals on Staten Island. The first was the NYSDEC Water Withdrawal Database involving withdrawal systems having the capability to withdrawal 100,000 gallons per day or more and the City’s DOHMH data regarding permitted non-potable water withdrawal systems. Based on a recent search of New York State Department of Environmental Conservation (NYSDEC) water withdrawal data, there are four ( $\geq 100,000$  gallons per day) water withdrawal systems located on Staten Island. These are 1) Silver Lake Golf Course located 4.8 miles north of GKP, 2) Richmond County Country Club located 2.4 miles north of GKP, 3) Arthur Kill Generating Station located 4.2 miles northwest of GKP, and 4) South Shore Country Club located 4 miles west of GKP. These water withdrawals are located on the opposite side of the groundwater water divide from GKP in a separate groundwater basin. There are no water withdrawals mapped in the groundwater basin shared by GKP as defined by the groundwater divide mapped by Soren (1988).

The City’s DOHMH data for the locations of licensed (permitted) non-potable water withdrawal systems within the Great Kills Staten Island Zone Improvement Plan (ZIP) codes 10306 and 10308 were requested and reviewed. These two ZIP codes surround the entirety of GKP. Based on the requested information, the DOHMH identified 13 water withdraw systems within ZIP Code 10306 and no wells in ZIP code 10308. The different subsurface geology in ZIP code 10306 versus ZIP Code 10308 likely provides the

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<sup>6</sup> Total acreage of Staten Island is 37,500 acres. Port of Richmond WPCP has a sewer tributary area of 15,000 acres (New York City, 1969). The Oakwood Beach Sewer Tributary Area has a 100% separate storm and sanitary sewer network.



basis for the presence of water withdrawal systems in ZIP code 10306 because ZIP Code 10306 is underlain by the productive and permeable glacial outwash, whereas ZIP Code 10308 is underlain by glacial till (a less productive and less permeable unit). The water withdrawal systems located in ZIP Code 10306 are presented in **Table 3-11** and on **Figure 3-10**. Twelve of the 13 water withdrawal systems in ZIP code 10306 are for inferred residential use (e.g., lawn irrigation and pools). Only one water withdrawal system was identified as associated with a business, Manfred Chevrolet, and its inferred use is likely associated with a car wash operation. The nearest permitted water withdrawal system for restricted non-potable use is located over 2,000 feet to the northeast of the Site. It is unlikely that Site groundwater would impact off site wells due to their distance from the Site and the presence of the intervening Oakwood Beach Watershed and adjacent ocean margin.

### 3.4.5. Regional Groundwater Quality

With respect to groundwater quality, Soren (1988) reported that groundwater beneath Staten Island is of a sufficient quality for most of New York City's permitted uses on Staten Island; however, wells screened in the shallow subsurface (less than 40 feet bgs) and located near the shore tended to have poorer groundwater quality. Soren (1988) reported that Staten Island groundwater tended to be moderately hard (60 to 120 milligrams per liter [mg/l]) as calcium carbonate ( $\text{CaCO}_3$ ) to very hard (more than 180 mg/l as  $\text{CaCO}_3$ ) with low to moderate chloride concentrations (8 to 70 mg/l). The hardness and chloride results were from wells screened in the glacial deposits ranging in depth from 22 feet to 180 feet deep, and were within 1 mile of the shore (most within 0.5 miles of the shore) (Soren, 1988). Iron concentrations of 5,400  $\mu\text{g/l}$  were detected in a groundwater sample collected from a well that tapped the Raritan Formation. The concentration of iron likely reflects the dissolved iron from minerals, including pyrite (iron sulfide), common in the Raritan Formation.

### 3.4.6. Site Hydrogeology

Based on investigations (soil borings) conducted in 1985, 1991, 1993, 1998, and the OU1 environmental investigation, the first occurrence of saturated soil ranged from 3 to 10 feet bgs with an average depth of 6.5 feet bgs. The OU1 environmental investigation also found that the Holocene deposit beneath OU1 (and likely OU2) is laterally continuous and with its clay-silt lithology has a lower hydraulic conductivity than the overlying waste fill and highly permeable underlying glacial outwash. The average depth of the glacial outwash deposit (within OU1) occurred at 8 feet bgs. Slug testing as part of the OU1 environmental investigation determined that the average hydraulic conductivity in Site monitoring wells was 753 feet/day, which is high, but consistent with literature estimates for the Upper Pleistocene formation (AECOM-Tidewater JV, 2017). The groundwater flows from the northern corner of the Site to the south towards the coastline and harbor (USGS, 1981). During the filling of GKP, the City noted certain portions of the waste filled area were always saturated due to groundwater and springs. The presence of the springs and mud slowed fill hauling and filling operations (New York City Department of Parks, 1949). The presence of springs suggests groundwater discharges to the surface, and an upward gradient exists in the vicinity of certain on Site areas.

Since the Site and GKP are located adjacent to and surrounded by three major saltwater surface water bodies, including Great Kills Harbor, New York Lower Bay, and Raritan Bay, the groundwater saline-freshwater interface occurs along the shoreline and extends at depth into the shallow Holocene deposit, Glacial Outwash deposit, and into the Raritan Formation beneath the Site. Based on the tide station located at Great Kills Harbor, the mean tidal range is 4.91 feet (e.g., difference in height between mean high water and mean low water) (see <https://tidesandcurrents.noaa.gov/stationhome.html?id=8519436>



(accessed on December 16, 2016). The maximum tidal range measured at the Great Kills Harbor ranges from -1.3 feet to 6.9 feet referenced to the Mean Lower Low Water (MLLW). The adjacent tidal surface water bodies influence the quality (brackish) and behavior (fluctuation) of surface water (drainage channels) and shallow groundwater at the Site.

Precipitation that infiltrates to the groundwater in the vicinity of the groundwater divide (discussed in Section 3.4.3), north to northwest of the Site, likely flows vertically downward (into the glacial deposits and Raritan Formation) to the south-southeast towards the Site, and then discharges toward the surface as the groundwater flow approaches the dense saltwater along and beneath the coast. This dynamic would explain the occurrence of springs as discussed above and noted by New York City Department of Parks (1949).

The presence of the bulkhead along Great Kills Harbor likely influences shallow groundwater flow and inhibits groundwater discharge from the Site into Great Kills Harbor. The vertical length of the steel sheet piling along the bulkhead ranges between 18 to 34 feet (Baker and Honig, 1982).

### 3.4.7. Site Surface Water Features

The major marine surface water features in the vicinity of GKP include the Lower New York Bay, Raritan Bay, and Great Kills Harbor. The historic tidal creeks formerly known as Mill Creek, Flat Creek, Lockmans Creek, and Duck Creek (**Figure 3-6**) and associated wetlands were filled, the surface graded, and the Site drainage reconfigured (as shown in the 1949 aerial photograph, **Figure 2-15**) with the following four man-made surface drainage channels:

- A Northeast to Southwest (Hylan Boulevard) Drainage Channel that drains parallel to Hylan Boulevard and extends from the intersection of Buffalo Street and Hylan Boulevard 3,800 feet to the southwest toward Fairlawn Avenue, and then turns to the east for 700 feet before discharging into Great Kills Harbor. The drainage channel is not a classified surface water body (e.g., for quality and use) by New York. This drainage channel is located along the north-northwest portion of Site.
- A Northwest to Southeast (Buffalo Street) Drainage Channel that receives drainage from the Willowbrook Parkway Right-of-Way (ROW) outside of GKP, extends beneath Hylan Boulevard, and drains parallel to Buffalo Street for approximately 2,680 feet. The channel then turns to the north for 660 feet, turns to the east where it is joined by Oakwood Beach Creek, and then drains an additional 1,500 feet parallel to the Oakwood Beach WPCP floodwall before discharging into the Lower New York Bay. This drainage channel is classified as “I/C.” The “I” classification designates the segment is marine water and indicates best usage for secondary contact recreation and fishing. The classification of “C” indicates the segment is best used for fishing. This drainage channel is located in the north and north eastern portion of Site and Site boundary.
- Oakwood Beach Creek receives runoff from the Oakwood Beach drainage basin, and also local storm sewers that discharge into a branch of the creek (USACE, 2015). Its flow is ultimately discharged via the west to east drainage channel (described above) into the Lower New York Bay. This creek is classified as “I/C.” A majority of the Oakwood Beach Creek is upstream and located off Site. A portion of the Oakwood Beach Creek forms the north-northeast boundary of OU1 and adjacent Oakwood Beach WPCP.



- Small Unnamed Northeast-Southwest 2,270 foot Drainage Ditch that parallels the beach and portion of the approximate hydraulic fill boundary (north of the Ranger Station) and shown in **Figures 3-4 and 3-5**), and extends from Buffalo Street and discharges into Great Kills Harbor. A portion of this drainage toward Great Kills Harbor was converted to a buried pipe and catch basin to convey surface runoff to the harbor. This unnamed drainage ditch is not classified by New York. This drainage is located along the southern portion of Site and boundary.

There are no Wild and Scenic Rivers designated by DOI within Richmond County.

### 3.5. WETLANDS

On Site wetlands consist of two categories 1) those identified by NYSDEC (e.g., state regulated) (**Figure 3-11**), and 2) those listed on the National Wetlands Inventory (NWI, e.g., federal regulated) prepared by the U.S. Fish and Wildlife Service (<http://www.fws.gov/wetlands/Data/Mapper.html>, **Figure 3-12**).

NYSDEC identified State-designated freshwater wetlands NA-10 on GKP in the vicinity of the area to the north and east of Buffalo Street; and to the north of the beach area adjacent to the Buffalo Street Drainage Channel, the Oakwood Beach Creek, and the former sludge drying beds south of the Oakwood Beach WPCP (USACE, 2009). Surrounding the NA-10 designated freshwater wetlands is a “Check Zone”, which is a NYSDEC-designated area that may contain additional wetlands because more precise delineation is usually required to determine the actual wetland boundary (<http://www.dec.ny.gov/imsmaps/ERM/viewer.htm>).

In addition to NYSDEC-designated freshwater wetlands, the NWI classified wetlands on GKP are primarily E2EM5P. The E2EM5P wetland classification represents “E” for Estuarine System, “2” for Intertidal Subsystem, “EM” for Emergent Class; “5” for - *Phragmites australis* Subclass, and “P” for Irregularly Flooded Water Regime. The E2EM5P wetlands are present in the vicinity of the NYSDEC-designated wetlands NA-10, as well as to the south and west of Buffalo Street, and mainly occupy the area within the 0 to 10 foot contour line within GKP. There is also a small area of E1EM5P near the mouth of the Northeast to Southwest (Hylan Boulevard) Drainage Channel at Great Kills Harbor near the southern end of Fairlawn Avenue. In addition to the E2EM5P, NWI identified two small wetland areas classified as PFO1A, which stands for Palustrine System, Forested Class and Broad-Leaved Deciduous Subclass. The two small designated PFO1A wetlands are located north of NPS Ranger Station and to the northeast of the Beach Parking Area. There is also a small wetland area classified as PSS1E: Palustrine System (P), Scrub-Shrub Subclass (SS), Broad-Leaved Deciduous Subclass (1), and Seasonally Flooded/Saturated Water Regime (E). The PSS1E wetland area is located northeast of the field area adjacent to the Northeast to Southwest (Hylan Boulevard) Drainage Channel. In summary, the majority of the wetlands on-Site are classified as E2EM5P, however smaller separate wetland areas designated PFO1A and PSS1E are also located within the Site.

#### 3.5.1 Site and Flooding Risk

The Site is prone to flooding and there are on Site areas with high flood risk (FEMA) (**Figure 3-13**). Mapped flood risk zones within the Site include zones VE, AE and X. Zone VE is defined as an area of high flood risk subject to inundation by the 1% annual-chance flood event with additional hazards due to storm-induced velocity wave action (a 3-foot or higher breaking wave). Zone AE is defined as an area of high flood risk subject to inundation by the 1% annual-chance flood event. Zone X is an area of moderate flood risk within the 0.2% annual chance floodplain; or areas of 1% annual chance flooding where average depths (flood waters) are less than 1 foot, where the drainage area is less than 1 square mile, or



areas protected from this flood level by a levee. At the Site, Zone VE occupies an area adjacent to the Great Kills Harbor bulkhead and wetland south and adjacent to the Oakwood WPCP. Zone AE occupies a slightly higher position on the landscape and is present within the areas ranging in sea-level up to 14 feet MSL adjacent to the on Site drainage channels and along the Bulkhead Road. Zone X includes areas along Buffalo Street north of the beach center (<http://apps.femadata.com/PreliminaryViewer/>). Adjacent Site residential communities are also prone to high flood risk. These include the Fairlawn Avenue residential community west of the Site, the Chesterton Avenue residential community, and residential community north of the Oakwood Beach WPCP.

The risk of flooding and flood zones at GKP was apparent during Hurricane Sandy (2012), when GKP experienced a storm surge of over 12 feet. Most of the surge followed (flowed into) the drainage channels and impacted OU1, the Oakwood Beach wetland area adjacent and north of the Oakwood Beach WPCP, the residential community to the north and the adjacent bulkhead area. In addition, the surge washed over the wetland areas occupying areas at or below the 10 foot topographic contour. The storm surge led to significant debris (flotsam consisting of trees and general refuse) on Site. The area above the 10 foot contour line occupying the waste fill area in OU2 did not experience flooding or surge due to the higher elevation. However, high winds contributed to a significant number of downed trees on the Site. The number of downed trees was likely not only due to the high winds but also to shallow tree root systems. With respect to damage, the storm surge significantly impacted the Nichols Marina dock area, while the beach center experienced moderate damage (Apostolou, 2013).

### 3.6. VEGETATION AND WILDLIFE

Much of the vegetation at Gateway National Recreation Area is altered by human activities (filling activities). Over 465 plant species have been identified within Gateway National Recreation Area, and of these NPS estimates that 33 to 50 percent are non-native species. Many of Gateway National Recreation Area's upland forest and grassland sites are artificial, and are the result of filling on former freshwater wetlands, saltmarsh, and intertidal mudflats. Vegetation within Gateway National Recreation Area was surveyed by Edinger et al. 2008 and classified into 35 associations. Of these, 20 are maintained by maritime influence including strong salt spray, high winds, and coastal processes such as dune deposition, shifting, and overwash. Edinger et al. (2008) divides these maritime communities into marine associations, estuarine associations, and terrestrial associations. Most of the remaining communities are classified as human-modified associations. **Table 3-12** presents the vegetation associations and communities present at GKP along with the underlying soil and vegetative assemblages. The dominant vegetation species in the upland areas of GKP consists of disturbed reed grass (*Phragmites*) marsh and mixed grasslands with thickets of small trees and shrubs (NPS, 1992). Other vegetation species associated with the upland areas include dominance of American hackberry with widespread Carolina poplar, bigtooth aspen, and pineoak. A deciduous forest is present along Hyland Boulevard that transitions into shrub thickets, early successional woodlands and grasslands to the north. Woodland species composition in this forest community (to the north) include sweetgums, tulip poplars, black cherry, mulberry, aspen, cottonwood, grey birch, blackgums, elms, and red cedar. Additional upland vegetation species in this area include red mulberry, staghorn, sumac, evening primrose, white clover, and common mullein.

On the Site, *Phragmites* (Reed-grass Tidal Marsh) dominates the majority of the area, particularly north of Great Kills Harbor and along the northern NPS property line, although additional successional forests (Northeastern Modified Successional Forest) grow west of the *Phragmites* (NPS, 2014) and are present



along Hylan Boulevard and along northern edge of Buffalo Street. Figure 3-14 presents the vegetation associations on Site.

### 3.6.1. Fire Ecology and Impact on GKP

NPS maintains the Wildland Fire Management Information System (WFMI). WFMI contains fire data (since 1980) regarding the number of fires that have occurred at GKP and the number of acres burned in each fire. Based on 1994 to 2016 data, GKP experienced 97 fires (one fire approximately every 84 days), the average fire burned area was 10.6 acres, the largest fire was 145 acres, and any given area within GKP burns once every 4.5 years (Liogys, 2016). When a fire occurs on GKP, the fire behavior is most intense in the areas covered with Phragmites because the fuel loads are greater than areas covered with trees and other upland vegetation. Typically, the fire spreads quickly in the Phragmites, and once it encounters the treed upland areas, the fire spread and height diminishes (Tomas Liogys, Personal Communication, John Wyckoff, August 30, 2016).

### 3.6.2. Wildlife including Endangered and Sensitive Species

Gateway National Recreation Area has more than 326 bird species, 101 fish species, 30 mammal species, 25 reptile and amphibian species, and over 500 invertebrates; including aquatic macro invertebrates, butterflies, moths, dragonflies, beetles, and other insects. At least 73 bird species nest in Gateway National Recreation Area. As noted in the “Marine Resources” section of the GMP/EIS (NPS, 2014), dolphins, whales, and seals sometimes inhabit Gateway National Recreation Area NPS managed waters. Harbor seals are winter visitors to Sandy Hook, Great Kills Harbor, Hoffman and Swinburne Islands, Jamaica Bay, and the Rockaway Inlet area and use local docks, the jetty at Breezy Point Tip, and other locations as haul-out areas (NPS, 2014).

The bird community in the Staten Island Unit of Gateway National Recreation Area is most varied at GKP, including Crooke’s Point. Wintering horned larks, snow buntings (*Plectrophenax nivalis*), and Lapland longspurs (*Calcarius lapponicus*) occupy shoreline habitat; and purple sandpipers (*Calidris maritima*), ruddy turnstones (*Arenaria interpres*), and gulls visit jetties at Crooke’s Point and north of the tidal flats at GKP (NPS, 2014). Fall bird migrants are numerous and include red-shouldered hawk (*Buteo lineatus*), rough-legged hawk, and northern harrier; as well as numerous warblers, vireos, orioles, and flycatchers. Shorebirds, wading birds, and waterfowl including herons, ibis, and egrets occupy seasonal ponds. Bank swallow (*Riparia riparia*) nests are present southeast of the parking lot.

In addition to the above, the 1990 amendment to the Gateway National Recreation Area’s 1979 GMP noted over 80 species of wildlife in the Great Kills/Crooke’s Point area. Species included waterfowl, wading birds, raptors and passerine species of birds. Open areas of beach grass provided habitat for large numbers of amphibians and reptiles. Diamond-backed terrapins (turtles) were found at the harbor on Crooke’s Point. Green frogs and Fowler’s toads were found in shaded areas south of Hylan Boulevard. Small mammals that do not require large areas of cover found at the Site included bats, mice, chipmunks, shrews, squirrels, and voles. Crooke’s Point contained diverse wildlife habitat and remains an important habitat for migrating birds and insects, particularly the Monarch butterfly (NPS, 2014).

**Table 3-13** presents the New York State-listed endangered and threatened species found within GKP, principally Crooke’s Point. Of the 13 identified species, two are animals (e.g., dragonflies) and 11 are plants.

**Table 3-14** summarizes the state and federally listed plant and animal species known to occur within Gateway National Recreation Area. This includes 42 birds, one invertebrate, two fish, six reptiles, eight



mammals, and 24 plants. There are no known federally listed or proposed endangered or threatened species at GKP under the U.S. Fish and Wildlife jurisdiction except for occasional transients (NPS, 1992).

### 3.6.3. Marine Resources

The GKP near shore zone lies within the New York Bight, an expanse of shallow-ocean located between Long Island to the north and east, and the New Jersey coast to the south and west. The term “bight” is a mariner’s term for a bend or curve in the shoreline, and the New York Bight is outlined by the east to west-trending coast of Long Island and north to south trending coast of New Jersey, which create a right angle where they intersect (NPS, 2014). The near shore zone adjacent to GKP is defined as that area of open water from the mean low-water line offshore to the 66-foot depth contour line. The New York Bight is located between the boreal waters of New England and the semitropical region to the south; this intersection of habitat types is important to marine species diversity (NPS, 2014).

The average salinity of the ocean areas is about 32 parts per thousand (ppt), subject to input from extreme periods of flooding rains. Winter water temperatures can be below 37 degrees Fahrenheit (°F), while summer temperatures can exceed 77°F. This coastal zone is dominated by tides that influence horizontal movement and transport of water, sand, and other sediments. The Staten Island shoreline along Raritan Bay from New Dorp Beach to Tottenville includes beach and intertidal and subtidal mudflats extending about one-quarter mile from the shoreline. GKP includes large areas of disturbed marsh ingrown with Phragmites and coastal shrub thicket at Crooke’s Point. (NPS, 2014).

More than 100 species of marine and anadromous boreal, temperate, and semitropical migratory fish use this productive ecosystem as a feeding area. A number of these species are commercially important or caught by anglers, including weakfish (*Cynoscion regalis*), striped bass (*Morone saxatilis*), summer flounder (*Paralichthys dentatus*), and winter flounder (*Pseudopleuronectes americanus*). Atlantic menhaden (*Brevoortia tyrannus*) also provide an important food source for marine wildlife, including fish, birds, and marine mammals. Anadromous species that use the Hudson or other coastal rivers to spawn include Atlantic sturgeon (*Acipenser oxyrinchus*), blueback herring (*Alosa aestivalis*), and Atlantic tomcod (*Microgadus tomcod*) (NPS, 2014).

## 3.7. CULTURAL RESOURCES

NPS has documented prehistoric archeological sites within GKP; however, the exact locations of the sites are not known. The Site has a low potential for historic and prehistoric archeological sites due to the extensive disturbance and landfilling.

## 3.8. CLIMATE AND PRECIPITATION

Information regarding the climate in the vicinity of GKP was obtained from the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service. The nearest weather station is located at the Newark Liberty International Airport. **Table 3-15** summarizes the mean monthly climatological data including average temperatures, precipitation, and snowfall. These data were obtained for the years 1996 through 2015. The total average annual rainfall exceeds 40 inches per year.



## 4. SITE OPERATIONS, SOURCES, AND HAZARDOUS SUBSTANCES

The following section describes operations (e.g., Bay Terrace Incinerator; the Oakwood Truck Fill; the GKP Marine Unloading Plant and Landfill; Oakwood Beach WPCP sludge drying beds and isolated dumping), sources (e.g., areas containing waste fill including refuse, incinerator residue, and coal ash, and sewage sludge) and associated hazardous substances at the Site. As a result of these former operations, the operation areas and the waste filled area are considered sources where hazardous substances were deposited, stored, disposed, or placed.<sup>7</sup>

### 4.1. OPERATIONS

The following subsections describe operations at the Site including: the Bay Terrace Incinerator; the Oakwood Truck Fill; the GKP Marine Unloading Plant and Landfill; and the Oakwood Beach WPCP USULs and sludge drying beds (**Figure 4-1**). These operations contributed to source areas containing waste fill, incinerator residue, coal ash,<sup>8</sup> radiological artifacts, and sewage sludge. These source areas are associated with releases of hazardous substances, including radiological contamination, within the Site boundary. These operations also included former tanks (both above ground and underground tanks), USULs where releases may have occurred, as well as use of chemicals (disinfectant) to treat the waste. **Table 4-1** summarizes Site information regarding operations, operation dates, source, and hazardous substances.

#### 4.1.1. Bay Terrace Incinerator Operation (1926-1941)

The Bay Terrace Incinerator was constructed by the New York City Department of Sanitation in 1926, operated by the City, and abandoned in 1941 (Sanborn Fire Insurance Map, 1937 and New York City Department of Parks Press Release, 1941). The Bay Terrace Incinerator was formerly located in the north-central portion of the Site. Based on a 1937 Sanborn Fire Insurance Map, the Bay Terrace Incinerator consisted of two buildings, a “Private Garage” and a “Burner House” (**Figure 2-12**). The Private Garage consisted of a one- to two-story building with truck storage (for 20 sanitation trucks), a locker room, auto-repair shop, and boiler room area. A coal fired boiler provided steam for heating the garage. A stove provided heat for the auto repair area. There was also a gasoline tank associated with the garage, presumably for filling Department of Sanitation trucks and other vehicles with fuel. The Burner House consisted of a three story building with a ramp to a second story entryway and circular brick chimney.

Walsh (2001) identified the “Great Kills” incinerator (a.k.a. Bay Terrace Incinerator) and reported that it operated between 1927 and 1947, had a design combustion capacity of 136 tons/day, and combusted 712 kilotons of waste during its operating life. Walsh (2001) also estimated that an incinerator’s residue production is approximately equivalent to 26.5% (on average) of the refuse mass combusted. This

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<sup>7</sup> PA guidance defines a source as, “an area where a hazardous substance may have been deposited, stored, disposed, or placed.”

<sup>8</sup> The terms “incinerator residue” and “coal ash” are used to differentiate the two “ash” components. Incinerator residue, generated from the burning of waste, unless specified, includes incinerator bottom ash and slag. Conversely, coal ash includes coal fired boiler slag (the melted mineral component) and bottom ash. The two categories do not include the fly ash component since the incinerator and boiler operations (prior to the 1950s) did not include air pollution controls capable of capturing fly ash (Walsh, 2001).



suggests the Bay Terrace Incinerator produced 36 tons per day of incinerator residue if it operated at capacity. It is likely the Bay Terrace Incinerator operated at a lower rate than at capacity because it received less refuse as a result of being located on Staten Island, and outside the densely populated Manhattan area (Walsh, 2001). Assuming the start of operations occurred in 1926 and ceased in 1941 (approximately 15 years), and a daily residue production rate of 36 tons per day, a total of 197,100 tons of residue were produced by the Bay Terrace Incinerator. Assuming a cubic foot of incinerator residue weighs 65 pounds results in a reasonable maximum of approximately 224,600 cubic yards of residue were disposed of in the vicinity of the Bay Terrace Incinerator. The filling of the area in the vicinity of the Bay Terrace Incinerator is confirmed by the 1940 aerial photograph, and 1943 (revised from 1936) contract drawings prepared by the City involving dredging and filling of the Site.

#### **4.1.2. Oakwood Truck Fill Operation (1934-1948)**

Sanitation trucks from Staten Island dumped refuse within an area of the Site historically referred to as “Oakwood Truck Fill”. The Oakwood Truck Fill commenced operations in 1934 and continued until August 21, 1948. Based on a 1949 City press release, over 4 million cubic yards of waste fill were deposited at the Site during the 14 years of operation (City Department of Parks, Press Release, 1949). The exact location of the Oakwood Truck Fill operations on Site is uncertain; however, they were most likely co-located with the Bay Terrace Incinerator. Sanitation trucks servicing Staten Island likely used the access road for the Bay Terrace Incinerator to dump their waste to be burned in the incinerator, or dumped at the Site, particularly after incinerator operations ended in 1941.

#### **4.1.3. Great Kills Park Marine Unloading Plant and Landfill Operation (1944-1948)**

From 1944 to the end of 1948, eight City waterfront disposal operations were utilized for unloading sanitation trucks servicing Manhattan and Brooklyn. The waste was then placed onto scows which were towed by tugs to the two Marine Unloading Plants (Lambert Unloader and Wellman Unloader) and Landfill operated by the City Department of Sanitation. As described in Section 3.3.5, over 15.1 million cubic yards of waste fill from both the Oakwood Truck Fill and Marine Unloading and Landfill operations were disposed at the Site (New York City Department of Parks, 1949).

The Lambert Unloader was formerly in operation at Rikers Island Landfill, and was transferred and erected on a foundation constructed at the GKP Marine Unloading Plant. The original boilers on the Lambert Unloading Station were replaced with 250 horse power (HP) boilers. The boilers were fired with fuel oil and produced steam used to operate the unloader. The foundation design for the Lambert Unloader indicated that three dry wells, with a diameter of 3 feet and a depth of 3 feet filled with 1.5-inch gravel, were constructed in the foundation to manage water (precipitation) and releases (if any) in the vicinity of the boilers (New York City Department of Parks, 1943). Similarly, the Wellman Unloader formerly operated at the Soundview Park Landfill, was transferred and erected on a foundation constructed at the Marine Unloading Plant (New York City Department of Parks, 1943).

Once the waste arrived at the Marine Unloading Plants, the waste was off loaded using “diggers” having bucket capacities ranging from 2 to 10 cubic yards. The steam diggers (unloaders) were powered by two oil fired boilers situated on an unloading platform equipped with two 10,000 gallon fuel oil tanks (City Department of Sanitation, 1947). The diggers transferred the waste from the scows via bucket into dump wagons having a capacity of 41 cubic yards. A tractor then pulled the dump wagon to an operation point on the fill where the waste was dumped, pushed, and compacted by bulldozers, and then disinfected using a flusher truck that sprayed the waste with disinfectant. The disinfectant was comprised of 7.5 gallons of



an orthodichloro-benzene based mixture combined with 1,000 gallons of water. The waste was then covered with layers of “clean sand and cinders” to seal in gases and odors.<sup>9</sup> Compacting and grading of surface materials were performed to complete the landfilling operation (New York City Department of Parks, June 30, 1949 Press Release; and City Department of Sanitation, 1947 Annual Report).

In addition, there was an outbuilding located west of the unloading plants at the eastern end of a road that extended off Hylan Boulevard near what is today, Fairlawn Avenue. Based on the nature of the building, its location, and Site operations, the inferred operations within the outbuilding likely included heavy equipment storage, maintenance, and repair (**Figure 2-15**).

#### **4.1.4. Oakwood Beach Water Pollution Control Plant Operations (1956 to Present)**

The Oakwood Beach WPCP was constructed by the City in 1954 and 1955, with operations commencing in 1956. The plant replaced a screening plant located at Oakwood Beach. The WPCP was designed to serve a population of 60,000 with a treatment capacity of 15 MGD. The constructed Oakwood Beach WPCP operations included screening and grit removal, sewage pumping, aeration tanks, and final solids settling tanks. The WPCP had three sewage pumps (two rated at 17.5 MGD and one rated at 12.5 MGD) powered by variable speed motors, and one diesel engine electric generator for emergency power. Chlorinated effluent from the WPCP was discharged via a 54-inch diameter pipe outfall located approximately 3,150 feet offshore in the Lower New York Bay.

The WPCP received a portion of its influent from a 30-inch diameter reinforced concrete pipe (RCP) sanitary sewer. This sanitary sewer extends beneath the Site and runs northeast-southwest parallel to Hylan Boulevard from Fairlawn Avenue to Buffalo Street, where it turns to the southeast to the Oakwood Beach WPCP (New York City Department of Parks, 1945). The invert elevation of the sanitary sewer line ranges from 7.0 feet below MSL to 13.6 feet below MSL. This sanitary sewer line was reconstructed in 1945. The reconstruction effort involved raising the elevations of the existing manholes by installing manhole extensions (in some cases over ten feet) to prevent the manholes from being buried due to the placement of waste fill.

WPCP activated sludge was digested and managed in sludge drying beds in an area adjacent (south) of the WPCP (U.S.G.S., 1966; City, 1969) on the Site. By 1966, the WPCP utilized approximately 13 acres of sludge drying beds (USGS, 1966). In the vicinity of the sludge drying beds there is buried piping, having diameters ranging from 8-inches to 12-inches. The configuration and use of the buried piping is unknown and its association with the sludge drying beds is inferred by its location. The dried sludge was removed from the drying beds and stockpiled for use as soil conditioner (a.k.a. soil amendment). The City conducted soil amendment efforts from 1955 to 1959 at the Site. During this time, the City used approximately 213,000 cubic yards of clay mixed with 285,000 cubic yards of sewage sludge to create “artificial top soil” to facilitate the revegetation of the waste filled area (Wrenn, 1975).<sup>10</sup>

By 1965, the WPCP reached its design capacity due to rapid Staten Island development. In 1969, Greeley and Hansen prepared designs to upgrade the WPCP with an increased treatment capacity of 40 MGD. The

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<sup>9</sup> The nature of the “cinders” is unknown; however, the term “cinders” hereinafter means both coal ash and incinerator residue since the City did not distinguish between the two materials and likely used both.

<sup>10</sup> The Oakwood Beach WPCP is assumed to be source of the sewage sludge due Oakwood Beach WPCP close proximity to the Site, use of sludge drying bed, and the fact it commenced operations at about the same time sludge was used on Site.



Oakwood Beach WPCP was upgraded in the late 1970s.<sup>11</sup> The WPCP upgrade included installing 6 heavy-duty mechanically raked bar screens (screenings were disposed of by truck to a sanitary landfill) and 4 primary sewage solids settling tanks with scum removal and incineration. Sludge discharged to the sludge box was pumped to 3 fixed covered digesters for storage, and then pumped via a 10-inch diameter underground force main to Port Richmond for disposal. As part of the upgrades the sludge drying beds were removed from service. The upgrade also included installing a new Lower New York Bay outfall located 6,000 feet from shore at a low tide depth of 15 feet below MSL.

The upgrade of the WPCP also extended sewer service to western Staten Island via installing an 8-foot diameter “West Branch” sewer interceptor beneath the Site. The West Branch Interceptor was constructed beneath the Site along a 75-foot wide permanent line of easement that extends west to east from Fairlawn Avenue to the Oakwood Beach WPCP (**Figure 4-1**). The construction method used for the interceptor is unknown. Two possible construction methods (used by Greeley and Hansen Engineers for estimating the cost of construction) involved the subsurface pipe-jacking method and the cut and cover trench method. The subsurface pipe-jacking method involves a subsurface boring machine that removes the geologic materials at the head of the boring machine and jacks pipe sections behind the borehead. Material removed from the boring machine is transported through the borehole to a vertical shaft for removal to the surface. The cut and cover method involves excavating a stabilized open trench that is 10 feet wide and 5 to 50 feet deep, placing a 12- to 25-foot long section of pipe in the trench and then covering that portion of the completed pipe as the next section of trench is being dug. The disturbance of waste fill and natural geological materials would have occurred under both construction methods; however, more material (fill and geologic materials) would have been disturbed using the cut and cover method as opposed to the pipe-jacking method.<sup>12</sup>

#### 4.1.5. Isolated Areas of Dumping on Site

During the execution of the field work for the TCRA conducted in 2013 and 2014 and the environmental investigation completed within OU1 in 2016, several isolated areas of dumping were identified on the Site, including an area within the sludge drying beds. Two of the identified areas contained drums that were empty and heavily rusted. There were no labels or other markings on the drums. In addition, areas containing an abandoned car, railroad ties, propane cylinders, and isolated areas with spilled tar-like material were identified.

In addition to the above, NPS Park Police Criminal Incident Reports (CIRs) that identified incidents of dumping on GKP were reviewed and compiled. Based on available CIRs from 2006 through June of 2016, there were a total of 82 incidents of dumping (average 8 per year) involving: 7 incidents in 2006; 8 incidents in 2007; 7 incidents in 2008; 3 incidents in 2009; 8 incidents in 2010; 16 incidents in 2011, 17 incidents in 2012; 2 incidents in 2013; 12 incidents in 2014; 10 incidents in 2015; and 3 incidents in 2016 (partial year). The CIRs indicate: 18 incidents of dumping garbage (e.g., household refuse and beer bottles etc.); 36 incidents of dumping of construction debris (e.g., sheetrock, broken concrete, glass, wood, shingles, soil, piping, granite slab, tile, plumbing fixtures; brick, plywood, paneling, sand, and gravel); 8 incidents of dumping vegetation debris (e.g., branches, brush, leaves, and wood chips); 6

<sup>11</sup> The year the WPCP upgrades were completed is unknown and likely occurred over time depending on the system being upgraded. Based on design drawings drafted in 1974, revised in 1978, the upgrades appear to have been completed before the end of 1978.

<sup>12</sup> Information regarding the construction method and resulting disturbance of waste fill and subsurface geologic materials is an identified data gap.



incidents of dumping electronic components (e.g., air conditioner, televisions, computer monitors; and hand tools); 9 incidents of dumping automobile components (e.g., tires, oil filter, and batteries); and 8 incidents of dumping paint and surface coating containers (e.g., paint and polyurethane containers - some contained liquid). In addition to the above, other incidents involved dumping furniture, shopping cart, medical waste (hypodermic needles), and containers of cooking oil. All of the dumping incidents were addressed by NPS and the wastes were collected and disposed of off Site. The areas where dumping occurred included the areas near Bulkhead Road, Crooke's Point, GKP parking lots, Wetland Road, and Model Airplane Field area (listed in order of approximate number of incidents).

#### 4.2. DESCRIPTION OF SITE SOURCES AND ASSOCIATED HAZARDOUS SUBSTANCES

The following section provides a description of site sources resulting from operations. The Site sources resulted from operations described in the preceding subsection and were identified using historical information (including the 1941 Survey of Landfill Characteristics, and City Department of Sanitation Annual Reports) as well as information obtained as part of the IRA, TCRA and OU1 environmental investigation completed in 2016. The composition and character of the sources associated with historical operations at the Site provides insight into the hazardous substances present in environmental media. Historically, the wastes were managed in a manner that caused them to be mixed and therefore the identification and classification of these materials in the subsurface at the Site is difficult (AECOM-Tidewater JV 2017). The operation of the Bay Terrace Incinerator (see Section 4.1.1) resulted in areas adjacent to the incinerator being filled predominantly with incinerator residue; however, other areas of the Site were filled with waste from trucks and scows. **Figure 4-2** presents the association between the Site operations, sources, and hazardous substances. The identification of sources (e.g., areas containing refuse, incinerator residue, coal ash, and sewage sludge) and associated hazardous substances shown in **Figure 4-2** is based on the 2016 OU1 environmental investigation (AECOM-Tidewater JV, 2017), Final TCRA Report (Tidewater, 2015), IRA Report (Cabrera Services, 2010), and studies conducted by the USEPA and others. The most recent 2016 OU1 environmental investigation identified several metals (arsenic, iron, lead) and organic chemicals (Aroclor 1254, Aroclor 1260, benzo(a)pyrene toxicity equivalent (TEQ), and dioxin TEQ) that exceeded background and frequently exceeded residential RSLs in surface and subsurface soil (waste filled area) within OU1.

Source areas within the Site contain the following materials:

- Waste Fill: material derived from New York City Department of Sanitation's historical waste disposal operations at the Site. The waste fill includes the following components:
  - Refuse: heterogeneous mixture of municipal waste, such as wood, paper, glass, metal, food waste, sand, straw, street sweepings (e.g., leaves, branches, dust and soil), and excavation and construction materials.
  - Incinerator Residue: incinerated waste material derived from the Bay Terrace Incinerator (on Site), off Site City incinerators, Multiple Dwelling Combustors, and other incinerators (hospitals, etc.).
  - Coal Ash: ash from commercial and residential coal fired boilers/furnaces.
- Sewage Sludge: used as soil amendment (artificial topsoil) to facilitate vegetative growth over the waste filled area; sewage sludge may also remain in the former sludge drying beds.



The radiological artifacts present at the Site and identified during the IRA, TCRA, and OU1 environmental investigation were generally found within the waste fill, but may also be associated with sewage sludge. The radiological artifacts at the Site are incidental items in the waste fill (and possibly sewage sludge) due to the historical use and subsequent disposal of radium in medical devices (brachytherapy), radioluminescent markers and dials, commercial products, and industrial applications (radiography).

#### 4.2.1. Waste Fill

Waste fill (over 15.1 million cubic yards) was disposed of at the Site as a result of the Oakwood Truck Fill, Marine Unloading Plant and Landfill Operations. The waste fill is a source of radioactivity detected at the Site (See Section 4.2.3.). The waste fill consists of a heterogeneous mixture of ash, wood, paper, glass, metal, food refuse, sand, straw, street sweepings (e.g., leaves, branches, dust and soil), and excavation and construction materials (City Department of Sanitation, 1941). Other items in the waste fill include clothing, shoes, large cartons, boxes and pack cases. As part of a 1941 survey of landfill characteristics<sup>13</sup>, the City found the amount of the waste materials (e.g., ash, food refuse, wood, paper glass and metal, etc.) varied seasonally, and that the ash component comprised the largest percentage (by weight) during the fall, winter, and spring months and paper was the largest component by volume. The next largest categories of waste materials included food, refuse, and glass. Metal, wood, and miscellaneous waste materials had lower volume/weight percentages. Included in the metals category were items such as bed-springs, stoves, table tops, plumbing fixtures, and tin cans (New York City Department of Sanitation, 1941).

With respect to the ash, the City 1941 survey did not make a distinction between coal ash and incinerator ash. The ash component consists of both incinerator residue and coal ash. The City reported landfilling was “the only means for disposing of such non-combustibles, such as ash, tin cans, building and construction wastes, and the incinerator residue from the Department’s destructor plants (a.k.a. incinerator plants)” (City Department of Sanitation, 1947). As described above, the City found in its 1941 Survey that the amount of the ash component increased during the fall, winter, and spring months reflecting in part the contribution of coal ash from residential, industrial, and commercial coal fired boilers used for heating during the cooler months. In addition to coal ash, City incinerators, hospital incinerators, and apartment house incinerators (a.k.a. multi-dwelling domestic waste combustors [DWCs]) were sources of incinerator residue (Walsh, 2001). **Table 4-2** summarizes the ranges in percent (volume and weight) and the average percent for waste materials identified by the City. In addition, **Table 4-2** provides an estimate of the volume and weight of these components at the Site calculated using survey average percentages and a total assumed Site volume of 15.1 million cubic yards of waste fill.

The following subsections present information regarding the origin, amount, and hazardous substances including metals, organic compounds, and radionuclides (including radium-226, thorium-232, uranium-238, uranium-235 and uranium-234) contained in the refuse, incinerator residue, coal ash, sewage sludge, and radiological contamination and artifacts.

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<sup>13</sup> The City issued a 1941 report entitled “Survey of Landfill Characteristics.” As part of the Survey, the City examined waste from 168 dump trucks from 19 of 41 sanitation districts servicing Baychester and Soundview Landfills in the Bronx, Juniper Valley Landfill in Queens, and the Fairfield and Floyd Bennett Field Landfills in Brooklyn. The 1941 Survey was used to support NPS’s understanding of the composition of the fill disposed of at the Site.



#### 4.2.1.1. Refuse

The refuse component of the waste fill consists of municipal waste such as wood, paper, glass, metal, food waste, sand, straw, street sweepings (e.g., leaves, branches, dust and soil), and excavation and construction materials. Based on **Table 4-2**, the refuse component of the waste comprised approximately 11.5 million cubic yards out of the 15.1 million cubic yards of waste fill deposited on Site (the balance [[3.6 million cubic yards]] is believed to be associated with the ash comprised of both incinerator residue and coal ash).

#### 4.2.1.2. Incinerator Residue

Incinerator residue from the Bay Terrace Incinerator was managed and disposed of on Site (see Section 4.1.1). In addition, between 1944 through the end of 1948, there were eleven incinerators owned and operated by the City Department of Sanitation (Walsh, 2001). These 11 incinerators may have contributed incinerator residue that was transported to the Site via scows with the City waste. The incinerator residue is a source of hazardous substances (see below) and radiological contaminants (see Section 4.2.3.).

Walsh estimated that the operating incinerators during the 1944 through 1948 time period combusted 4,613 kilotons of waste and produced 1,246 kilotons of incinerator residue. **Table 4-3** presents the data for each incinerator, including the plant location, combustion design, year opened and year closed, air pollution control class (as defined by Walsh), the amount of waste combusted, and the calculated amount of residue produced (Walsh, 2001). DWCs also contributed incinerator residue to sanitation waste that was also transported to the marine unloading operations via scows. Walsh reported that by the 1920s apartment house incinerators (i.e., DWCs) were widely used in U.S. cities and by 1960 the City had more than 11,000 DWCs. Walsh estimated that the DWCs in the City combusted 1,632 kilotons of refuse and generated 609 kilotons of DWC residue (Walsh, 2001). Based on these estimates, approximately 1,246 kilotons of incinerator residue was generated by Municipal Waste Combustors (MWCs) and 609 kilotons of incinerator residue was generated by the DWCs between 1944 and 1948 (Walsh 2001). The Bay Terrace Incinerator also contributed approximately 197 kilotons of incinerator residue to the Site. Collectively, incinerator residue from MWCs (1,246 kilotons from 1944 to 1948), DWCs (609 kilotons from 1944 to 1948), and the Bay Terrace Incinerator (197 kilotons from 1926 to 1941) resulted in an estimated total of 2,052 kilotons of incinerator residue being managed at GKP.<sup>14</sup> These incinerators did not have air pollution controls (APCs), suggesting that the incinerator residue associated with waste fill at GKP would not have included fly ash.

Identified hazardous substances associated with incinerator residue include inorganic, organic, and radiological contaminants. Walsh (2001) identified metals including chromium, copper, and lead in incinerator residue. These metals are present at concentrations above RSLs for residential soil and above Ecological Screening Values (ESVs) established by NPS. USEPA studies regarding environmental sources of PAHs and dioxins, confirmed these hazardous substances are present in the incinerator residue from municipal trash incinerators (ATSDR, 1995; USEPA, 1993). PAH concentrations in ash samples from domestic municipal incinerators ranged from not detected to 7,400  $\mu\text{g}/\text{kg}$  (ATSDR, 1995).

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<sup>14</sup> The portion of MWC and DWC incinerator residue transported to and managed at the Site versus other City landfills is unknown. The incinerator residue amount is a reasonable maximum when compared to the potential estimated total of 3,250 kilotons of ash (both incinerator ash and coal ash) that may have been managed at the Site based on the percentages of different waste components found in the waste (See Table 4-2).



Combustion of municipal waste mixed with substances containing chlorine and chlorinated organic chemicals is a source of dioxins, although concentration of dioxins in bottom ash, were negligible and more prevalent in ash, particularly fly ash (USEPA, 1993). The TCRA identified elevated levels of radioactivity associated with cinder-slag (incinerator residue) mixed with the waste fill. More information regarding incinerator residue and radiological contamination is described in section 4.2.3.

#### 4.2.1.3. Coal-Fired Boiler Bottom Ash

The sources of the coal ash present within the waste fill include residential, commercial and industrial coal fired boilers.<sup>15</sup> The coal ash from residential, commercial and industrial coal fired boilers was transported with city waste to the GKP Marine Unloading Plant via scows or transported with the trucked waste as part of the Oakwood Truck Fill.

Similar to MWCs and DWCs, the coal fired boilers did not have APCs; therefore, the coal ash (managed at the Site) did not contain fly ash and consisted of bottom ash with boiler slag (a melted mineral component in coal ash).

Depending on the furnace, the coal combustion process results in the generation of ash, (about 10 percent of the original volume of combusted coal). The typical mineral content in coal used in the U.S. ranges from 3 to 30 percent, with the average being 10 percent. During the combustion process, much of the ash is entrained with hot flue gases to form fly ash. The remainder of the ash, which is too large or heavy to be entrained, settles to the bottom of the boiler to form bottom ash. Liquid slag forms when the bottom ash melts. Bottom ash is typically gray to black, coarse granular material with a porous surface texture. Bottom ash grain size typically ranges from fine sand to fine gravel (AECOM, 2012).

Based **Table 4-2** and a total estimated tonnage of various waste components present at the Site including 3,250 kilotons of ash (incinerator ash and coal ash) results in a reasonable maximum of 1,198 kilotons of coal ash (3,250 kilotons of total ash minus 2,052 kilotons of incinerator residue). Identified hazardous substances associated with coal ash include metals, PAHs, and radiological contaminants (ATSDR, 1995, AECOM, 2012 and AECOM-Tidewater JV, 2017). Elemental analyses of bottom ash samples collected from five power plants had detected concentrations of arsenic, chromium and cobalt above RSLs (AECOM, 2012). Incomplete combustion or burning and use of coal are also known sources of PAHs (ATSDR, 1995).

In addition to metals and PAHs, coal also contains naturally occurring uranium and thorium as well as their decay products. The radioactivity of coal varies over two orders of magnitude depending on the type of coal and source region. The concentrations of uranium-238 and thorium-232 in coal can range from 0.08 picocuries per gram (pCi/g) to 14 pCi/g, and 0.08 pCi/g to 9 pCi/g, respectively (Dehmel, 1993). Analysis of 800 coal samples indicated only 0.5 percent of the samples had a concentration of uranium-238 exceeding 10 pCi/g. Another analysis of over 1,000 U.S. coal samples had arithmetic average concentrations of uranium-238 and thorium-232 of 0.6 pCi/g and 0.5 pCi/g, respectively. Concentrations of uranium-235 are much lower than concentrations of uranium-238 (Dehmel, 1993).<sup>16</sup> Studies of coal

<sup>15</sup> Coal fired power generation plants are not included in this analysis because these sources managed the resultant coal combustion products very differently from boilers, and likely did not dispose of their ash in the City sanitation waste stream.

<sup>16</sup> The abundance of uranium-235 in natural uranium is only 0.72 percent in comparison to 99.27 percent for uranium-238. Assuming the relative abundance of uranium-235 to uranium-238 in coal has the same ratio and taking into account the difference in decay rate between uranium-235 and uranium-238, for each 1 pCi/g of uranium-238 in coal there should only be about 0.5 pCi/g of uranium-235.



ash indicate that the coal ash tends to have slightly higher concentrations of radionuclides than the unburned coal. The range of radioactivity in coal bottom ash as measured by concentrations of radium-226 ranges from a low concentration of 1.6 pCi/g, an average of 3.5 to 4.6 pCi/g, to a maximum concentration of 7.7 pCi/g (USEPA, 2000).

As described above, coal contains naturally occurring radionuclides, and as such the radionuclides in the coal ash may become concentrated or exposed to the accessible environment as a result of the coal combustion and ash management process (USEPA, 2000). Coal ash and other coal combustion products may be considered Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM). The National Academy of Sciences defines TENORM as “any naturally occurring material not subject to regulation under the Atomic Energy Act whose radionuclide concentrations or potential for human exposure have been increased above levels encountered in the natural state by human activities” (USEPA, 2000).

#### 4.2.2. Sewage Sludge

This subsection describes the source and the nature of the sewage sludge that was mixed with clay to amend the surface of the waste filled area. The source of the sewage sludge is assumed to be the Oakwood Beach WPCP sludge drying beds that were installed in 1956 (eight years after completing the filling of the Site in 1948) and expanded to over 13 acres by 1966. The City removed the sludge drying beds from service when the WPCP was upgraded (approximately in 1978), and a force main was installed to pump the sludge to the Port of Richmond for disposal. The sludge drying beds are located on the Site immediately adjacent to and west of the Oakwood WPCP. During the years 1956 to approximately 1978, the sludge from the WPCP was managed using the sludge drying beds.

Sewage sludge from the WPCP was used to amend the surface of the waste fill at the Site during 1955 through 1959 after the City opened GKP as a City park. The soil amendment used 285,000 cubic yards of sewage sludge mixed with 213,000 cubic yards of clay. The total volume of soil amendment (a.k.a. artificial soil) applied to the Site was 498,000 cubic yards. As part the TCRA, and OU1 environmental investigation, gamma surveys were conducted in the sludge drying beds and showed elevated radioactivity readings. These elevated radioactivity readings appear to be associated with radiological artifacts imbedded in the waste fill (Tidewater, 2015 and AECOM-Tidewater JV, 2017).

Identified hazardous substances in sewage sludge are based on surveys conducted by the USEPA. These surveys were reviewed to evaluate the potential hazardous substances associated with the management and land application of sewage sludge. The USEPA conducted three national sewage sludge surveys since 1988 to determine the presence of contaminants including, metals, dioxins, SVOCs, PCBs and other pollutants (see <https://www.epa.gov/biosolids/sewage-sludge-surveys>). As part of this report, the sludge concentration data in the following two sources were reviewed:

- USEPA. 1992. Statistical Support Documentation for the 40 CFR, Part 503, Final Standards for the Use or Disposal of Sewage Sludge Final Report (Volume I). November 11, 1992.
- USEPA. 2009. Targeted National Sewage Sludge Survey Sampling and Analysis Technical Report. January 2009.

The USEPA 1992 Final Report is based on the 1988 National Sewage Sludge Survey (NSSS). The NSSS data for sewage sludge generated from publicly owned treatment works (POTWs) that had daily flows ranging from 10 MGD to 100 MGD were summarized (i.e., this range of daily flows is consistent with the



Oakwood Beach WPCP daily flow range of 15 MGD to 40 MGD). The NSSS data indicates that the mean concentrations of arsenic and bis(2-ethylhexyl)phthalate were detected in sewage sludge above USEPA's RSL for residential soil.

With respect to the second source, the Targeted National Sewage Sludge Survey (TNSSS), USEPA began sewage sludge sampling in August 2006 and completed sampling in March 2007. USEPA focused the TNSSS sampling effort on POTWs that treated more than one million gallons of wastewater per day. The selected category of POTW treated flow range is consistent with the Oakwood Beach WPCP flow range of 15 MGD to 40 MGD. This group of facilities collectively generates approximately 94 percent of the wastewater flow in the U.S. Based on the TNSSS sewage sludge data, the maximum detected concentrations for arsenic, iron, manganese, phosphorus, silver, vanadium, 4-chloroaniline, bis(2-ethylhexyl)phthalate, and benzo(a)pyrene were above the USEPA's RSLs for residential soil.

The Interagency Steering Committee on Radiation Standards (ISCORS) Assessment of Radioactivity in Sewage Sludge: Radiological Survey Results and Analysis provides information regarding radioactivity in sewage sludge. The ISCORS Final Report was issued in 2003 by the U.S. Nuclear Regulatory Commission (NRC), USDOE, and USEPA. Based on this survey, radium-226 was detected in 289 samples out of 311 at concentrations ranging from non-detect to 47 pCi/g, with a mean concentration of 2 pCi/g and a 95<sup>th</sup> percentile concentration of 13 pCi/g. These data indicate that the average concentration of radium-226 exceeds the human health soil screening benchmark of 0.6 pCi/g (i.e., specified in US Nuclear Regulatory Commission Regulation (NUREG) 1757, Volume 1 [U.S. NRC, 2006]), but is below the NPS ESV of 8.1 pCi/g for terrestrial organisms. The 95<sup>th</sup> percentile for radium-226 in sewage sludge (i.e., 13 pCi/g) exceeded the NPS ESV of 8.1 pCi/g, suggesting that sewage sludge has the potential to contain concentrations of radium-226 at levels that exceed both human health and ecological screening benchmarks.

#### 4.2.3. Radiological Contamination

The Site radiological contamination investigated by NPS as part of the IRA, TCRA, and OU1 environmental investigation appears to be associated with the waste fill and possibly sewage sludge. Radiological contamination is associated with the artifacts as well as with slag and cinder material (i.e., incinerator residue and coal ash) in the subsurface. In addition, sewage sludge may also contain radionuclides, as evidenced by the USEPA studies. This section presents information regarding the nature and extent of radiological impacts and artifacts recovered at the Site, based on the following:

- November 2010, IRA Report, prepared by Cabrera Services;
- June 2015, Final Radiation Dose Assessment for Fire Fighter, Maintenance Worker, Park Ranger, and Member of the Public at the GKP prepared by Tidewater, Inc.;
- June 2015, TCRA Completion Report prepared by Tidewater, Inc.; and
- June 28, 2017, Draft Final Environmental Investigation Report for Great Kills Park Operable Unit 1 prepared by AECOM-Tidewater JV.

The IRA mitigated seven hotspots involving soil contaminated with radium-226 and uranium consisting of uranium-234, uranium-235, and uranium-238 in natural ratios, as well as their progeny. Cabrera Services identified the hotspot areas for removal with over 1,000,000 counts per minute using a Ludlum 44-20 sodium iodide (NaI) detector. In five of these hotspot areas Cabrera Services did not identify a discrete source, but rather diffuse radiological contamination in the soil and debris, and removed a total of



three 55-gallon drums (0.8 cubic yards) of contaminated material for disposal at the Energy Solutions facility in Clive, Utah. At two of the hotspots, Cabrera Services removed two artifacts: one radium needle and one radium tube. Cabrera Services concluded that source items (needle and tube) were likely included in the waste fill material deposited at the Site (Cabrera, 2010).

As part of the TCRA, Tidewater:

- Conducted drive over and walkover gamma surveys during January 2013 through May 2013. The walkover survey included over 262 acres and the two drive over surveys involved 43 to 127 acres, respectively;
- Installed 35 borings in July 2013 along the northern, eastern and southern sides of the Site to define the lateral extent of the waste fill;
- Completed additional drive over and walkover gamma surveys during January 2014 through May 2014;
- Installed 16 borings in July 2014 along the northeastern boundary of the Site to determine the lateral extent of the waste fill in relation to NPS legislative boundary on City owned property (this area is within OU1);
- Reviewed, and analyzed 2013 and 2014 TCRA gamma surveys and issued Gamma Survey Data Analysis Report (Tidewater 2014). This effort evaluated the different gamma survey instruments, combined the survey data, separated the data by instrument and methods into gridded data subsets, and then developed descriptive statistics used to normalize the data sets and calculate a Z-Score. A Z-Score is a number of standard deviations an observation is below and or above the mean. Thus, a positive standard Z score indicates a datum above the mean, while a negative standard Z score indicates a datum below the mean. For the TCRA Gamma Survey Data Analysis a Z-score of  $\pm 3$  (standard deviations) was used to identify contamination (e.g., elevated levels);
- Conducted source removal at 37 locations. Two locations that exceeded the TCRA established dose limit of 2 mR/hr were excavated in February 2013. During June 2014 through July 2014, 35 locations were addressed (via removal) including five locations where dose measurements exceeded 2 mR/hr on contact, and an additional 30 locations along “road and trail corridors” as well as areas of interest/concern having dose measurements greater than 100 microRoentgens per hour ( $\mu\text{R/hr}$ ). The removal at each location was deemed complete if the source was removed, achieved a detected dose limit below 50  $\mu\text{R/hr}$ , or removed 7.5 cubic feet of contaminated soil (volume of 1 drum).

The TCRA drive over gamma and walkover gamma surveys indicated widespread elevated radioactivity across the Site. Most readings were less than 2 mR/hour on contact, but were two times greater than background levels. **Figure 4-3** presents the locations of elevated radioactivity (using a  $\pm 3$  Z-score), the boring locations where waste fill was encountered and not encountered, and the locations where artifacts were recovered. In addition, and as part of the radiation dose assessment, Tidewater:

- Collected samples of soil, roots, and vegetation from five areas 1) western GKP south of the former ball fields, 2) 200 feet west of the Education Field Station, 3) in the parking area for the former model airplane field, 4) north and adjacent to the former model airplane field, and 5) the northern portion of GKP, approximately 1,000 feet southeast of the intersection of Hylan Boulevard and Buffalo Street;



- Analyzed 33 samples using gamma spectrometry for an extensive library of radioactive isotopes to identify radionuclides of potential concern;
- Analyzed a select set of samples using alpha spectrometry for uranium-234, uranium-235, uranium-238, and thorium-232. The alpha spectrometry results were preferred over the gamma spectrometry analytical results for these radionuclides because the alpha spectrometry results have lower detection limits (e.g., minimum detectable concentrations (MDCs));
- Analyzed 33 soil samples for radium-226 via EPA method 901.1 allowing for radon-222 to reach equilibrium. Concentrations of radium-226 (from the 33 soil samples) were detected ranging from 0.5 pCi/g to 1,030 pCi/g, with an average concentration of 36 pCi/g. The collection of these samples was biased to sampling areas with elevated radioactivity readings after the removal; and
- Identified radium-226, natural uranium (consisting of uranium-234, -235, and -238 in natural ratios and their progeny), and thorium-232 as the ROPCs consistent with the IRA. While the radium was associated with commodities, no conclusions were made regarding the physical or chemical properties of the thorium and its source.

Cabrera Services and Tidewater recovered radiological artifacts as part the IRA and TCRA, respectively. The presence, type, and condition of the artifacts combined with historical research provide information regarding the distribution of radioactivity at the Site and its association with the waste fill, including incinerator residue.

**Table 4-4** summarizes information regarding the artifacts recovered at the Site, including the type of artifact, number of artifacts recovered, the dose at contact associated with the artifact, a description of the artifact, and a photograph of the artifact. The recovered artifacts contained radium-226 and included:

- Three types of radioluminescent markers (e.g., deck, personnel, and helmet/pellet);
- Radium impregnated switch board buttons;
- Two types of containers for radium paint (4 ounce jar and a small vial); and
- Two types of brachytherapy devices (1 needle and 1 tube).

Tidewater also identified, and containerized in drums for shipment and disposal, radium contaminated material including slag, soil, ash, cinder, and debris (including metal, cloth, and ceramic pieces). The radioactivity at the Site appears to be associated with the artifacts as well as with slag and cinder material mixed with (and contaminating) soil and debris contained within the waste fill. Tidewater detected elevated radioactivity readings associated with recovered cinder and slag. Also, as discussed in Section 4.2.2, sewage sludge may also contain radiological contamination.

During the IRA and TCRA, artifacts were recovered from the waste fill at depth via excavation, suggesting they were disposed in the City's sanitation waste. Certain radiological artifacts recovered during the TCRA (e.g., radioluminescent markers, paint jar, and vial) were relatively intact. Conversely, the radium tube and needle recovered during the IRA were significantly degraded (in appearance). Cabrera Services and Tidewater both noted that the elevated radioactivity was not only associated with recovered artifacts, but was also associated with cinder and slag material (a.k.a. incinerator residue) and a "cinder layer" encountered at depth in the waste fill. The dumping and spreading of the waste fill may account for the distribution (and mixing) of radiological contamination and artifacts across the Site



(Figure 4-3). In addition, the reported use of “clean sand and cinders” spread on top of the waste fill to seal in gases may have also distributed radiological contamination within the subsurface.

A review of the soil units underlying the Site and those soil units derived from “refuse parent material” mirrors the location of the radioactivity identified during the TCRA and areas underlain by waste fill. The soil units known as Gravesend and Oldmill (GOB) and Great Kills Gravelly Sand (GrA) are derived from parent material described as sandy to loamy human transported material over refuse (Figure 3-8).

Correlation of the waste fill with the soil units defines the location of the waste fill, and the areas where the radioactivity is likely present at the Site (Table 3-9). For example, the TCRA identified elevated levels of radioactivity in the sludge drying beds (Figure 4-2). This area is underlain by GOB, Gravesend and Oldmill Coarse Sands, and is described as sandy human transported material over refuse human transported material. Based on the soil map, the Oakwood WPCP history, and the 1949 aerial photograph, this area was filled with waste fill and graded. The sludge drying beds were then constructed (1955-56) on top of the former waste fill surface.

Several articles authored by Lubenau and others<sup>17</sup> provide historical context during the 1920s to 1960s, and describe the failure to control, account for, and dispose of radiological sources like those found to date at the Site. For example, during the time period in which the Site was receiving waste, the use of radium in medical devices (brachytherapy), military items (radioluminescent markers and dials), and industrial applications (radiography) increased from less than 1,000 users before 1940 to over 6,000 users just after World War II (Lubenau, 1999). In addition, the Oak Ridge Institute for Science and Education on behalf of the U.S. NRC published a catalog of 170 items that contained radium (Buchholz, and Cervera, 2008). These items included many consumer products, such as fraudulently marketed radioactive curative devices, spa and cosmetic products, toys, and other novelties. Many of these consumer products were manufactured in the 1920s and 1930s, while the medical devices and radioluminescent devices were manufactured from the early 1900s through the early 1960s. Aronowitz and Lubenau (2012) reported on radium-containing medical devices being disposed of in the trash and sent to landfills or burned in hospital incinerators. Gynecological applicators (i.e., containing radium) were also reported to have been flushed down toilets, which would have been connected to the city sewer system (Aronowitz, 2012).

The use of radium declined after World War II (Lubenau, 1999). The price of radium also decreased from its peak in 1914 due to an abundant and cheaper source of Belgian radium ore (Cantor, 2008). The combination of poor regulatory control and peak use, followed by declines in use and decreased value, may explain the prevalence of artifacts containing radium in the City’s waste in the late 1940s. The potential presence and concern for radioactivity in the City’s sanitation waste is evidenced in part by the Inter-agency Council on Radiation established by City Mayor Robert F. Wagner in 1958. The Council directed a survey of the refuse handled by the Department of Sanitation at 223 locations including hospitals, universities and industries that used radioactive materials (City Department of Sanitation, 1958 Annual Report). While this effort commenced after Site operations, it reflects the City’s concern about the potential for radioactive materials to be disposed of in the City’s sanitation waste. Overall, the historical and widespread use of items containing radium along with unregulated disposal practices during the time period in which waste was transported to GKP likely accounts for the presence of the radiological artifacts and contamination at the Site.

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<sup>17</sup> Joel Lubenau was the former senior assistant to the Chairman of the NRC; and Dr. Jesse Aronowitz, worked in the Department of Radiation Oncology at the University of Massachusetts Medical School.



## 5. EXPOSURE PATHWAY AND ENVIRONMENTAL HAZARD ASSESSMENT

This section summarizes information regarding environmental media (groundwater, surface water and sediment, soil, and air), exposure pathways, receptors and sensitive environments,<sup>18</sup> and the potential for hazardous substance release at the Site.

Based on the IRA, TCRA, and OU1 environmental investigation (AECOM-Tidewater JV, 2017), there is evidence of chemical and radiological contamination in soil at elevated concentrations that may pose a risk to human and ecological receptors. Data regarding hazardous substances in incinerator residue, coal ash, and sewage sludge is based on data compiled by USEPA and others, and OU1 environmental investigation completed in 2016 (AECOM-Tidewater JV, 2017). Other considerations for suspected release include waste volume (large), proximity to groundwater and surface water (e.g., close point of entry); infiltration, aquifer permeability, contaminant mobility, flood frequency (high) and precipitation (more than 40-inches) (USEPA, 1991).

The ATSDR (2007) Health Consultation (see Section 2.2.) and TCRA final report and radiation dose assessment (Tidewater, 2015) provide information regarding radiological contamination and potential for exposure. The TCRA dose radiation assessment is summarized below because it is based on recent sampling data (soil and vegetation) and Site characterization information. Following the summary of TCRA dose assessment is an assessment of potential releases to groundwater, surface water and sediment, soil and air.

### 5.1. TCRA RADIOLOGICAL DOSE ASSESSMENT

The TCRA radiological dose assessment determined it was unlikely that site receptors (e.g., nearby resident, recreational visitor, a fire fighter, maintenance worker, or park ranger) would be exposed to a radiological dose above the NRC regulatory limit (i.e., 25 mrem above natural background). The TCRA radiological dose assessment estimated annual doses for external, inhalation, and ingestion exposure pathways based on the assumption that access to the Site would continue to be controlled. The estimated doses are summarized in **Table 5-1**.

While there are potentially complete pathways identified for the evaluated receptors associated with the closed Site, the dose assessment's calculated exposures (doses) are low. This supports measures taken by NPS to limit exposure (i.e., closing portions of GKP) have been effective at protecting receptors. However, chemical and radiological contamination at the Site may pose an unacceptable risk to site receptors based on NPS's planned future use of the Site.

### 5.2. GROUNDWATER

This section evaluates the local geologic and hydrogeologic setting and groundwater use and potential for hazardous substance release for the purposes of evaluating the groundwater exposure pathway and hazard assessment.

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<sup>18</sup> A "sensitive environment" is a terrestrial or aquatic resource, fragile nature setting or other area with unique or highly-value environmental or cultural features. Examples include National Parks, National Monuments, habitats of threatened or endangered species, wildlife refuges, and wetlands, (USEPA, 1991).



### 5.2.1. Local Geologic and Hydrogeologic Setting

Information regarding Site geology, hydrogeology, wetlands, vegetation and wildlife is presented in Section 3. The shallow unconfined groundwater aquifer occurs at an average depth of 4.5 feet bgs and includes groundwater within the underlying fill, Holocene deposit, and outwash deposit, which is highly permeable. Locally, the shallow aquifer may be confined in areas where the Holocene clay-silt overlies the more permeable glacial outwash. The shallow unconfined aquifer extends to the depth of the top of the Raritan Formation (a lower permeable formation), which occurs at a depth greater than 35 feet bgs.

Groundwater discharge from the shallow surficial aquifer provides a portion of the base flow for Site drainage channels (Section 3.4.7.) and on Site wetlands (Section 3.5.). At least portions of these drainage channels and wetlands are tidal and also receive surface water from off Site, including from the Willowbrook ROW and Oakwood Beach watershed. The Staten Island stormwater sewer system also discharges to wetlands and underlying shallow aquifer.

Site groundwater quality (higher salinity) and character (tidal fluctuation) are influenced by the adjacent Lower New York Bay/Raritan Bay, and Great Kills Harbor. The presence of timber bulkhead along Great Kills Harbor likely influences groundwater flow and may inhibit groundwater discharge from the Site into Great Kills Harbor. Groundwater flow beneath the Site predominantly flows toward the ocean (east), and given the regional flow and recharge from the Staten Island upland area to the west and north of the Site, the area beneath GKP is likely an area of groundwater discharge to surface water. This is supported by the former (paleo) drainage pattern present at the Site (now buried) and the reported occurrence of springs on the Site prior to filling.

Impacts to groundwater character and quality from the waste fill and USULs, including the West Branch Interceptor and Sanitary Sewer, are unknown but likely given the nature of these structures and the high probability for groundwater and/or effluent to infiltrate (e.g., leak in) and or exfiltrate (e.g., leak out).

### 5.2.2. Groundwater Use

As described above and in Section 3.4.4., groundwater is not used for potable water on Staten Island. All potable water on Staten Island is supplied by a series of freshwater reservoirs and aqueducts that convey water from the Catskill Mountains in upstate New York to Westchester and Putnam Counties in southern New York. Local groundwater is limited to non-potable uses including lawn irrigation, filling swimming pools, and car washing. Non-potable groundwater use in the area (north and east) of the Site is limited to ZIP code 10306. Groundwater beneath the area west and south of the Site, or within ZIP code 10308, is not used for non-potable uses. The nearest permitted non-potable well to the Site is located over 2,000 feet to the northeast (**Figure 3-10**). None of the identified 13 non-potable wells are located down gradient from the Site. An intervening watershed (Oakwood Beach Creek) is also present between the closest well and the Site. Groundwater is also not used on Site by NPS for irrigation or potable water supply.

### 5.2.3. Potential Hazardous Substance Release

Based on information presented in Section 2.2. - Previous Environmental Investigations, Section 3. - Site Characteristics, and Section 4. - Site, Operations, Sources, and Hazardous Substances, a release of radionuclides and other hazardous substances including metals, and organic compounds to groundwater has occurred based on former Site operations (including the Bay Terrace Sanitation Operations, Oakwood Truck Fill, marine unloading and landfill, Oakwood Beach WPCP operations, and isolated areas with dumping). These operations contributed to the on Site presence of waste fill (over 15.1 million cubic yards), incinerator residue (2,052 kilotons), coal ash (1,198 kilotons), sewage sludge (285,000 cubic yards



plus volume contained in the 13-acre sludge drying beds), and the presence of radionuclides and other hazardous substances identified contained therein. These operations also included tanks (above ground and underground), USULs, and the use of chemicals to disinfect waste fill and to maintain vehicles.

Precipitation (in excess of 40-inches per year -- average annual rainfall) infiltrating through the waste fill and former operations areas, and groundwater contacting and flowing through the waste fill, results in releases of radionuclides, metals, and organic compounds to groundwater.

As indicated in Section 4, data from USEPA studies as well from investigations performed at the Site, including the OU1 environmental investigation completed in 2016, support that hazardous substances are present within environmental media at the Site due to releases from waste fill (including incinerator residue and coal ash) and sewage sludge. Specifically, the 2016 investigation in OU1 confirmed that metals, organic chemicals, and radionuclides are present in groundwater at concentrations that are elevated above background (AECOM-Tidewater JV, 2017).

### 5.3. SURFACE WATER AND SEDIMENT

Section 3.4.7. provides information regarding the Site and surface water. The major marine surface water features in the vicinity of GKP include the Lower New York Bay, Raritan Bay, and Great Kills Harbor. On Site surface water bodies include four drainage channels: 1) a Northeast to Southwest (Hylan Boulevard) Drainage Channel that drains parallel to Hylan Boulevard and discharges into Great Kills Harbor; 2) a Northwest to Southeast (Buffalo Street) Drainage Channel that receives drainage from the Willowbrook Parkway ROW, drains across the north portion of the Site, and discharges to Lower New York Bay; 3) the Oakwood Beach Creek that receives runoff from the Oakwood Beach drainage basin and local storm sewer (USACE, 2015), and discharges to the Lower New York Bay; and 4) a Small Unnamed Northeast-Southwest Drainage Ditch that drains parallels to the beach, and discharges into Great Kills Harbor.

The dominant NWI designated wetlands adjacent to the surface water drainage channels are E2EM5P consisting of estuarine, intertidal, and irregularly flooded wetlands with Phragmites. There are also three small Palustrine wetland areas. Two Palustrine areas are designated PFOIA wetlands, and are located north of NPS Ranger Station and northeast of the beach parking area. The third designated Palustrine wetland is a PSS1E wetland area located northeast of the field area, adjacent to the Northeast-Southwest (Hylan Boulevard) Drainage Channel that drains parallel to Hylan Boulevard.

#### 5.3.1. Local Hydrologic Setting

The four drainage channels flow across the Site and receive surface water runoff from former operation areas and areas underlain by waste fill, incinerator residue, coal ash, sewage sludge and areas with isolated dumping. At least two of the drainage channels receive surface water and storm water from off Site. The drainage channels discharge either to Great Kills Harbor or to Lower New York Bay. Two of the drainage channels, the Northwest to Southeast (Buffalo Street) Drainage Channel and the Oakwood Beach Creek, are classified as "I/C" indicating the segment is marine and its best usage includes secondary contact recreation and fishing. The other drainage channels are not classified by NYSDEC.

The surface waters in and around GKP are used for recreational activities including boating, fishing, and swimming. GKP has a marina, boat launch, and numerous anchored boats primarily for recreational purposes, and GKP offers the public a seasonal kayaking program (**Figure 2-1**). Fishing in GKP is allowed along the areas extending from Great Kills Harbor to Raritan Bay and Lower New York Bay.



GKP attracts numerous anglers year round. Swimming areas are restricted to beaches located south of the bay side of the harbor.

Coastal areas and adjoining waters including Raritan Bay, Lower New York Bay, and Great Kills Harbor, are directly adjacent or near the contaminated part of the GKP (e.g., Site). These coastal areas and waters are heavily used for human activities along with the roads, biking areas, and playgrounds.

Based on the OU1 environmental investigation, organic chemicals including PAHs were detected in sediment above ESVs; and PAHs and metals were detected in surface water above ESVs. However, no radionuclides were detected in surface or sediment at levels that exceeded relevant ESVs.

A suspected release of contaminants from the Site may occur as a result of contaminants migrating directly or indirectly into adjacent water bodies used for swimming, boating, and fishing. Ecological receptors may also be exposed to contaminants present at the Site, or contaminants that may leach directly or indirectly into adjacent water bodies including the four on Site drainage channels, wetlands, and off Site surface water bodies (Lower New York Bay, Raritan Bay, and Great Kills Harbor).

The Site is prone to flooding and there are Site areas with high flood risk according to FEMA. At the Site, Zone VE occupies an area adjacent to the Great Kills Harbor bulkhead, GKP beach area and shoreline, and wetland south and adjacent to the Oakwood WPCP. Zone AE occupies a slightly higher position on the landscape and is present within the areas ranging from sea-level up to 14 feet MSL within OU1 and OU2 and in particular in areas adjacent to Site drainage channels and along the Bulkhead Road. Zone X includes areas along Buffalo Street north of the beach center and parking lot area (<http://apps.femadata.com/PreliminaryViewer/>). Adjacent Site residential communities are also prone to high flood risk. These include the Fairlawn Avenue resident community, the Chesterton Avenue residential community, and residential community north of the Oakwood Beach WPCP.

Erosion within areas of the Site containing waste fill, incinerator residue, coal ash, and sewage sludge may result in suspected releases and migration of radionuclides and other hazardous substances within the waste fill to surface water and sediment in channels that discharge to the Great Kills Harbor, Lower New York Bay, and Raritan Bay.

### **5.3.2. Drinking Water Intakes**

Similar to drinking water wells, there are no drinking water intakes in any surface water bodies within a 15 mile radius of the Site.

### **5.3.3. Local Fisheries**

Information regarding the local fishery (marine resource is presented in Sections 3.6.3. Surface water and groundwater discharge occurs directly from the Site into both surface drainage channels as well as to the adjacent near shore marine water bodies including Lower New York Bay, Raritan Bay, and Great Kills Harbor. The groundwater contribution and surface water discharge from the Site to these surface water bodies is likely diluted due to the vast size of the receiving water bodies and the presence of oceanic tides and currents. In addition to the above, the Oakwood Beach WPCP adjacent to the Site has the capacity to treat 40 MGD of effluent and discharges the chlorinated (treated) effluent to Lower New York Bay and Raritan Bay via a submarine outfall located approximately 6,000 feet from shore (southeast of GKP) at a low tide depth of 15 feet below MSL.

GKP supports public fishing and recreation opportunities (swimming and kayaking) along its shoreline. As noted in Sections 3.6.2. and 3.6.3. there are more than 100 species of marine and anadromous boreal,



temperate, and semitropical migratory fish that inhabit the GKP offshore marine environment. These include fish species that are commercially important or caught by anglers.

#### 5.3.4. Sensitive Environments

Information regarding sensitive environments is presented in part in Section 3.2. regarding surrounding land use, in Section 3.5. regarding wetlands, and in Section 3.6. regarding vegetation and wildlife. GKP is a unit of the National Park System and as such is considered a sensitive environment per USEPA (USEPA, 1991). Additionally, the NPS is mandated to ensure the non-impairment of national park resources for the enjoyment of present and future generations in accordance with the Organic Act of 1916. Information regarding endangered and threatened species is included in Section 3.6. The Staten Island shoreline along Raritan Bay from New Dorp Beach to Tottenville includes beach, and intertidal and subtidal mudflats extending about one-quarter mile from the shoreline. GKP includes large areas of disturbed marsh ingrown with Phragmites and coastal shrub thicket at Crooke's Point (NPS, 2014). There are also public beaches and parks that provide public access to Lower New York Bay and Raritan Bay southwest of GKP. These include Crescent Beach Park, (opposite - northwest of Crooke's Point), Wolfe's Pond Park (approximately 3 miles southwest of Crooke's Point); Lemon Creek Park (approximately 3.5 miles southwest of Crooke's Point), Butler Manor Woods (approximately 5 miles southwest of Crooke's Point), and Conference House Park (approximately 6 miles southwest of Crooke's Point). New York State listed endangered and threatened species found within GKP are identified in **Table 3-13**. Federally listed plant and animal species known to occur at the Gateway National Recreation Area are identified in **Table 3-14**. There are no known federally listed or proposed endangered or threatened species at GKP under the U.S. Fish and Wildlife jurisdiction except for occasional transients (NPS, 1992).

#### 5.3.5. Potential Hazardous Substance Release

The 2016 OU1 environmental investigation identified metals and organic chemicals in sediment and surface water from the Oakwood Beach Creek at concentrations that exceed relevant ESVs and observations from background sampling locations. Conversely, the 2016 OU1 environmental investigation did not detect radionuclides (in surface water or sediments) at concentrations that exceeded relevant ESVs (AECOM-Tidewater JV, 2017). Releases of hazardous substances (metals and organic chemicals) are suspected based on distance to surface water (close point of entry), flood frequency and OU1 environmental investigation. Releases to surface water and sediment are suspected based on information presented in Section 2.2 (Previous Investigations); Section 4 (Site Operations, Sources, and Hazardous Substances), and Section 5.2.3 (Potential Hazardous Substance Release.). These releases are suspected because the four Site surface water drainage channels receive groundwater discharge and surface water runoff (with hazardous substances) from former operation areas, and areas underlain by waste fill, incinerator residue, coal ash, sewage sludge and isolated dumping areas. Suspected releases may have occurred to both the drainage channels and to Great Kills Harbor and to Lower New York Bay. In addition to the above, releases may have occurred to the Great Kills Harbor near the Marine Unloading Plants when waste containing refuse, incinerator residue, coal ash, and radiological artifacts was transferred from the scows to the dump wagons.

### 5.4. SOIL

Information regarding Site soil is presented in Section 3.3.11. The soil units including GOB and GrA are derived from parent material described as sandy to loamy human transported material over refuse (**Figure 3-8**). Correlation of the waste fill with the GOB and GrA soil units defines the approximate lateral extent



of the waste fill, and the area where radionuclides and other hazardous substances are present at the Site. The estimated area underlain by 15.1 million cubic yards of waste fill is over 265 acres. Information regarding the composition of the waste fill, incinerator residue, coal ash, and sewage sludge; and the presence of radionuclides and other hazardous substances including metals, and organic compounds, is presented in Section 4.2. While the radioactivity is scattered throughout the Site, and likely within the underlying waste fill, the surficial soil amendment layer covering portions of the waste fill may shield the underlying radiation and reduce the likelihood of direct exposure in some areas. Conversely, where the soil amendment is absent or thin, the likelihood of radiation exposure increases, due to lack of cover material and shielding (AECOM-Tidewater JV, 2017).

#### 5.4.1. Potential Receptors

Information regarding surrounding land use and demographics is presented in Section 3.2. includes information regarding potential receptors, population, zoning, day care and school facilities, parks, and playgrounds near the Site. The area surrounding the Site is densely inhabited and characterized as urban with zoned residential, commercial, and manufacturing districts with over 17,000 people living within 1,000 to 2,000 feet of the Site. No one lives within the Site.

Potential receptors exposed to releases to soil may include Site workers, visitors (only if access controls were lifted without addressing the contamination), trespassers, and nearby residents living adjacent (within 200 feet) to the Site. Information regarding these potential receptors is presented below.

NPS facilities within the Site include an Education Field Station, former athletic fields (softball, baseball, and soccer), former model airplane flying field, associated parking areas, walking trails and bike paths, and roads including Bulkhead Road, Sewerline Road, Fire Road and Buffalo Street. GKP is open during daylight hours seven days a week (ASTDR, 2007) (**Figure 2-1**).

NPS GKP workers include United States Park Police (USPP), NPS Park Rangers, NPS Maintenance Staff, NPS Wildland Fire Control personnel, NPS Surf Guards, and volunteers. USPP monitor all parks within the Gateway National Recreation Area and typically conduct daily, routine vehicle patrols and periodic police and fire emergency/incident response actions when necessary at GKP Wildland Fire Control personnel conduct fire monitoring and periodically maintain fire breaks along roads and trails on Site. This includes cutting brush along roads and trails to contain fire and prevent fire from escaping or spreading within GKP. All of these activities conducted in the closed area of the Site are overseen by a NPS Site Safety Officer (SSO) and conducted in accordance with a Site Safety and Health Plan (SSHP) to reduce potential for worker contact and exposure to contaminants present in the waste fill. NPS maintenance personnel do not enter the closed area unless approved by the SSO. Surf Guards do not enter the closed area, and primarily monitor the beach for distressed swimmers and/or recreational water users that need assistance. Other Site workers may include workers involved with the inspection and maintenance of the USULs and City Fire Department personnel conducting fire response activities.

There are no schools located within 200 feet of the Site boundary. The closest school is Public school 053 Bay Terrace, The Barbara Esselborn School located at 330 Durant Avenue. Public school 053 is located over 288 feet to the north and upgradient from the Site. This school includes grades from pre-kindergarten through 5<sup>th</sup> grade and has 780 Students.

Nearby residential areas (within 200 feet of the Site) include: area located to the southwest of Fairlawn Avenue; the area located north of Hylan Boulevard; the area located north and east of the Site on the west side of Chesterton Avenue; and the area located north of the Oakwood Beach WPCP. The likelihood of



off Site residential receptors located to the north and potential exposure to Site releases is remote because these receptors are upgradient from the Site and are separated from the Site by Hylan Boulevard. Residents on the west side of Chesterton and north of the Oakwood Beach WPCP are adjacent to the Site. These areas have a high risk of flooding and surface water runoff containing surficial soil from Site may be transported and deposited on adjacent areas during flood stage, however such impacts may be limited because the Site surface is heavily vegetated with Phragmites limiting sheet-wash and transport off Site.<sup>19</sup> There is also a tributary (Oakwood Beach Creek) between the intervening neighborhood to the north of the Oakwood Beach WPCP which may limit off Site migration and surface runoff to the residential community to the north and east of the Site. Similarly, residents on the west side of Fairlawn Avenue are separated from the Site by an intervening asphalt road (Fairlawn Avenue) as well as the drainage channel that discharges to Great Kills Harbor. There is no evidence that waste fill extends beyond the Site boundary near Fairlawn Avenue and all surface water runoff is directed to the drainage channel limiting the potential for runoff from the Site to Fairlawn Avenue and adjacent resident area.

Ecological receptors in addition to human receptors may be exposed to radionuclides and other hazardous substances present in surface and subsurface soil in the former operation areas and areas underlain by waste fill at the Site. Potential human and ecological receptors may also be exposed to sediment generated from Site surface runoff to Site surface water bodies (drainage channels) and sediment transported to adjacent surface water bodies including Great Kills Harbor, Lower New York Bay, and Raritan Bay.

#### **5.4.2. Sensitive Environments**

Information regarding sensitive environments is presented in Section 3.2 (regarding surrounding land use), Section 3.5 (regarding wetlands), and Section 3.6 (regarding vegetation and wildlife).

#### **5.4.3. Potential Hazardous Substance Release**

The IRA, TCRA and the 2016 OUI environmental investigation have confirmed releases of metals, organic chemicals, and radionuclides to soil due to former Site operations including Bay Terrace Incinerator, Oakwood Truck Fill, marine unloading and landfill, sludge drying beds, and isolated areas with dumping. These operations contributed to the presence of waste fill (over 15.1 million cubic yards) and sewage sludge (285,000 cubic yards plus volume contained in the 13-acre sludge drying beds), and the hazardous substances contained therein. These operations also included structures such as tanks (above ground and underground tanks), USULs, and the use of chemicals to disinfect waste fill and to maintain vehicles.

### **5.5. AIR**

No known air releases have been observed (including reports of odors) or documented at the Site. Due to the presence of elevated levels of radium on Site, there is a potential for radon and releases of radon in the subsurface and air. The Site is closed and fenced for the purposes of restricting human access. The Site is thickly vegetated limiting access as well as reducing the likelihood of releases of contaminated particulates in the case of wind erosion due to exposed or bare ground. In addition, no observed air releases of contamination or radioactivity were detected and no contaminant vapors/odors were detected in the breathing zone during air monitoring of TCRA intrusive activities. Air monitoring during the

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<sup>19</sup> NPS, Environmental Assessment reported that Phragmites is an effective invader of disturbed areas and serves as a stabilizing agent for the fill material (NPS, 1992).



TCRA included: 1) breathing zone monitoring, 2) work zone monitoring, and 3) general area (boundary) monitoring.

#### **5.5.1. Potential Receptors**

Information regarding surrounding land use and demographics is presented in Section 3.2., which includes information regarding potential receptors, population, zoning, day care and school facilities, parks, and playgrounds near the Site. Weather data regarding wind speed and wind direction for Staten Island indicate the prevailing winds speeds are greater (up to 25 miles per hour) from the west, northwest followed by winds from the east northeast at speeds up to 15 miles per hour. (Metroblue, 2017). The area surrounding the Site is densely inhabited and characterized as urban with zoned residential, commercial, and manufacturing districts with over 17,000 people living within 1,000 to 2,000 feet of the Site. Since the Site is closed, only authorized NPS workers are allowed to conduct work on Site, and the worker must obtain authorization from the SSO and conduct their work according to the SSHP to reduce potential for risk of exposure to Site related to contaminants. There are no people living on Site and visitors to GKP are only allowed during daylight hours to non-closed sections of the Park. The number of annual visitors in 2015 was approximately 500,000. This number of annual visitors translates to approximately 1,369 visitors per day on average over 365 days per year.

Information regarding vegetation and wildlife is presented in Section 3.6; information regarding cultural resources is presented in Section 3.7 and information regarding schools and day care facilities is presented in Section 3.2. The nearest residential community is the community located on the west side of Chesterton Avenue in northeast corner of the Site adjacent to OU1.

The TCRA dose assessment concluded that with current Site closure restrictions it was not probable that a Recreational Visitor, Fire Fighter, Maintenance Worker, Park Ranger, or Nearby Resident will receive a dose that exceeds the NRC regulatory limit of 25 mrem in a year above natural background. The estimated inhalation radiation dose ranged from 0.01 (Fire Fighter) to 0.17 mrem (Park Ranger). Similarly, the potential annual fire inhalation radiation doses ranged from 0.19 mrem (Fire Fighter) to 0.24 mrem (Nearby Resident).

#### **5.5.2. Sensitive Environments**

Information regarding sensitive environments is presented in part in Section 3.2 (regarding surrounding land use), Section 3.5 (regarding wetlands), and Section 3.6 (regarding vegetation and wildlife).

#### **5.5.3. Potential Hazardous Substance Release**

No known current air releases have been observed (including reports of odors) or documented at the GKP, however the presence of elevated levels of radium in the waste indicates there is a potential for radon and releases of radon in the subsurface and air. The Site is heavily vegetated with limited areas that are bare or prone to wind erosion of particulates. In addition, there are no structures (Field and Ranger Stations are located outside the boundary of waste filled area) situated on top of the waste fill reducing the likelihood of radon accumulating in these structures. In addition, air monitoring during TCRA did not detect or observe air releases of radionuclides.

Lastly subsurface movement (off Site) of contaminant vapors (if any) or radon (if present) through the uncapped, shallow, thin waste fill (at the Site boundary) and thin vadose zone, and shallow groundwater table is possible however unlikely giving the intervening tributaries and drainage channels and the



distance to the adjacent resident communities. The possibility that USULs may provide preferential pathways for contaminants in groundwater, vapor, and or radon is unknown.



## 6. CONCLUSIONS AND RECOMMENDATIONS

This HSA/RS Summary presents information regarding the Site including: previous environmental investigations, history, and characteristics (e.g., topography, land-use, geology, hydrogeology, wetlands, vegetation and wildlife, cultural resources and climate); operations, sources and hazardous substances; and Site exposure pathway and environmental hazard assessment. This section presents the HSA/RS:

- Conclusions regarding Site characteristics;
- Conclusions regarding operations, sources and hazardous substances; and releases;
- Conclusions regarding pathways, and potential exposure of human and ecological receptors;
- Conclusions regarding impacted and non-impacted areas;
- Data gaps; and
- Recommendations.

### 6.1. CONCLUSIONS REGARDING SITE CHARACTERISTICS

The Site consists of approximately 280 acres within the 523 acre GKP. The Site is defined as the GKP waste filled area and any area where hazardous substances, pollutants, or contaminants disposed of at or released at or from the waste filled area have come to be located. Currently at GKP, NPS manages a National Recreation Area with public recreational facilities including a beach center, hiking and biking trails, fishing areas, marina and boat launch ramp, parking areas, a multi-use path, adjacent to Buffalo Street; grassy areas used for recreational uses, as well as swing-sets and playgrounds. After 2009, NPS closed (to public access) the area of Great Kills Park southeast of Hylan Boulevard and north of Great Kills Harbor to a line approximately 1,000 feet south of Wetland Road. A portion of the Site consisting of the strip of land between the bulkhead to Great Kills Harbor and Bulkhead Road from the boat ramp, along the promenade and bulkhead fishing area to the walking bridge to the access point at Fairlawn Avenue and road with access to Hylan Boulevard remain open to pedestrians and anglers. The park facilities within the closed Site area include five ball fields, model airplane field, associated parking areas, walking and hiking trails (Blue Dot Trail) and access roads (Wetland Road, Ballfields Road, and Fire Road). Access to the closed area is restricted by a fence with signage warning “Danger Hazardous Area” posted every 25 feet (**Figure 2-1**).

The area surrounding the Site is urban with over 39,900 people living within a one mile radius of the Site. The area includes a mixture of residential, commercial, and industrial/manufacturing uses and zoning. The Site is underlain by hydraulic fill and waste fill (includes, refuse, incinerator residue and coal ash) and sewage sludge mixed with clay overlying the Holocene deposit comprised of dark gray silty clay to clayey silt with sand lenses overlying highly permeable red-brown glacial outwash (graded coarse to medium sand with gravel) followed by the fine sand clayey silt and less permeable Raritan Formation and bedrock consisting of Staten Island Serpentine and Manhattan Schist. The depth to the more permeable glacial outwash deposit ranges from 13 to 28 feet bgs, the depth to the less permeable Raritan Formation ranges from 35 to 90 feet bgs; and the depth to bedrock occurs at over 270 feet bgs. Groundwater beneath the Site occurs in the shallow subsurface and flows toward the east-southeast. Both groundwater quality (e.g., brackish) and character (e.g., groundwater table fluctuation and flow direction) are influenced by the adjacent tidal Lower New York Bay. No groundwater is used on Staten Island for potable water supply,



while limited non-potable use (including irrigating lawns, filling swimming pools and washing cars) occurs to the northeast of the Site within ZIP Code 10306 area.

Site surface water features include four manmade drainage channels and a small quarter-acre manmade pond near NPS Education Field Station. Two of the drainage channels are classified for secondary contact and recreation/fishing uses. The other two drainage channels are not classified. Adjacent to the drainage channels are wetlands and the dominant on Site wetland is characterized as estuarine, intertidal, and irregularly flooded with Phragmites (E2EM5P). These wetlands and drainage channels are prone to flooding and are within zones designated by FEMA as high flood risk. Adjacent Site residential communities are also designated as a high flood risk. These include the Fairlawn Avenue resident community, the Chesterton Avenue residential community, and residential community north of the Oakwood Beach WPCP.

## 6.2. CONCLUSIONS REGARDING OPERATIONS, SOURCES, AND HAZARDOUS SUBSTANCES

The Site operations involving the Bay Terrace Incinerator, the Oakwood Truck Fill, the GKP Marine Unloading Plant and Landfill, and Oakwood Beach WPCP USULs and sludge drying beds contributed to the on Site presence of waste fill (over 15.1 million cubic yards), sewage sludge (285,000 cubic yards plus volume contained in the 13-acre sludge drying beds) and the presence of metals, organic contaminants, and radionuclides contained therein (**Table 4-1**). These operations also included structures such as tanks (above ground and underground tanks) and USULs, and the use of chemicals to disinfect waste fill and to maintain vehicles. In addition to the identified sources above, there are isolated areas on the Site where dumping has occurred as evidenced by the presence of rusted drums, railroad ties, and an automobile. These areas may also be potential sources of hazardous substances.

Results from the IRA, TCRA, and 2016 OU1 environmental investigation provide evidence that the nature and extent of waste fill is consistent with the correlation of the GKP soil units (mapped by the USDA NRCS) with the underlying parent material described in part as “refuse”. These soil units lie within the TCRA boundary, and the distribution is consistent with findings of the TCRA, IRA, the 2016 OU1 environmental investigation and the historical contemporaneous City documents (grading plans) and aerial photographs (1940 and 1949) that provide information regarding: park boundaries and location of Fairlawn Avenue, Hylan Boulevard, and former Emmet Avenue; and the placement and grading of the waste fill (**Figure 3-5**) and hydraulic fill (**Figure 3-4**).

The hazardous substances associated with sources were identified using available Site data (IRA, TCRA, and 2016 OU1 environmental investigation), and data from studies conducted by USEPA and others. Based on these resources the following radionuclides and other hazardous substances were identified:

- Radionuclides including: radium-226; natural uranium (uranium-234, -235, -238 and their progeny); and thorium-232 due to the presence of radiological artifacts, incinerator residue (from the incineration of orphan sources), and to a lesser extent coal bottom ash and sewage sludge.
- Metals and inorganic elements including: chromium, copper, and lead associated with the incinerator residue; arsenic, chromium and cobalt associated with the coal bottom ash; and arsenic, iron, manganese, phosphorus, silver, and vanadium associated with the sewage sludge.



- Organic compounds including: PAHs, PCBs, and dioxins/furans were associated with waste fill and sewage sludge in OU1.
- Based on studies conducted by USEPA, 4-chloroaniline, bis(2-ethylhexyl)phthalate, and benzo(a)pyrene were identified as contaminants in sewage sludge.
- In addition to the above, potential releases from: the Bay Terrace Incinerator and Garage gasoline tank and vehicle maintenance; the oil storage for the marine offloading plant and the spraying of disinfectant (dichlorobenzene); and the Oakwood Beach WPCP USULs including sanitary sewer, and interceptor; and isolated dumping may have resulted in the on Site presence of hazardous substances including, but not limited to: VOCs, SVOCs, and metals.

The radioactivity at the Site is most likely associated with waste fill (including incinerator residue) given the recovery of artifacts to date including radioluminescent markers, vials, jars and brachytherapy devices, as well as the detected elevated readings associated with the slag and cinder material mixed with (and contaminating) soil and debris contained within the waste fill. However, data published in the ISCORs Final Report in 2003 and the possible disposal of radiological artifacts to the sewer system, support that sewage sludge also has the potential to contain radiological contamination.

### 6.3. CONCLUSIONS REGARDING RELEASES, PATHWAYS, AND RECEPTORS

Based on Section 5 - Exposure Pathway and Environmental Hazard Assessment, the following conclusions were identified:

- Actual releases of metals, organic chemicals, and radionuclides to Site soil and groundwater.
- Suspected releases of metals, organic chemicals, and radionuclides to Site surface water and sediments.
- No evidence of a release of radionuclides or other hazardous substances to air. There is a potential for a suspected release of radon in the subsurface and air due to the presence of elevated levels of radium.
- There are potentially complete pathways for on Site human and ecological receptors due to the presence of Site-related contaminants in soil, groundwater, surface water, and sediment.
- There is potential for off Site migration of releases via groundwater and surface water features presented within the Site boundary.
- There are potentially complete pathways for certain off Site human and ecological receptors due to the potential migration of Site-related contamination in groundwater and within Site surface water features.

Based on the above, **Figure 6-1** presents a preliminary schematic Conceptual Site Model (CSM). The CSM will be revised as information, regarding sources, contaminants, migration pathways and receptors, is developed during the on-going remedial investigation. **Figure 6-1** is an illustrative representation of the Site including Site features, surroundings, surface water, geology, hydrogeology and physical and chemical processes that control transport and migration of hazardous substance in environmental media (soil, groundwater, surface water and sediment, and air) and presence of human and ecological receptors.



**Figure 6-2** presents the human and ecological exposure pathway diagram for the Site and defines the sources, radionuclides/potential hazardous substances, releases to environmental media, exposure route, pathway, and potential receptors. Each identified pathway shown in **Figure 6-2** was evaluated to determine whether the pathway was complete. A complete pathway is an exposure route (e.g., direct exposure, ingestion, dermal contact, and inhalation) with a potentially impacted receptor (human or ecological).

Based on the characterization of the exposure setting and existing land use, the potential human receptors considered as part of the CSM include:

- NPS and City employees (park rangers, police, fire fighters, construction workers, and maintenance workers);
- Trespasser;
- Park recreation user - There is no current exposure due to Site access controls, however, the CSM assumes a recreation user and complete exposure pathway for the purposes of HSA/RS;
- Construction worker (A worker not employed by NPS or City); and
- Off Site resident.

Ecological receptors include wetlands, terrestrial, and aquatic (marine and fresh) receptors.

#### **6.4. CONCLUSIONS REGARDING IMPACTED AND NON-IMPACTED AREAS**

In accordance with MARSSIM, the HSA provides information to support “initial classification of the Site as impacted or non-impacted (MARSSIM, 2001).” MARSSIM defines an impacted area as an area with a reasonable potential of containing residual radioactivity in excess of natural background or fallout levels; and impact areas are areas that cannot be classified as non-impacted. Based on the OU1 environmental investigation, TCRA and, IRA and the information regarding Site operations, sources and hazardous substances and information regarding releases and pathways, the impacted area includes the area underlain by waste fill and the area including and surrounding the former marine unloading operations. The impacted area is defined in part by the soil units that have parent material associated with waste fill. The marine unloading area includes the area along the bulkhead where the two unloading stations were located as well as the area extending into the Great Kills Harbor in the area of the former mooring platforms and booms. These structures extended approximately 500 feet from the bulkhead (see **Figure 2-15**). The area around the former mooring platforms and booms is considered potentially impacted because there is a reasonable possibility that waste containing residual radioactivity (including radiological artifacts, incinerator residue, and residual radioactive contamination) may have fell off the scows and diggers during unloading operations.

#### **6.5. HSA/RS DATA GAPS**

During preparation of this HSA/RS information regarding, construction, operation, and maintenance of the Oakwood Beach WPCP USULs (sanitary sewer, interceptor, and force main) and sludge drying beds was limited (largely unknown). The potential for these structures to result in impacts to soil and groundwater quality and to act as preferential transport pathways is unknown.



## 6.6. RECOMMENDATIONS

Based on the results of this HSA/RS, further investigation of the Site is recommended under CERCLA. The available records support that historical operations have resulted in on Site sources that contain hazardous substances. Historical investigations, including the environmental investigation completed in 2016 within OU1, have confirmed the presence of chemicals and radionuclides in soil, groundwater, surface water and sediment at levels that exceed background and that may pose a risk to human health and environment. Therefore, it is recommended that the Site continue to be evaluated under CERCLA as part of a Site-wide remedial investigation that addresses both OU1 and OU2.



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## **FIGURES**

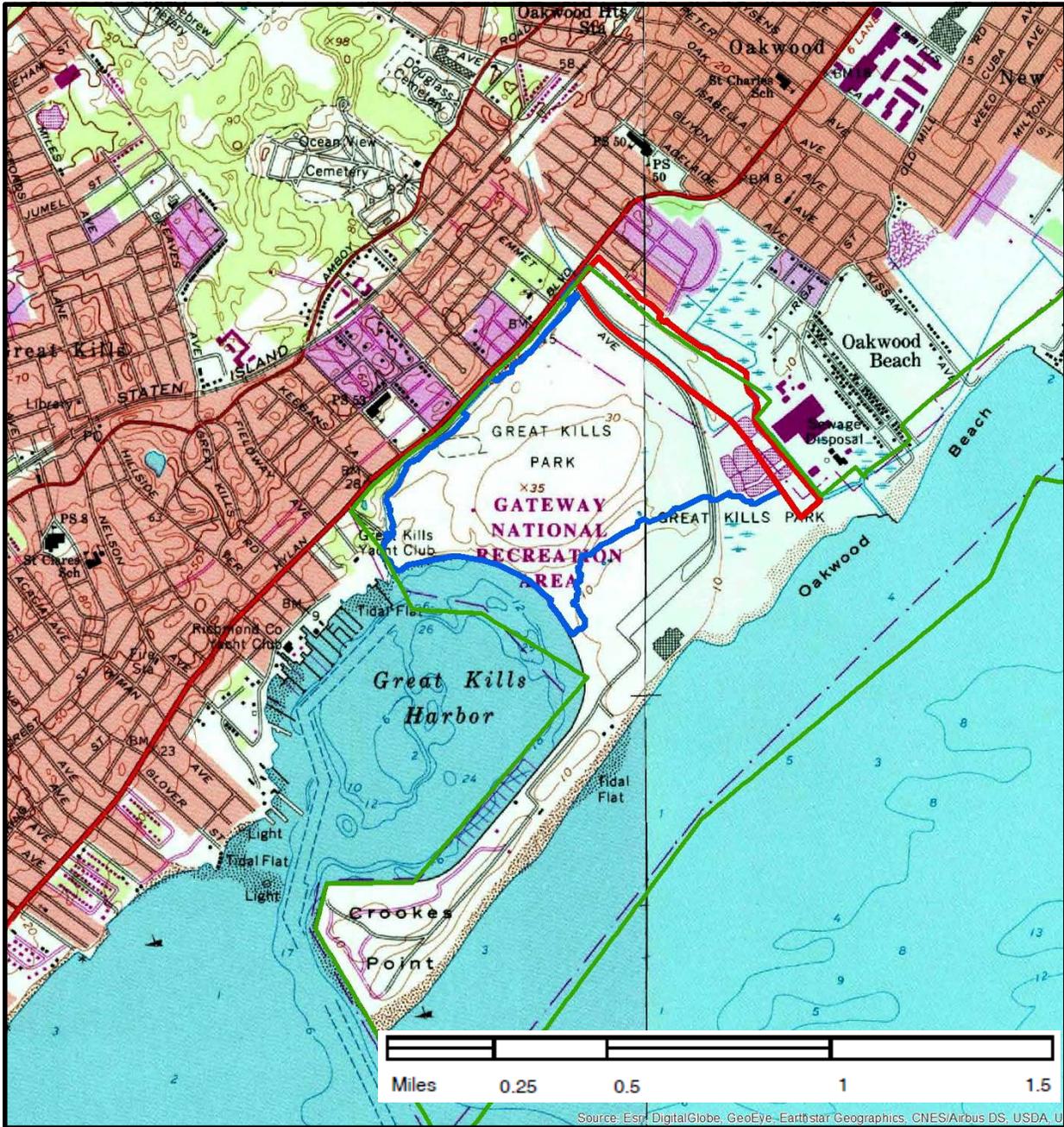


Map source: National Park Service ([www.nps.gov](http://www.nps.gov))  
 Accessed 9/1/2016.



DESIGNED BY	Gateway National Recreation Area and Geographic Unit Locations	
JHG		
DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	FIGURE 1-1
JSW		
CHECKED BY	Contract No. W912DR-13-D-0016	August 2017
JHG		

**Figure 1-1. Gateway National Recreation Area and Geographic Unit Locations**



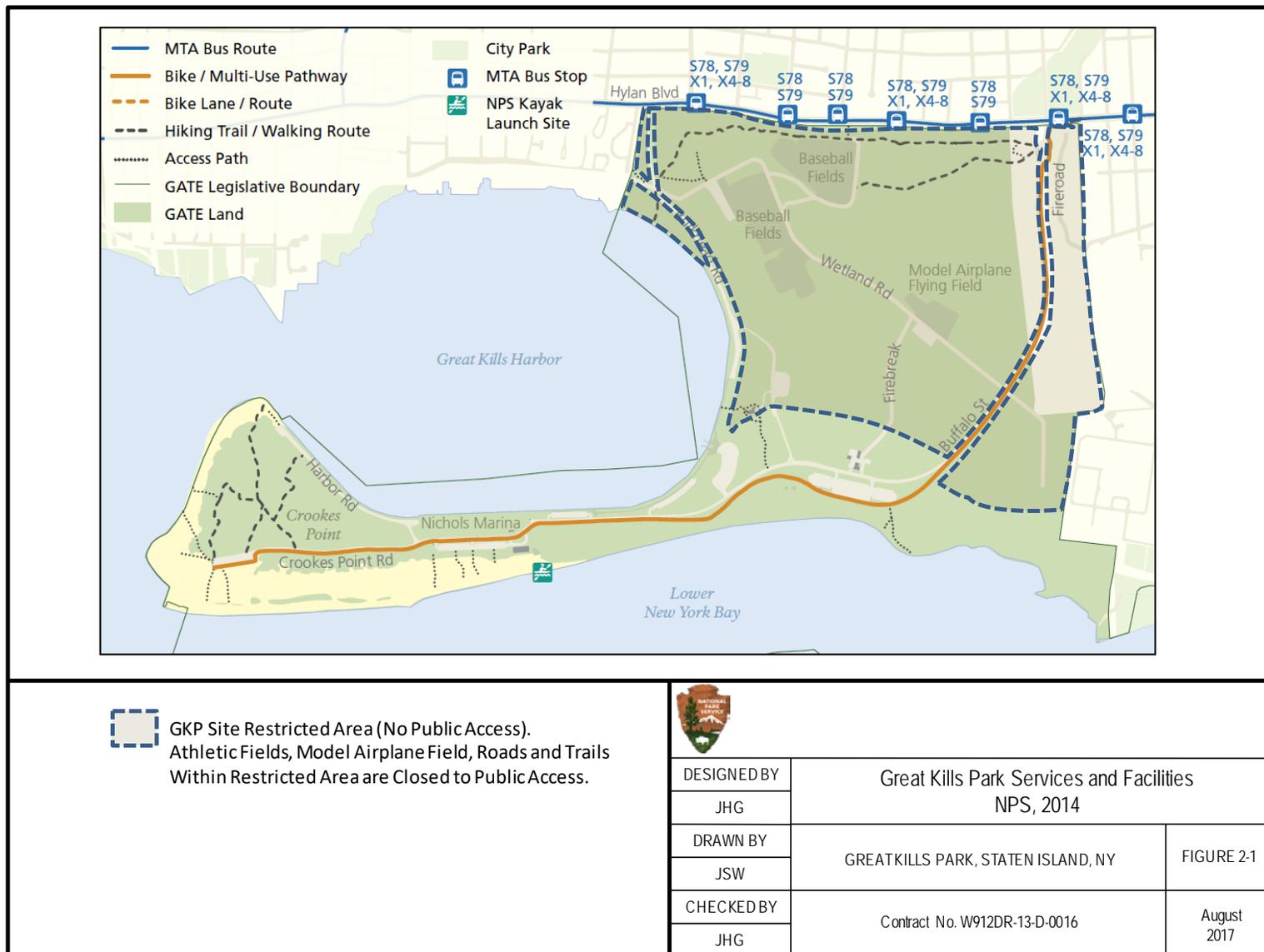
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, U

<ul style="list-style-type: none"> <li><span style="color: green;">—</span> Legislative Boundary</li> <li><span style="color: red;">—</span> Operable Unit 1</li> <li><span style="color: blue;">—</span> Operable Unit 2</li> <li><span style="color: red;">~</span> 10 Foot Contour Line</li> </ul>			
	DESIGNED BY	Great Kills Park Site Operable Units 1 and 2 (Source: U.S.G.S. Arthur Kill and The Narrows 1981, 7.5 Quad)	
	JHG		
	DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	FIGURE 1-2
	JSW		
CHECKED BY	Contract No. W912DR-13-D-0016		
JHG	August 2017		

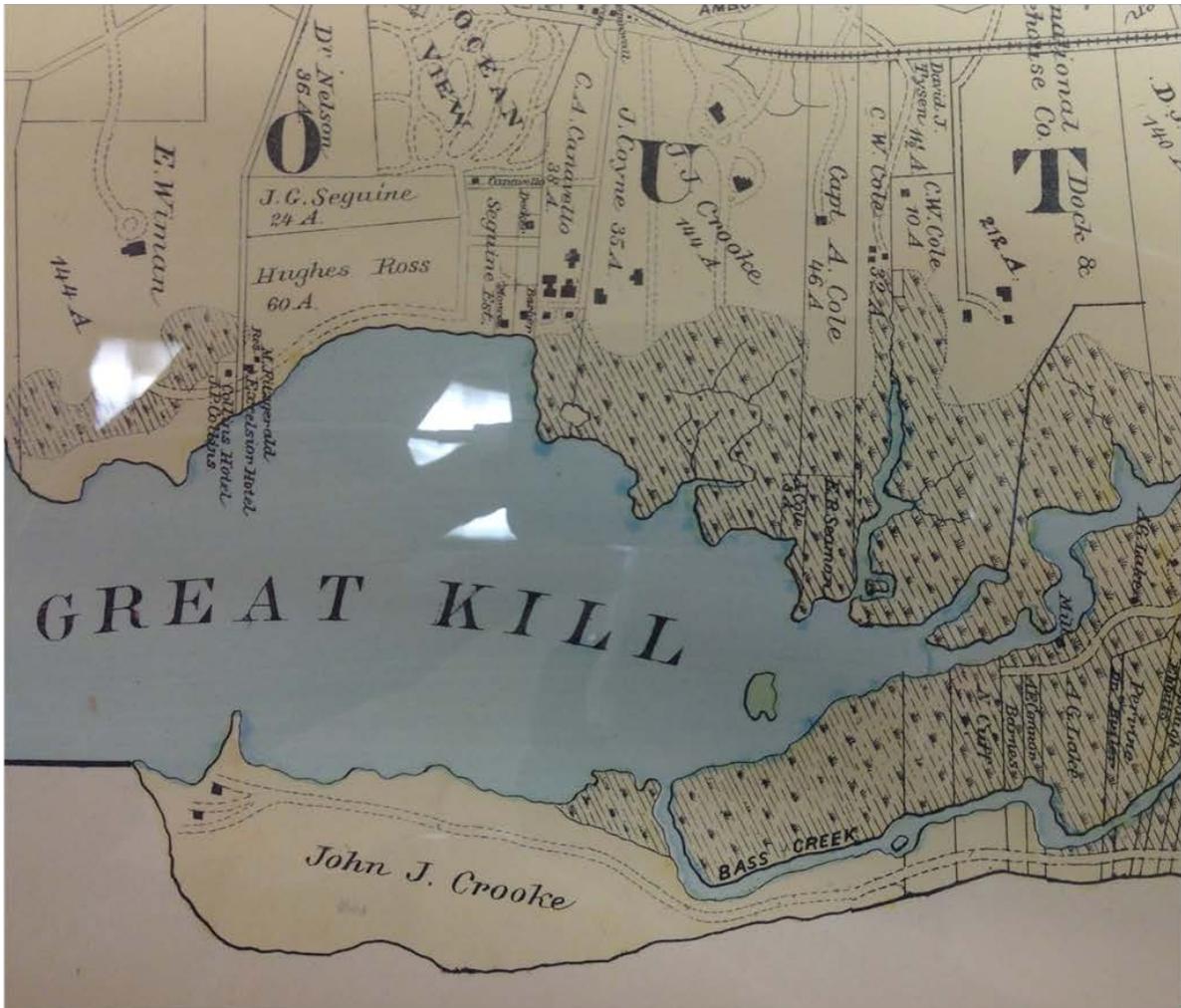
**Figure 1-2. Great Kills Park Site Operable Units 1 and 2**



**Figure 1-3. Great Kills Park Site Features**

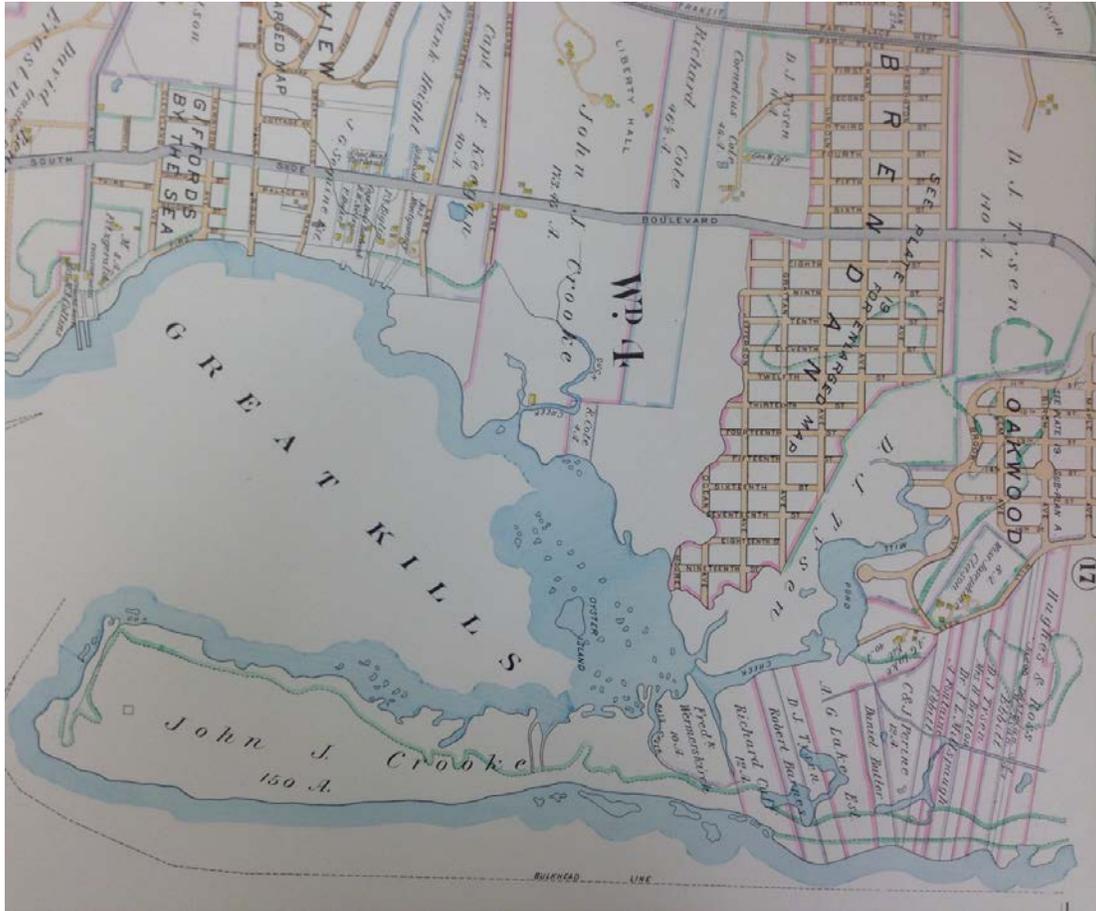


**Figure 2-1. Great Kills Park Services and Facilities**



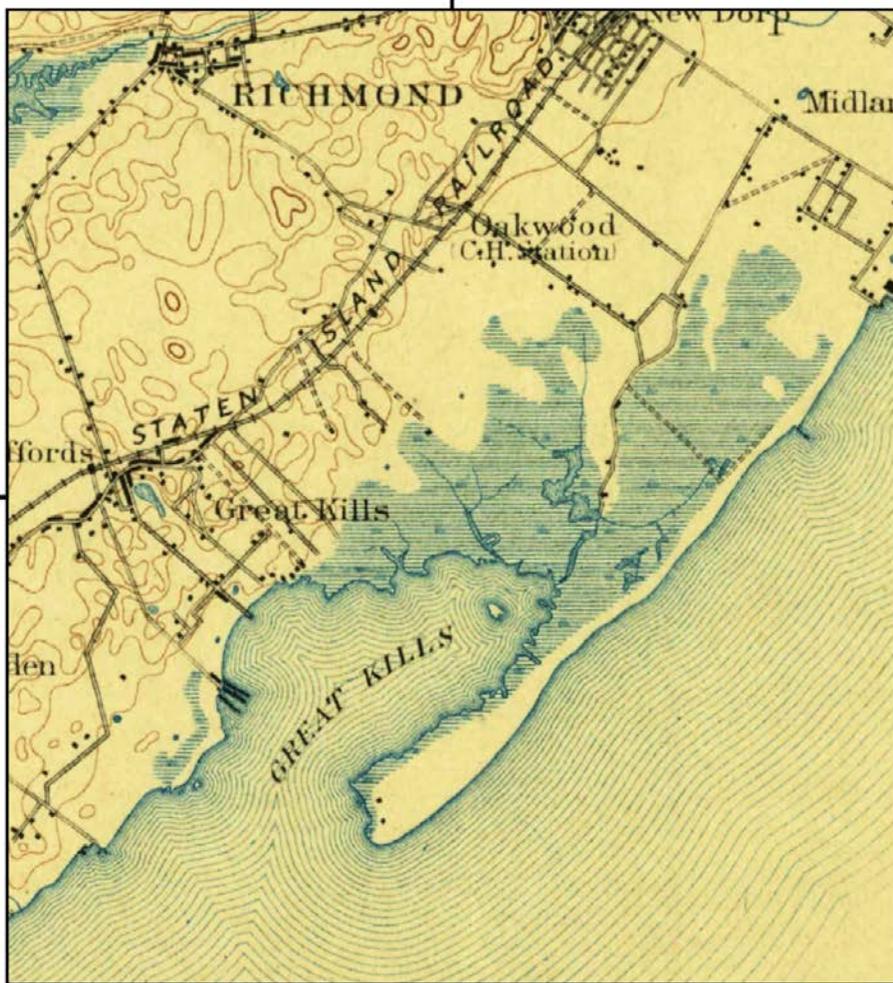
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		JHG			
		DRAWN BY		GREAT KILLS PARK, STATEN ISLAND, NY	
		JSW		FIGURE 2-2	
		CHECKED BY		Contract No. W912DR-13-D-0016	
		JHG		August 2017	

Figure 2-2. 1887 J.B. Beers & Co., Atlas of Staten Island, Richmond Co., New York

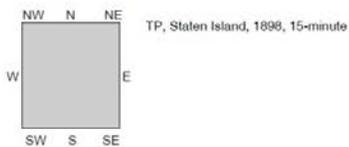
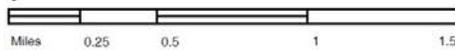


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		JHG			
		DRAWN BY		GREATKILLS PARK, STATEN ISLAND, NY	
		JSW		FIGURE 2-3	
		CHECKED BY		Contract No. W912DR-13-D-0016	
		JHG		August 2017	

**Figure 2-3. 1894 I.A. Lefevre, Atlas of Staten Island, Richmond Co., New York**



This report includes information from the following map sheet(s).



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 ADDRESS: 198 Buffalo Street  
 Staten Island, NY 10306  
 CLIENT: Tidewater Environmental

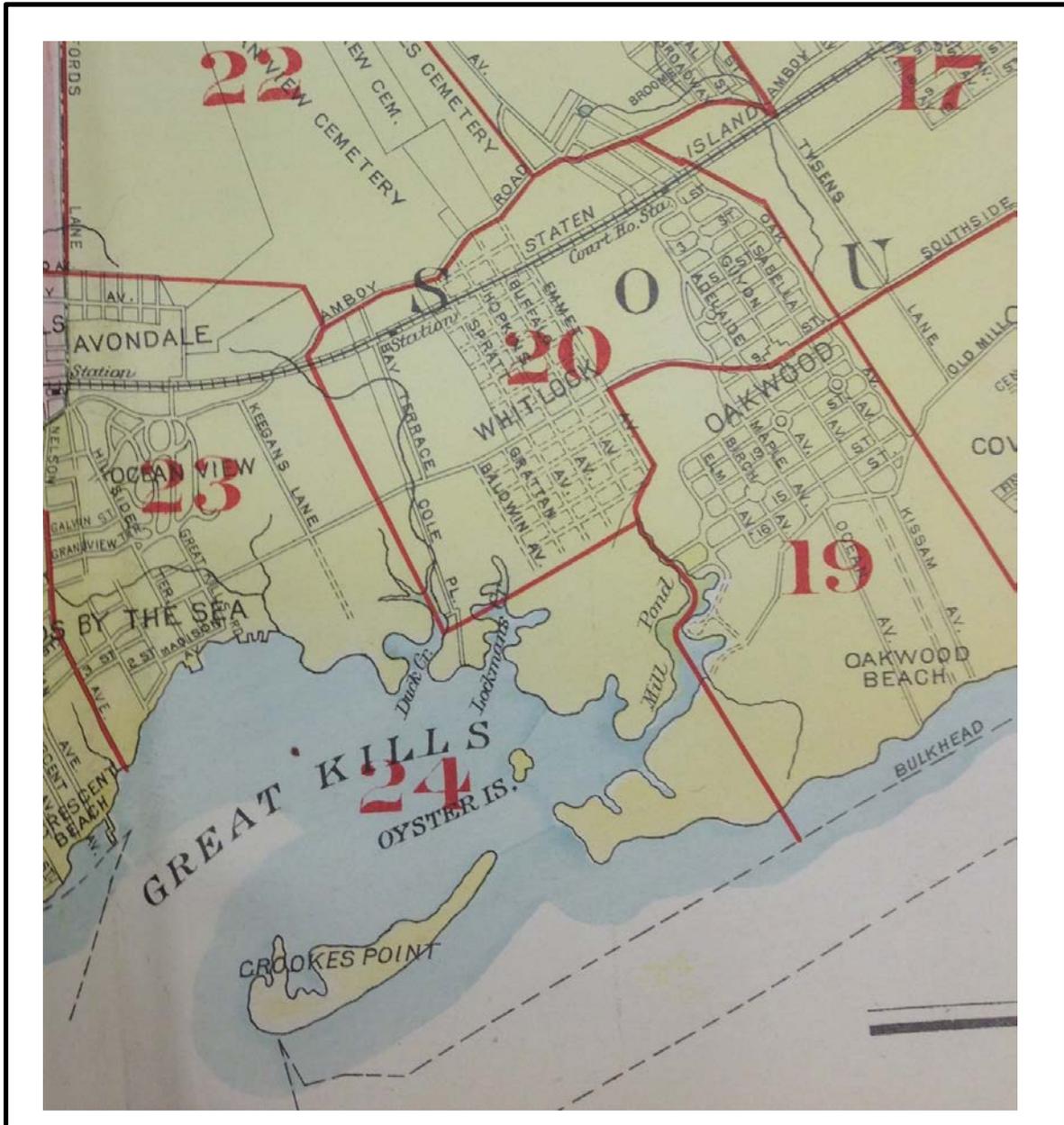


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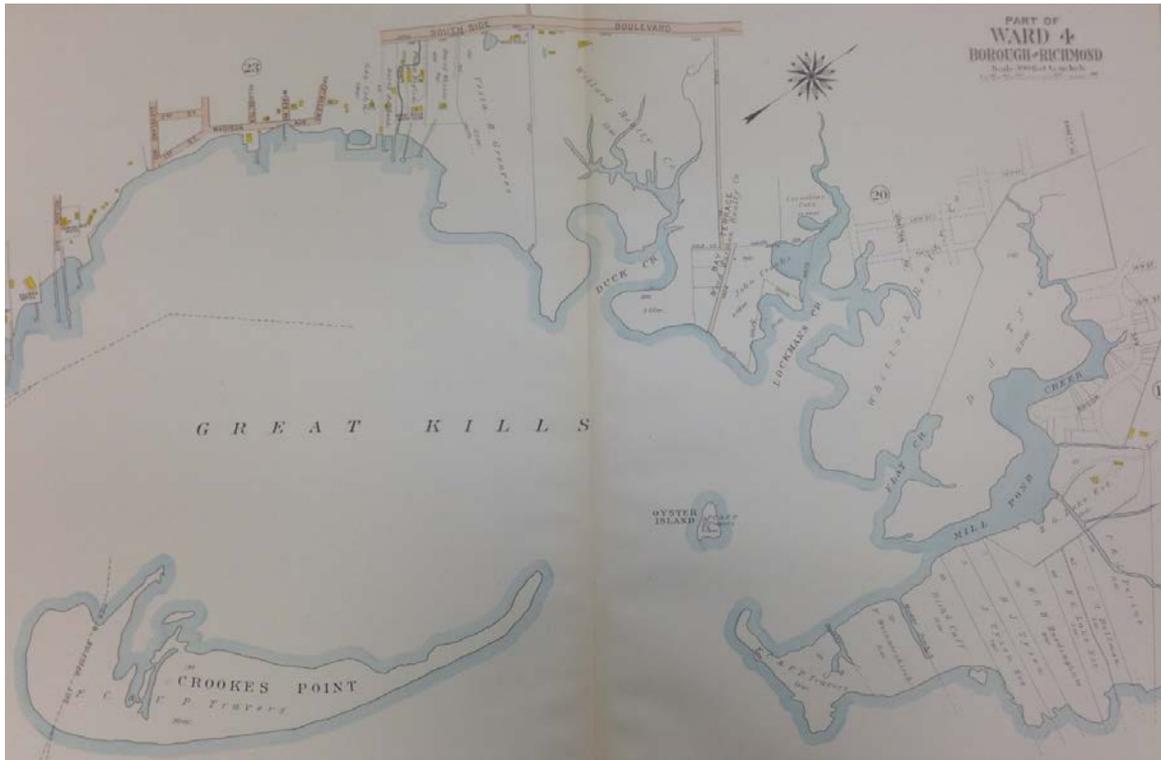
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JHG		
DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	FIGURE 2-4
JSW		
CHECKED BY	Contract No. W912DR-13-D-0016	August 2017
JHG		

**Figure 2-4. 1898 Historical 15 Minute Topographic Quadrangle, Staten Island, New York**



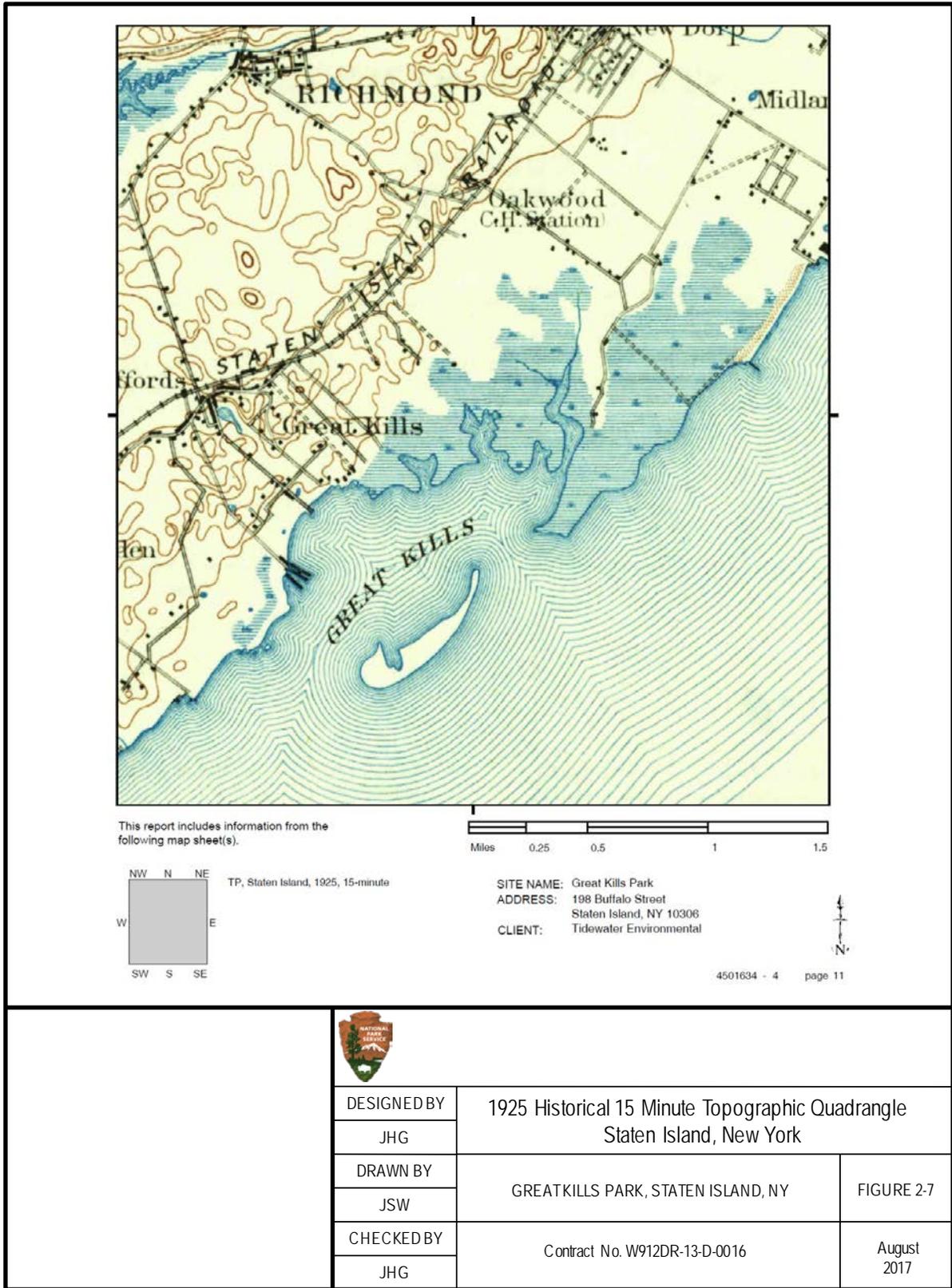
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		JHG			
		DRAWN BY		GREATKILLS PARK, STATEN ISLAND, NY	
		JSW		FIGURE 2-5	
		CHECKED BY		Contract No. W912DR-13-D-0016	
		JHG		August 2017	

**Figure 2-5. 1917 G.W. Bromley and Co. Atlas of the City of New York, Borough of Richmond, Staten Island Wards 4 & 5**

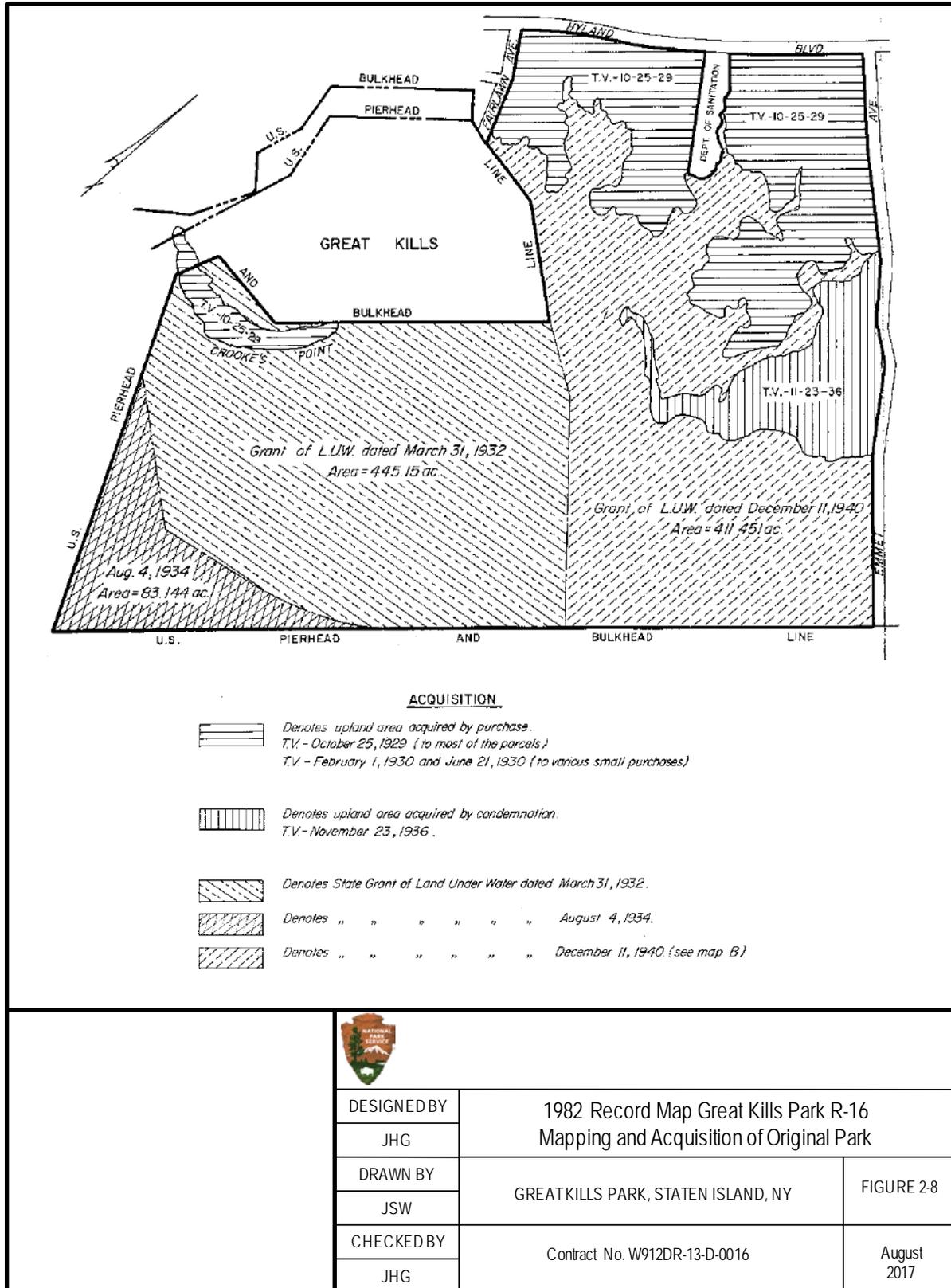


			
DESIGNED BY	1917 G.W. Bromley and Co. Atlas of the City of New York, Borough of Richmond, Staten Island, Portion of Ward 4		
JHG			
DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY		FIGURE 2-6
JSW			
CHECKED BY	Contract No. W912DR-13-D-0016		August 2017
JHG			

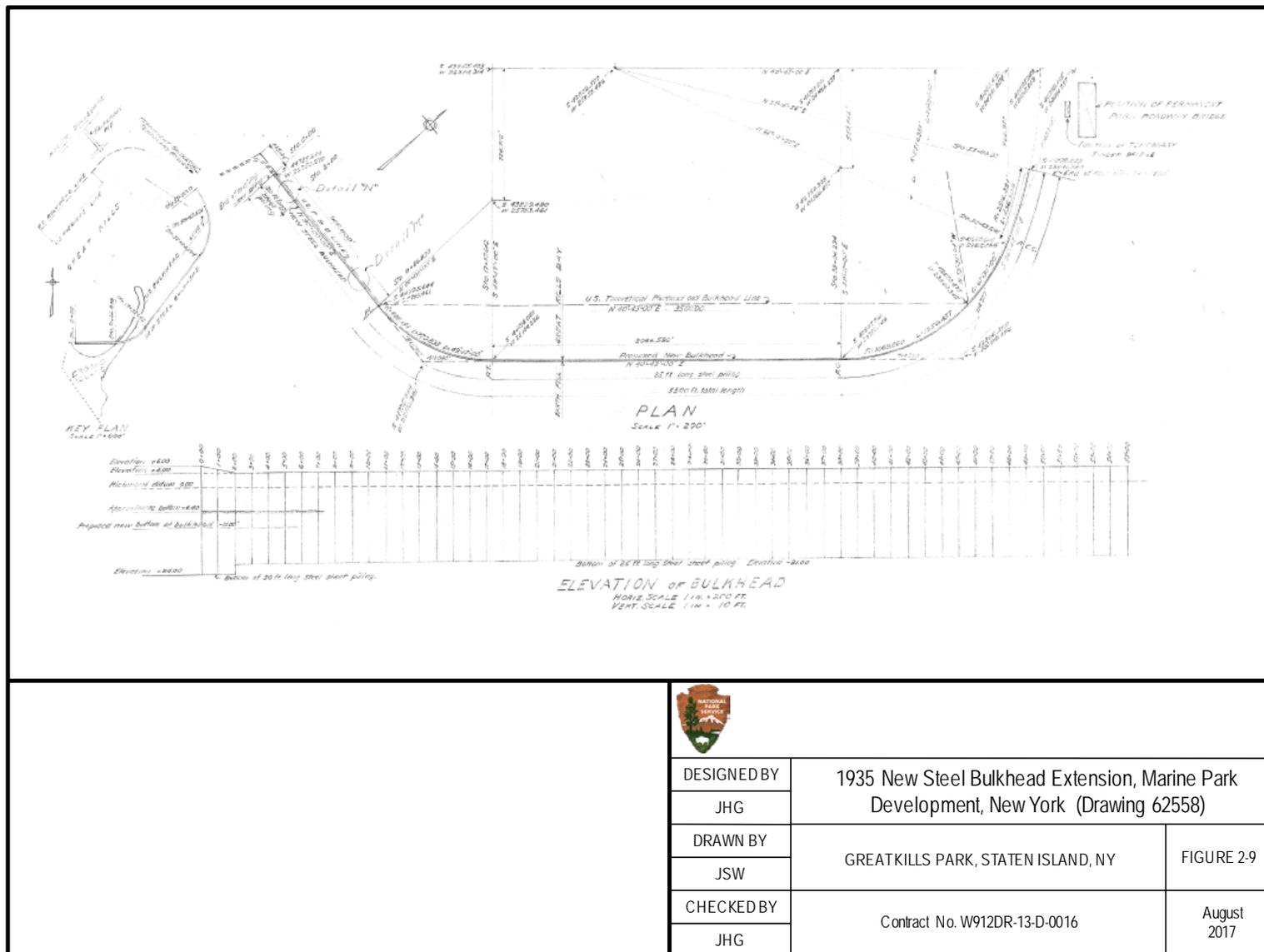
**Figure 2-6. 1917 G.W. Bromley and Co. Atlas of the City of New York, Borough of Richmond, Staten Island, Portion of Ward 4**



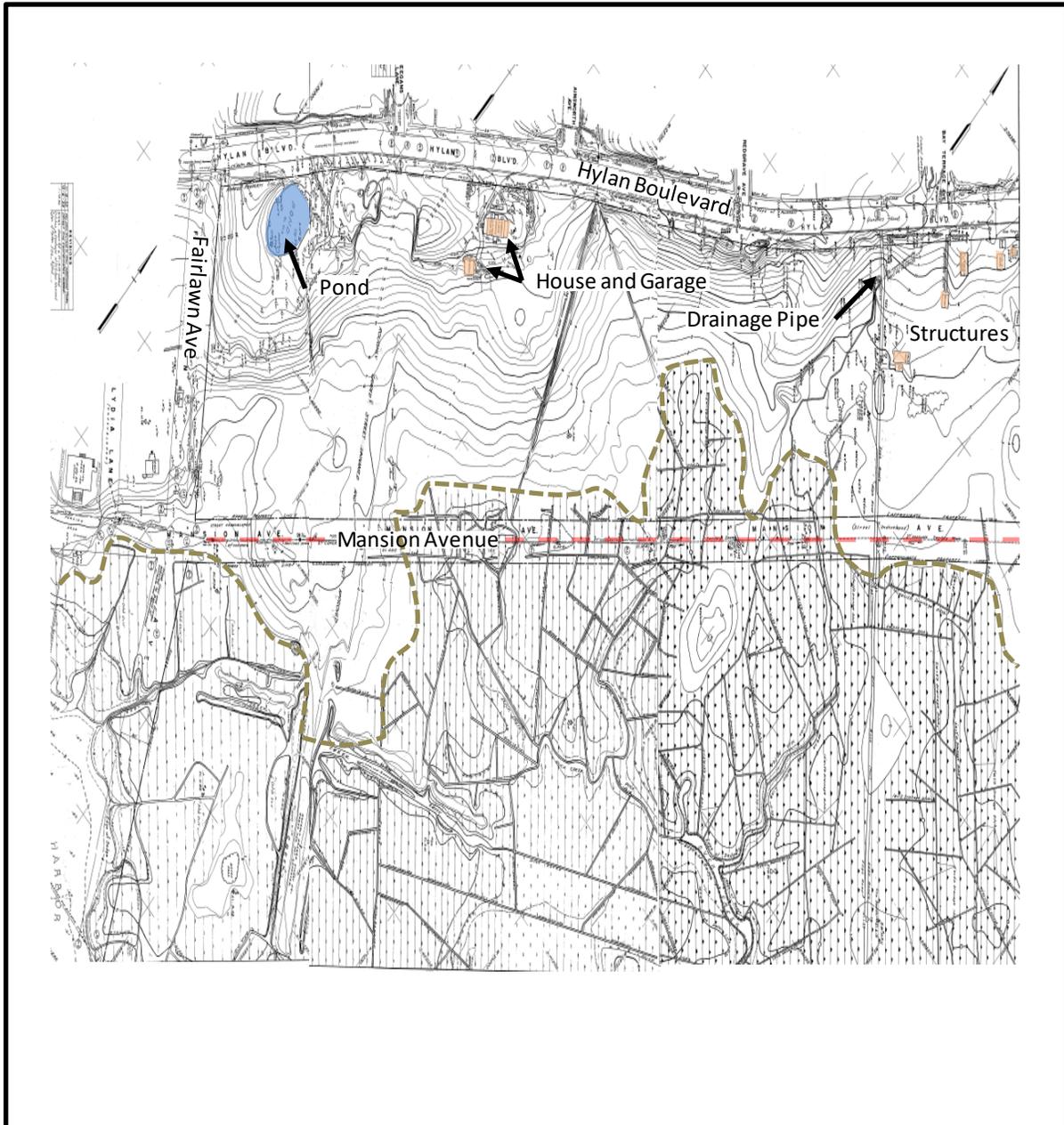
**Figure 2-7. 1925 Historical 15 Minute Topographic Quadrangle, Staten Island, New York**



**Figure 2-8. 1982 Record Map Great Kills Park R-16 Mapping and Acquisition of Original Park**

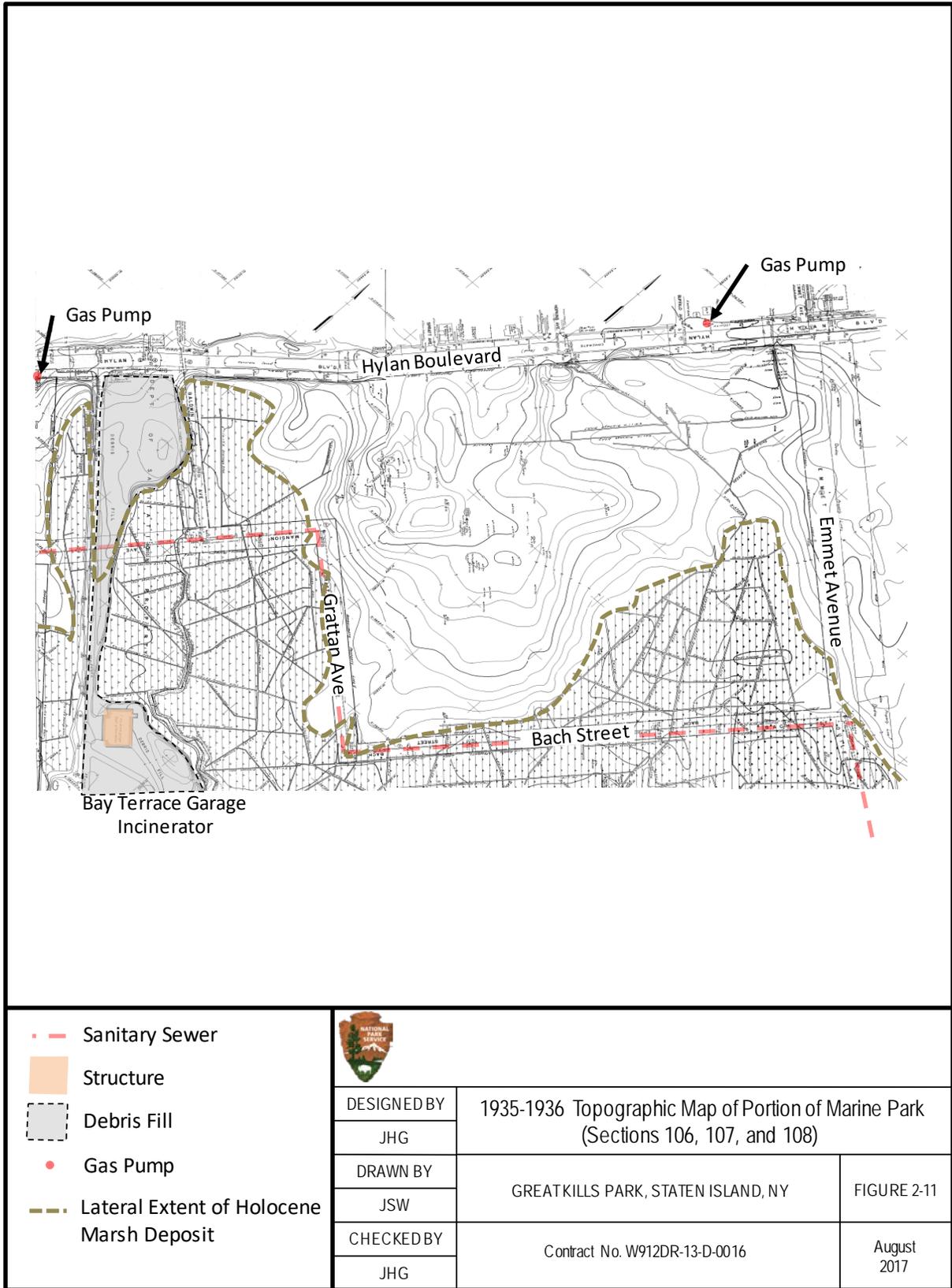


**Figure 2-9. 1935 New Steel Bulkhead Extension, Marine Park Development, New York**

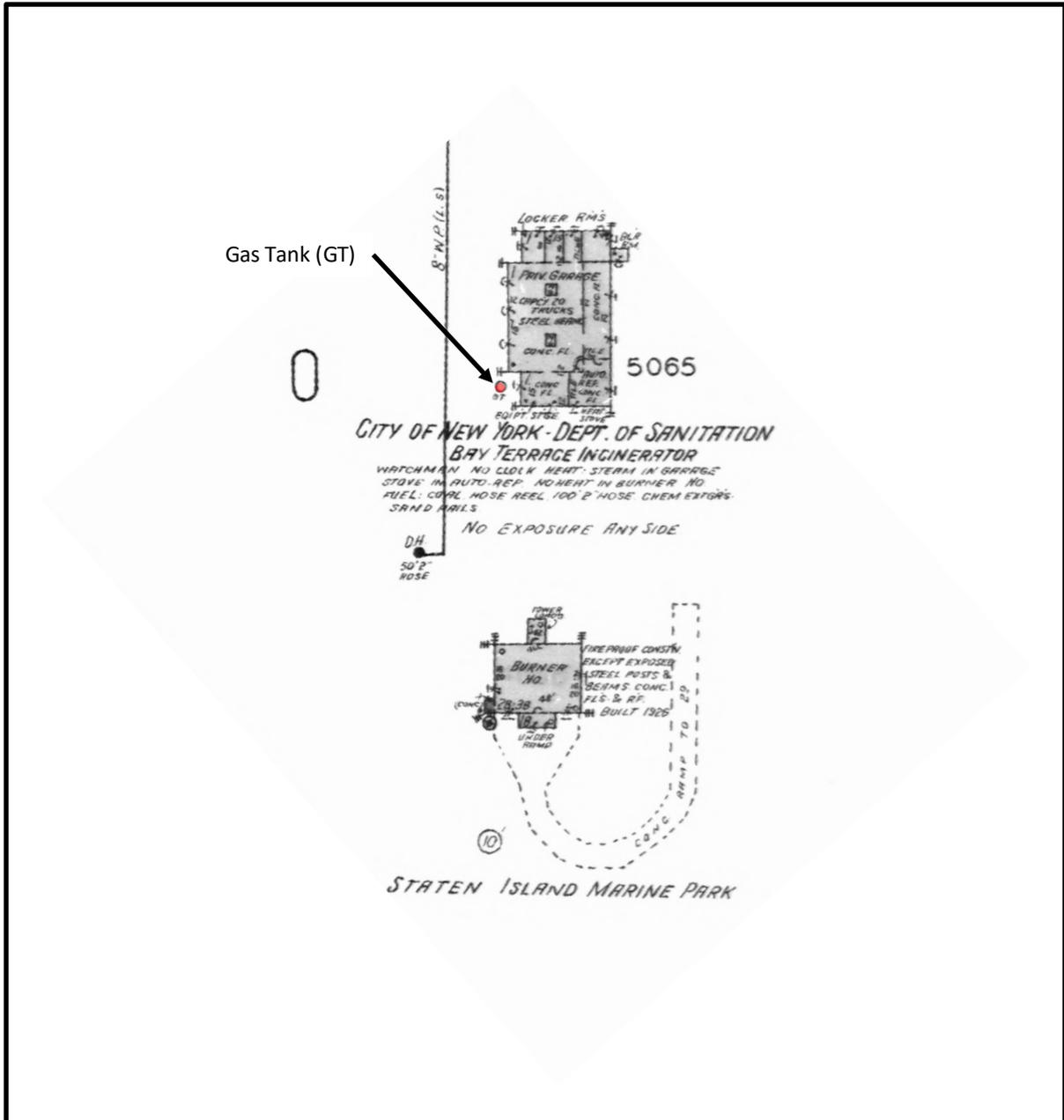


<ul style="list-style-type: none"> <li><span style="color: red;">- - -</span> Sanitary Sewer</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: orange; border: 1px solid black;"></span> Structure</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: lightblue; border-radius: 50%; border: 1px solid black;"></span> Pond</li> <li><span style="border-bottom: 2px dashed brown; width: 20px; display: inline-block;"></span> Lateral Extent of Holocene Marsh Deposit</li> </ul>			
	DESIGNED BY	1935-1936 Topographic Map of Portion of Marine Park (Sections 103, 104, and 105)	
	JHG		
	DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	FIGURE 2-10
	JSW		
CHECKED BY	Contract No. W912DR-13-D-0016	August 2017	
JHG			

**Figure 2-10. 1935-1936 Topographic Map of Portion of Marine Park (Sections 103, 104, 105)**

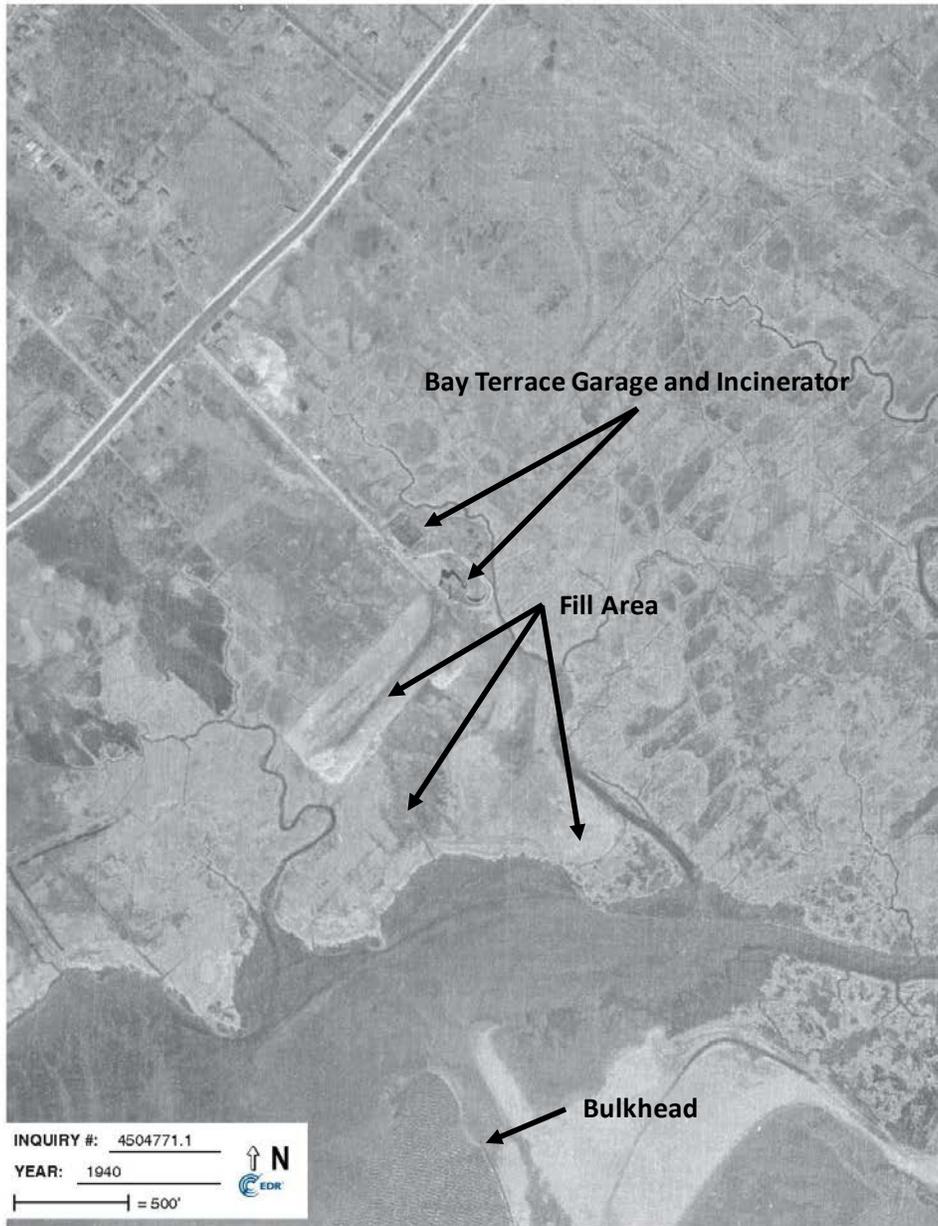


**Figure 2-11. 1935-1936 Topographic Map of Portion of Marine Park (Sections 106, 107, 108)**



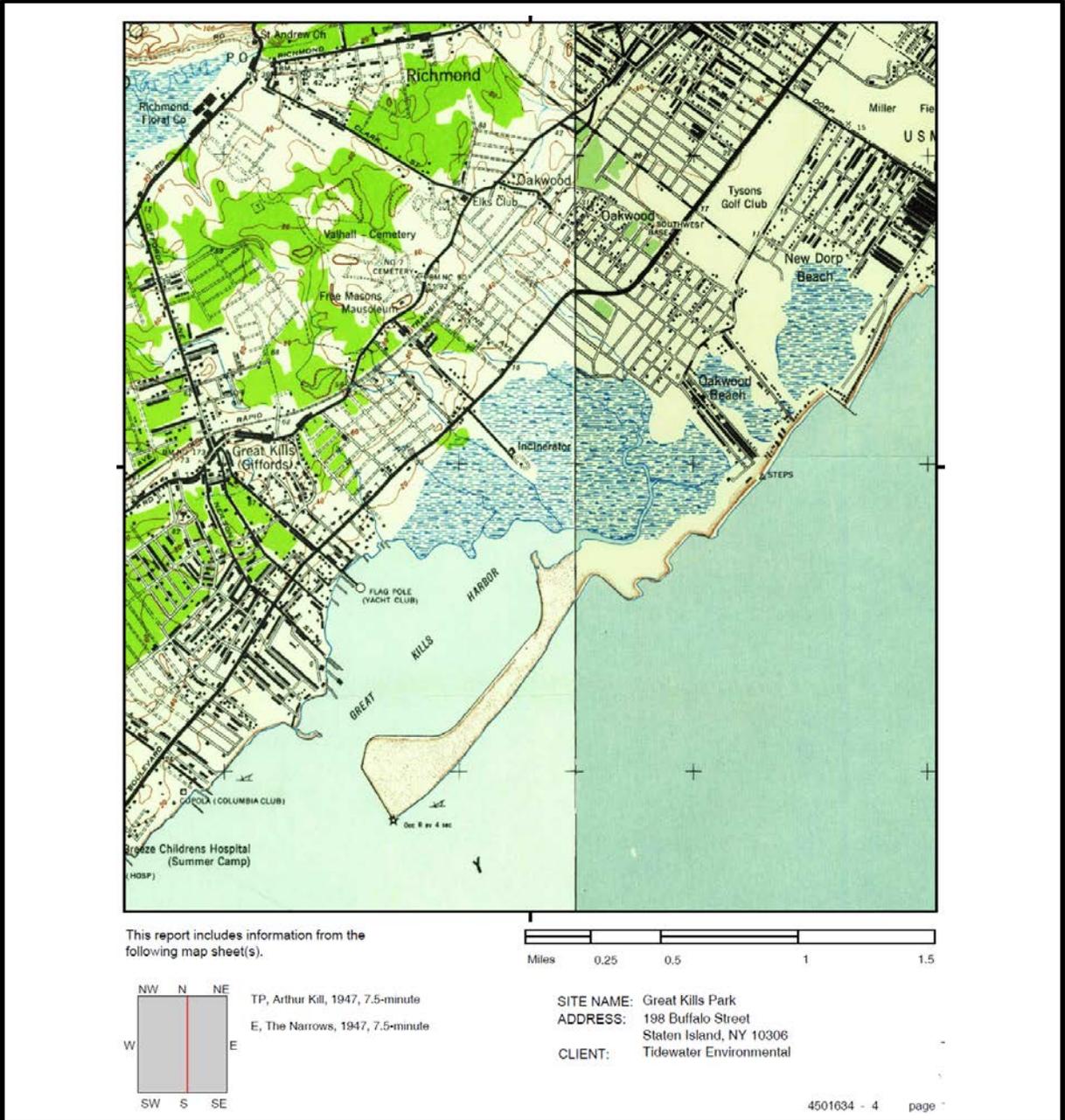
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		JHG		Bay Terrace Incinerator and Garage	
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		JSW			
		CHECKED BY		Contract No. W912DR-13-D-0016	August 2017
		JHG			

**Figure 2-12. 1937 Sanborn Insurance Map, Bay Terrace Incinerator and Garage**



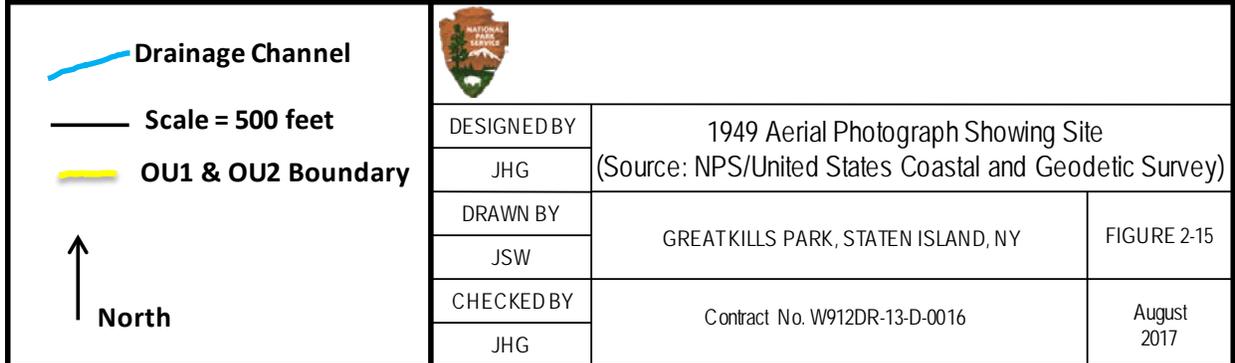
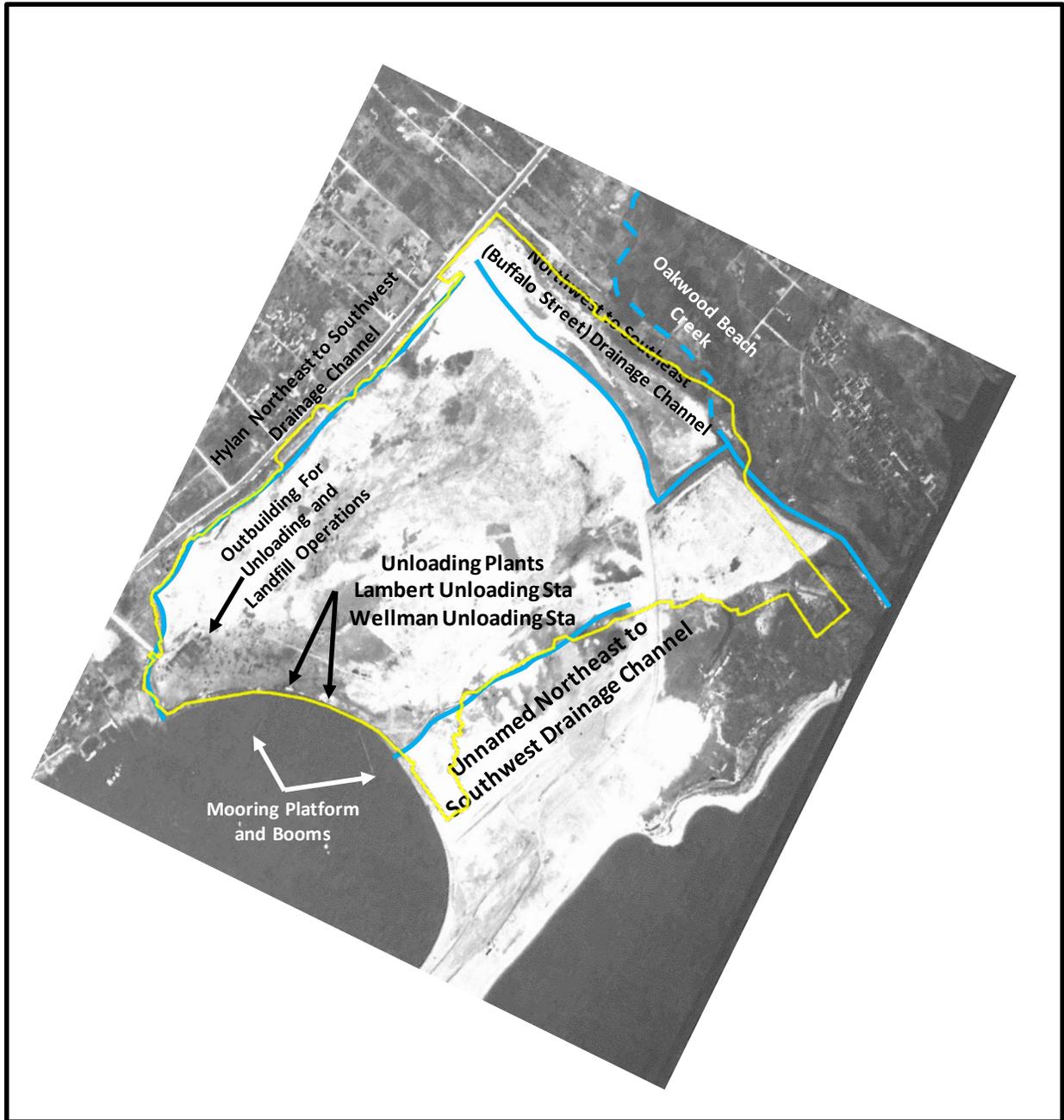
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	JHG			
	DRAWN BY		GREATKILLS PARK, STATEN ISLAND, NY	
	JSW		FIGURE 2-13	
	CHECKED BY		Contract No. W912DR-13-D-0016	
JHG		August 2017		

**Figure 2-13. 1940 Aerial Photograph Showing Site**



		
	DESIGNED BY	1947 Historical 7.5 Minute Topographic Quadrangle Arthur Kill and The Narrows Maps
	JHG	
	DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY
JSW		FIGURE 2-14
CHECKED BY	Contract No. W912DR-13-D-0016	August 2017
JHG		

**Figure 2-14. 1947 Historical 7.5 Minute Topographic Quadrangle Arthur Kill and The Narrows**



**Figure 2-15. 1949 Aerial Photograph Showing Site**



INQUIRY #: 4501834.9  
 YEAR: 1951  
 | = 500'



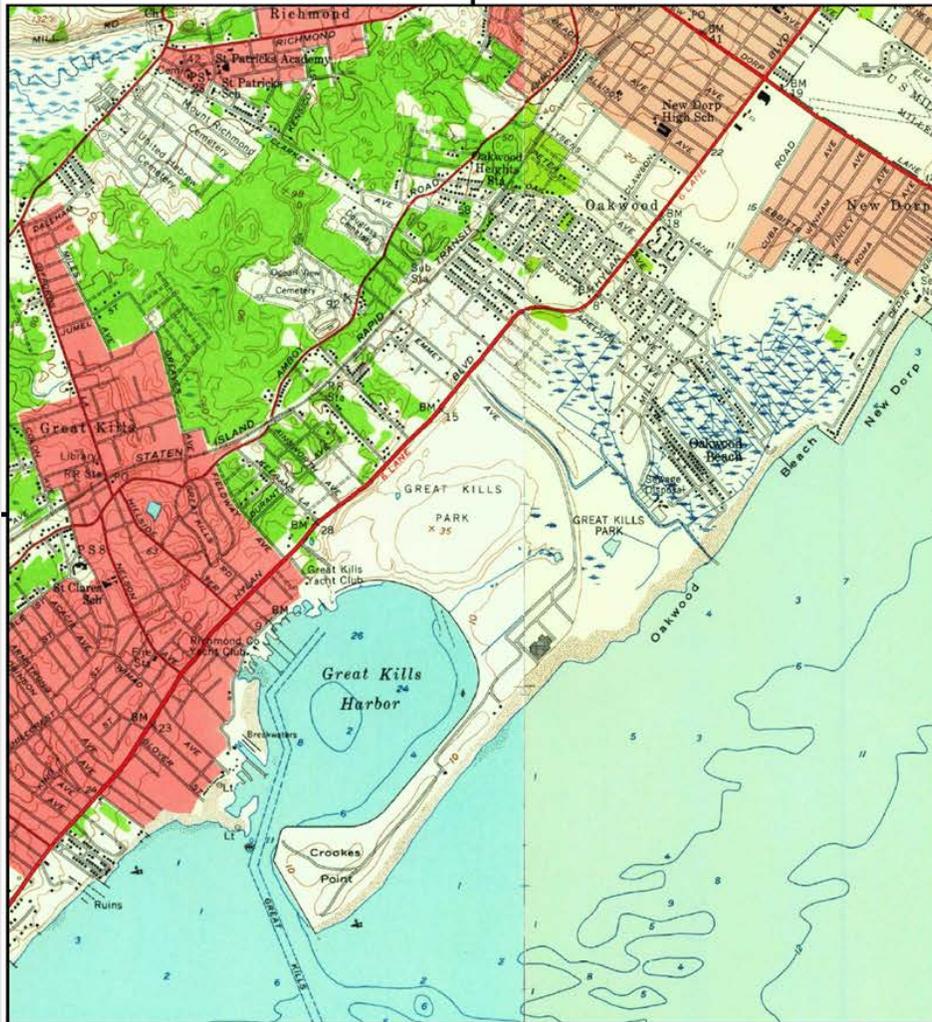
			
		1951 Aerial Photograph Showing Site (Source: EDR Proprietary Aerial, Viewpoint)	
		DRAWN BY JSW	GREATKILLS PARK, STATEN ISLAND, NY
		CHECKED BY JHG	
		Contract No. W912DR-13-D-0016	

**Figure 2-16. 1951 Aerial Photograph Showing Site**

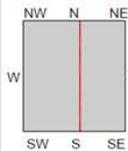


		DESIGNED BY 1954 Aerial Photograph Showing Site (Source: U.S. Geological Survey)		
		JHG		
		DRAWN BY JSW	GREATKILLS PARK, STATEN ISLAND, NY	FIGURE 2-17
		CHECKED BY JHG	Contract No. W912DR-13-D-0016	August 2017

**Figure 2-17 1954 Aerial Photograph Showing Site**



This report includes information from the following map sheet(s).



TP, Arthur Kill, 1955, 7.5-minute  
E, The Narrows, 1955, 7.5-minute

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ADDRESS: 198 Buffalo Street  
Staten Island, NY 10306  
CLIENT: Tidewater Environmental

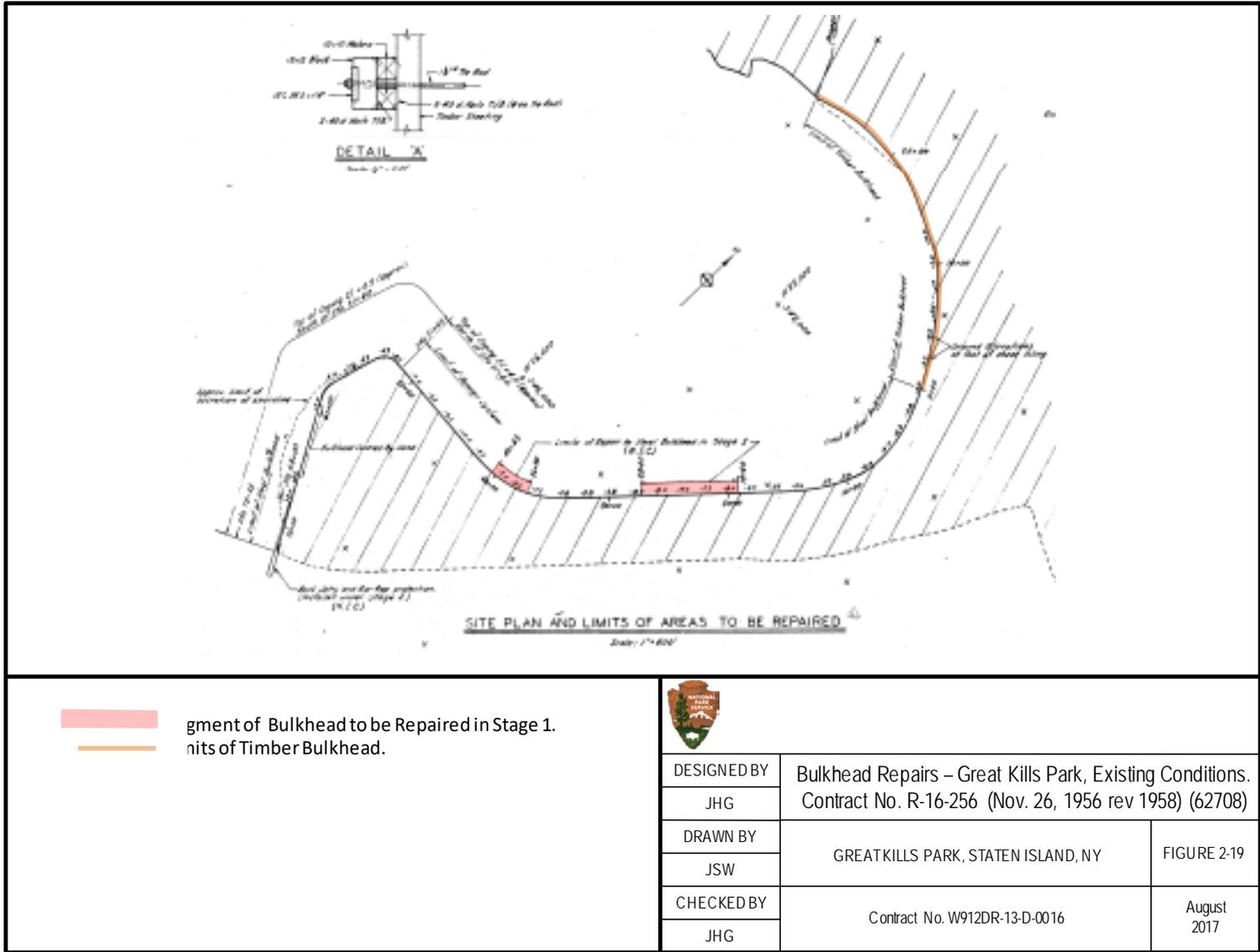


4501634 - 4 page 9



DESIGNED BY	1955 Historical 7.5 Minute Topographic Quadrangle Arthur Kill and The Narrows Maps	
JHG		
DRAWN BY	GREAT KILLS PARK, STATEN ISLAND, NY	FIGURE 2-18
JSW		
CHECKED BY	Contract No. W912DR-13-D-0016	August 2017
JHG		

**Figure 2-18. 1955 Historical 7.5 Minute Topographic Quadrangle Arthur Kill and The Narrows**

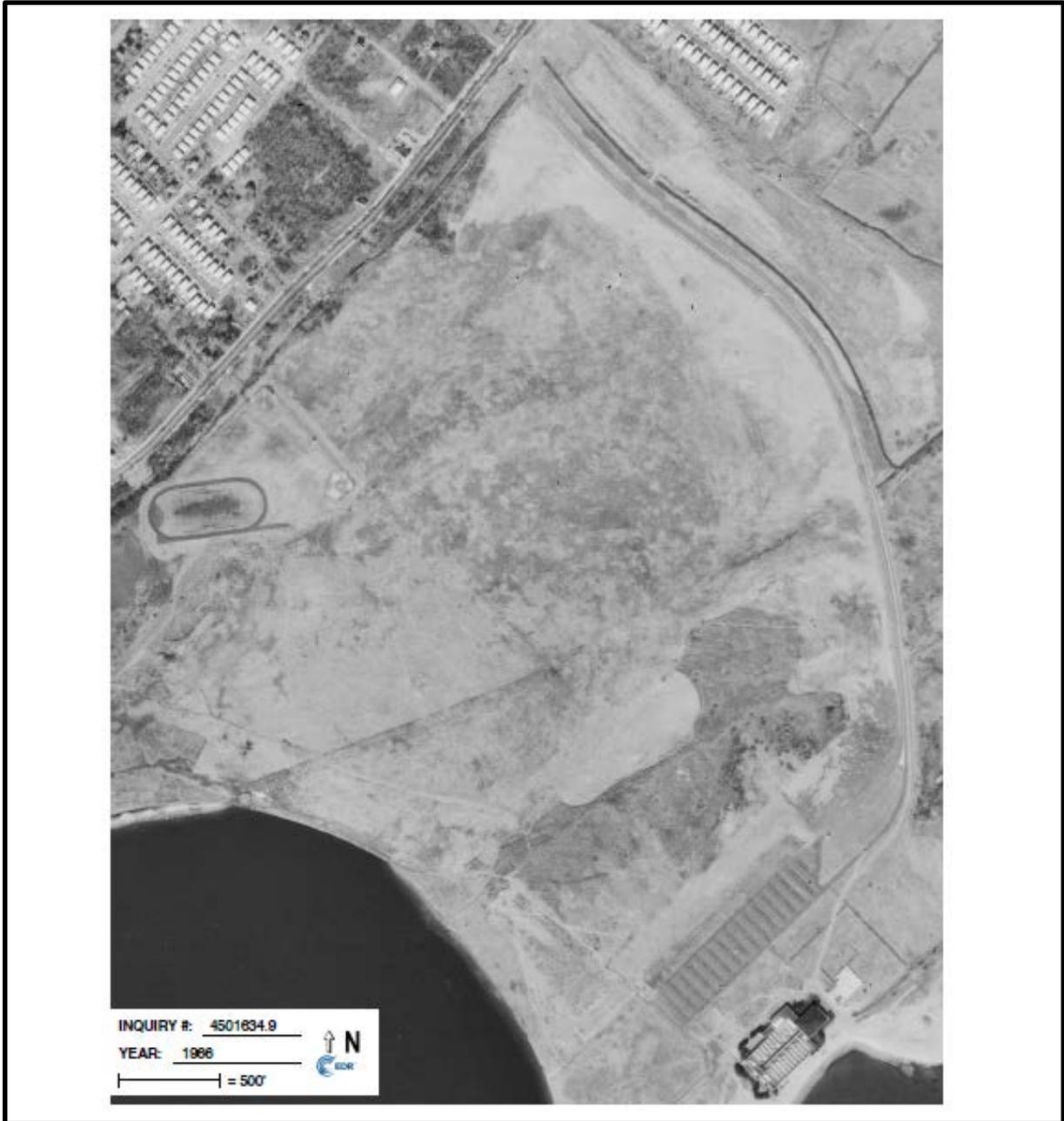


**Figure 2-19. Bulkhead Repairs – Great Kills Park, Existing Conditions**



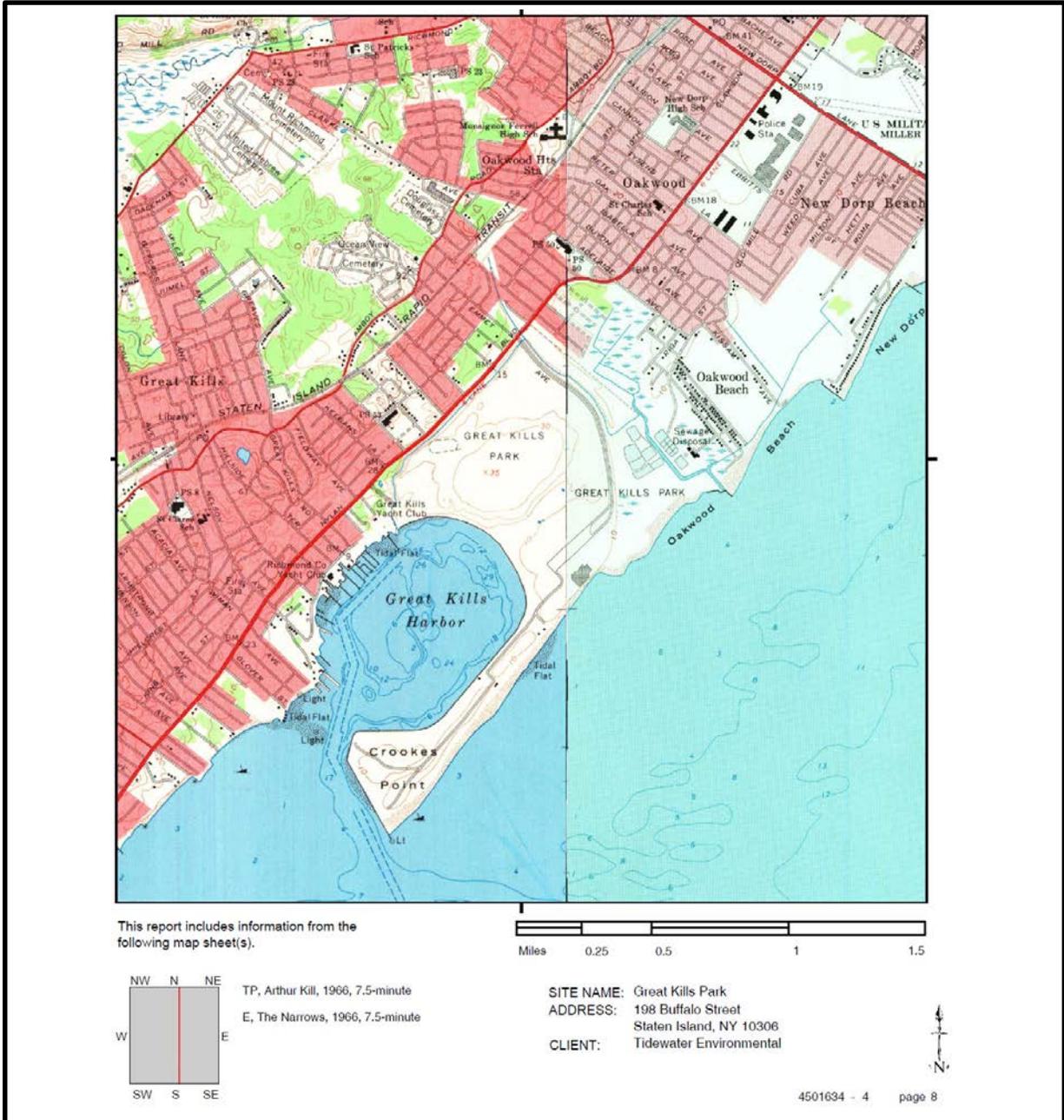
				
		DESIGNED BY	1961 Aerial Photograph Showing Site (Source: EDR Proprietary Aerial Viewpoint)	
		JHG		
		DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	
		JSW	FIGURE 2-20	
		CHECKED BY	Contract No. W912DR-13-D-0016	
JHG	August 2017			

**Figure 2-20. 1961 Aerial Photograph Showing Site**



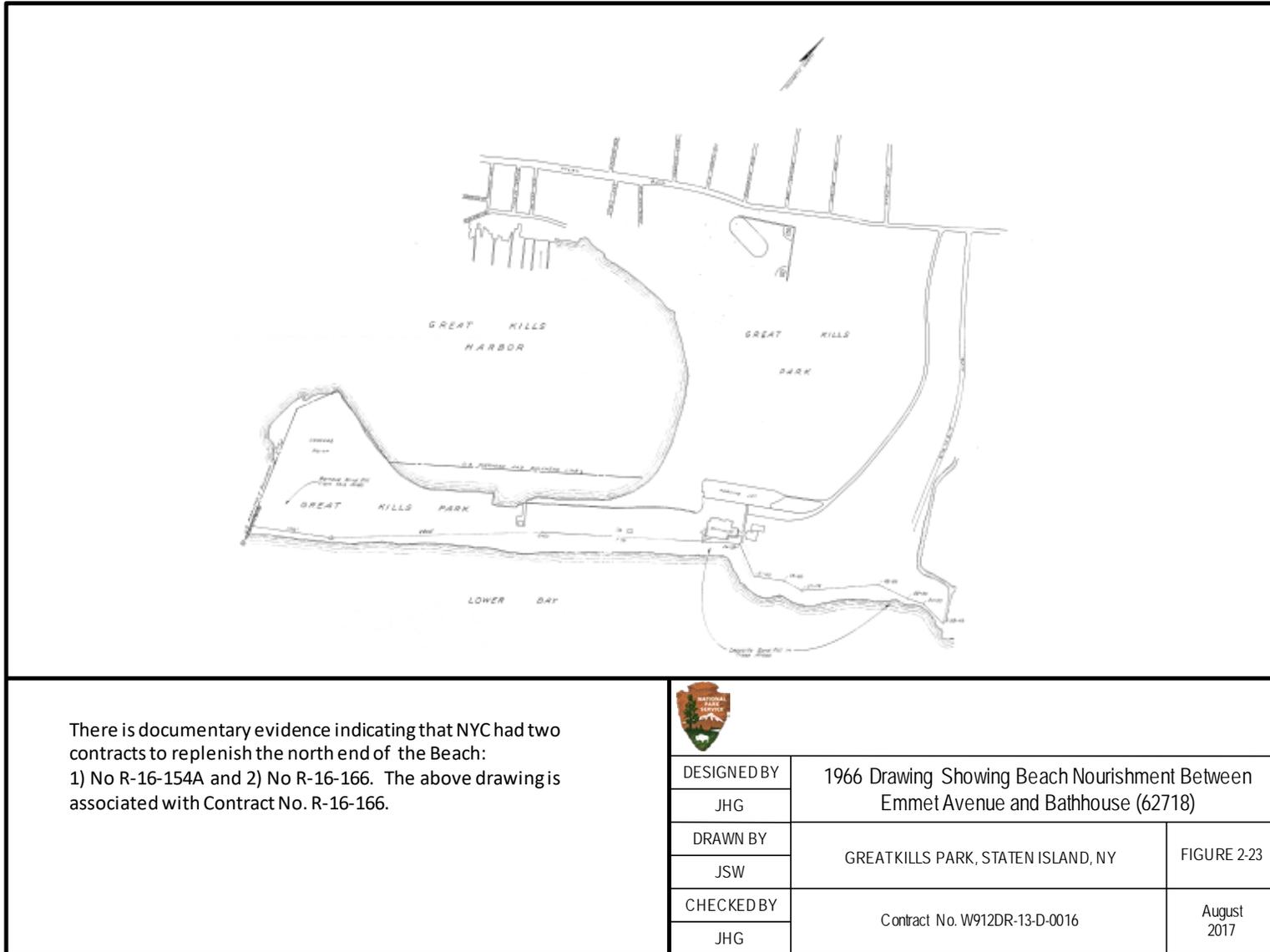
		1966 Aerial Photograph Showing Site (Source: U.S. Geological Survey)	
		GREATKILLS PARK, STATEN ISLAND, NY	FIGURE 2-21
DESIGNED BY	JHG		
DRAWN BY	JSW		
CHECKED BY	JHG	Contract No. W912DR-13-D-0016	August 2017

**Figure 2-21. 1966 Aerial Photograph Showing Site**

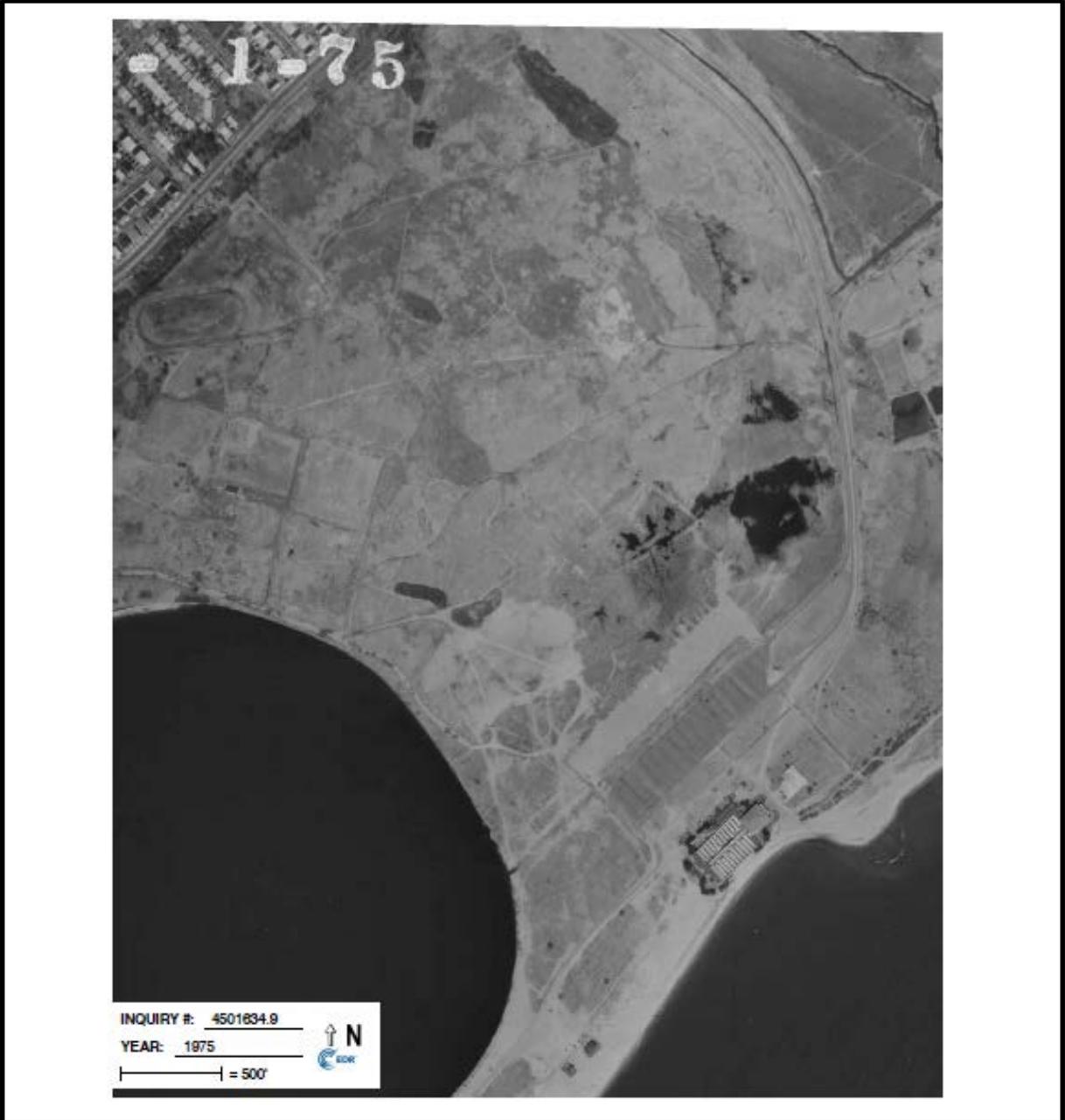


	DESIGNED BY		1966 Historical 7.5 Minute Topographic Quadrangle Arthur Kill and The Narrows Maps		
	JHG				
	DRAWN BY		GREATKILLS PARK, STATEN ISLAND, NY		
	JSW		FIGURE 2-22		
CHECKED BY		Contract No. W912DR-13-D-0016		August 2017	
JHG					

**Figure 2-22. 1966 Historical 7.5 Minute Topographic Quadrangle Arthur Kill and The Narrows**

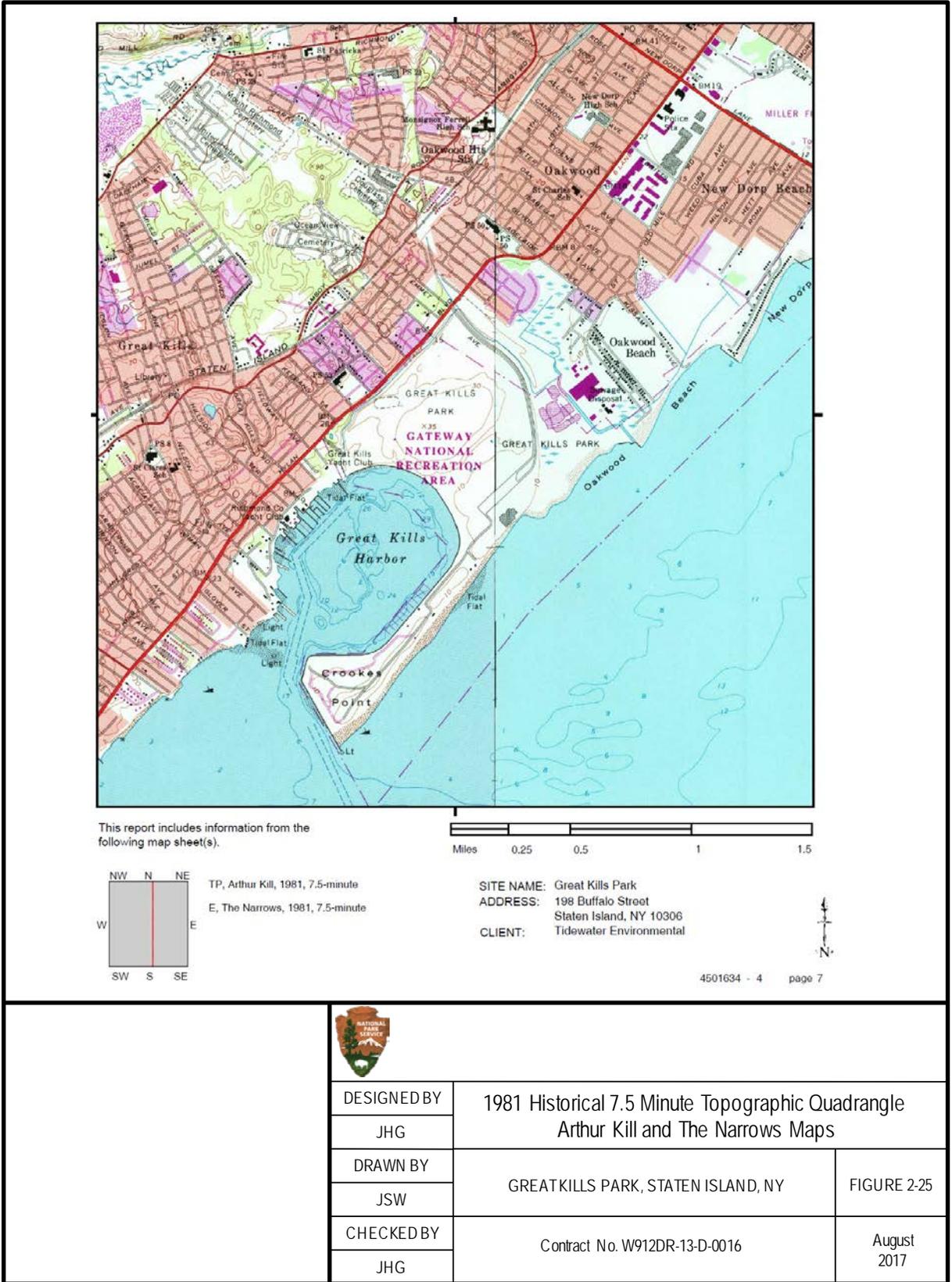


**Figure 2-23. 1966 Drawing Showing Beach Nourishment Between Emmet Avenue and Bathhouse**



			
	DESIGNED BY	1975 Aerial Photograph Showing Site (Source: EDR)	
	JHG		
	DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	FIGURE 2-24
	JSW		
	CHECKED BY	Contract No. W912DR-13-D-0016	August 2017
JHG			

**Figure 2-24. 1975 Aerial Photograph Showing Site**



**Figure 2-25. 1981 Historical 7.5 Minute Topographic Quadrangle Arthur Kill and The Narrows**

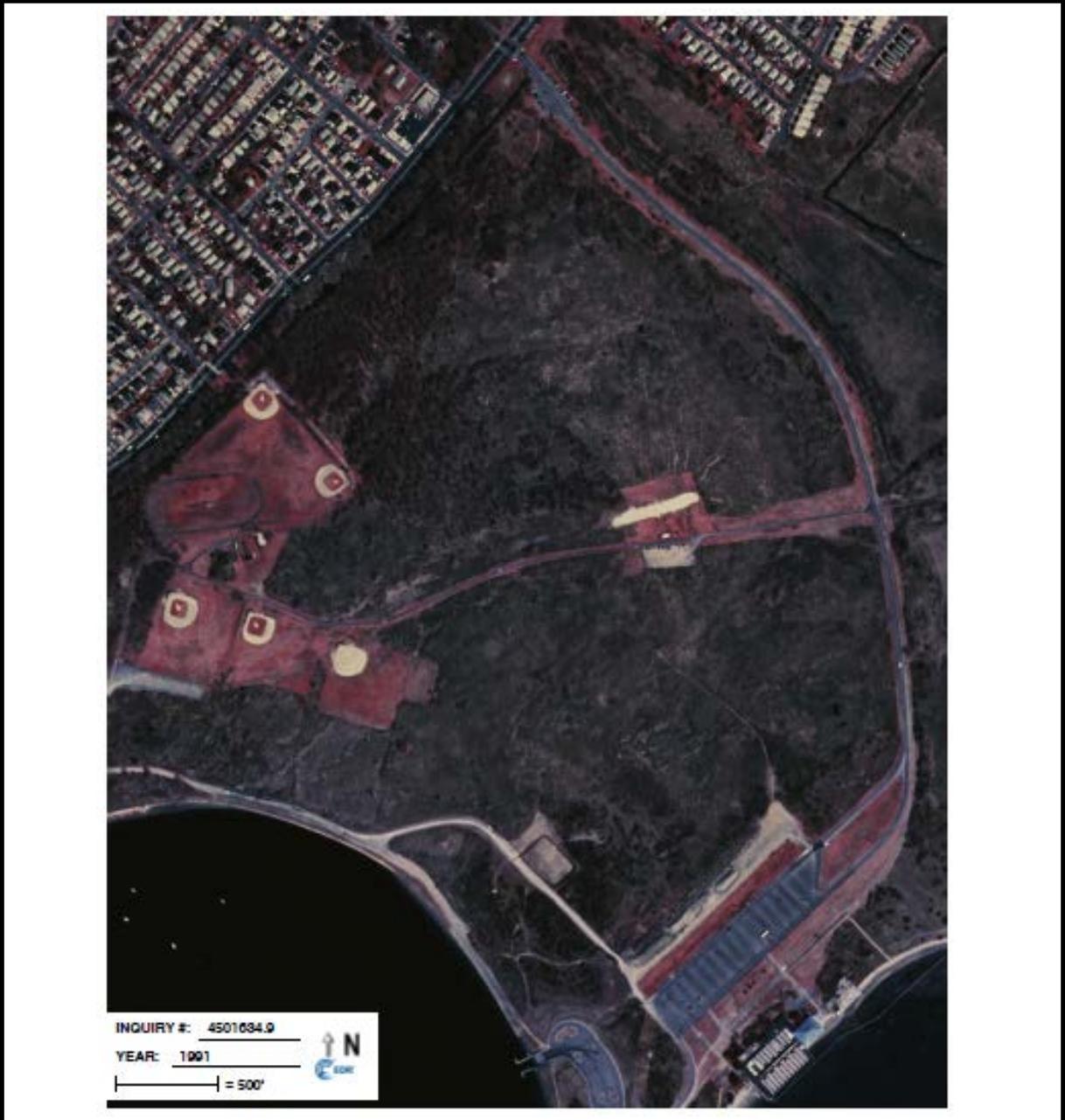


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 YEAR: 1984  
 = 500'



DESIGNED BY	1984 Aerial Photograph Showing Site (Source: U.S. Geological Survey)	
JHG		
DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	FIGURE 2-26
JSW		
CHECKED BY	Contract No. W912DR-13-D-0016	August 2017
JHG		

**Figure 2-26. 1984 Aerial Photograph Showing Site**



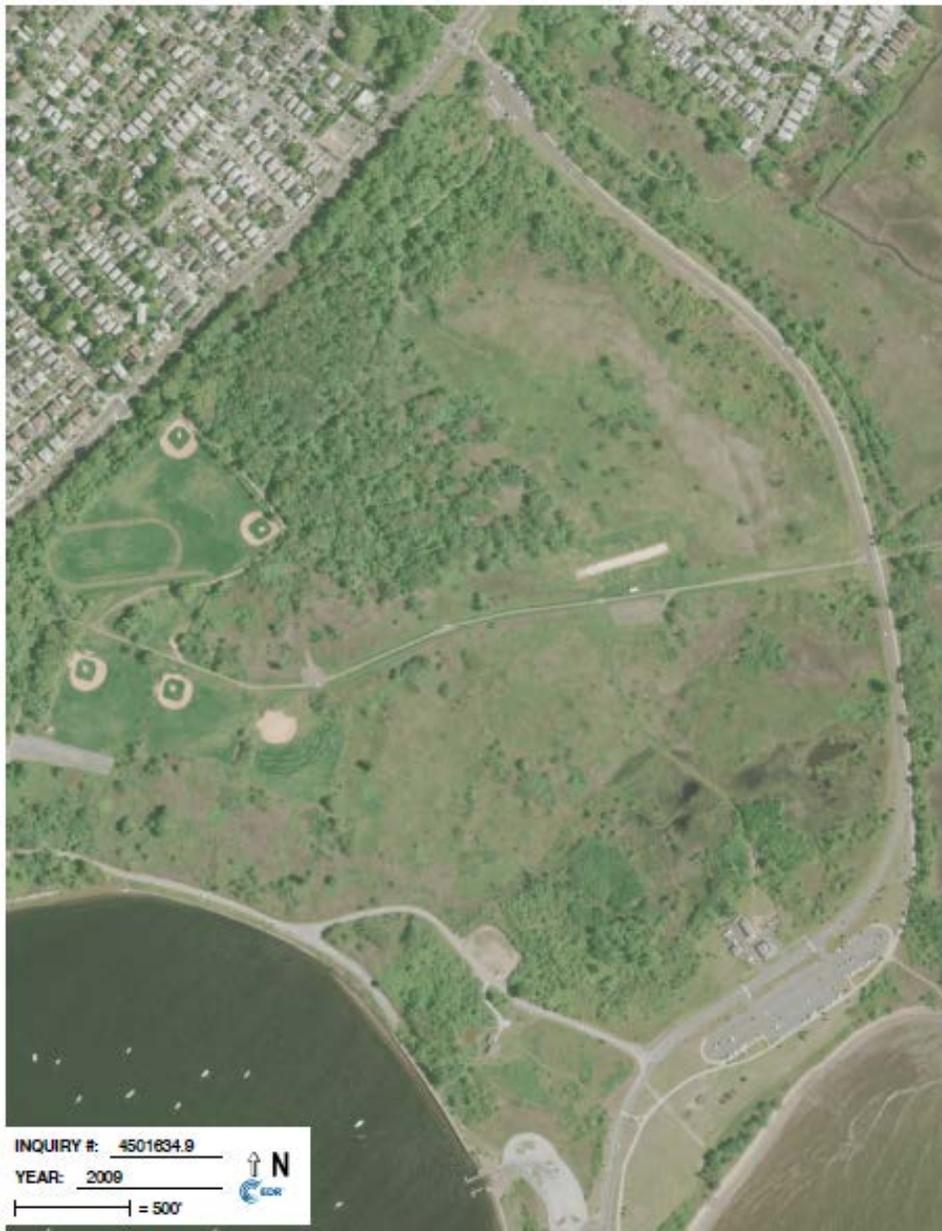
				
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		DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	
		JSW	FIGURE 2-27	
CHECKED BY	Contract No. W912DR-13-D-0016		August 2017	
JHG				

**Figure 2-27. 1991 Aerial Photograph Showing Site**



			
		2006 Aerial Photograph Showing Site U.S.G.S./ National Agriculture Imagery Program	
		DRAWN BY JSW	GREATKILLS PARK, STATEN ISLAND, NY
		CHECKED BY JHG	
		Contract No. W912DR-13-D-0016	

**Figure 2-28. 2006 Aerial Photograph Showing Site**



				
				DESIGNED BY
		JHG		
		DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	
		JSW	FIGURE 2-29	
		CHECKED BY	Contract No. W912DR-13-D-0016	
		JHG	August 2017	

**Figure 2-29. 2009 Aerial Photograph Showing Site**



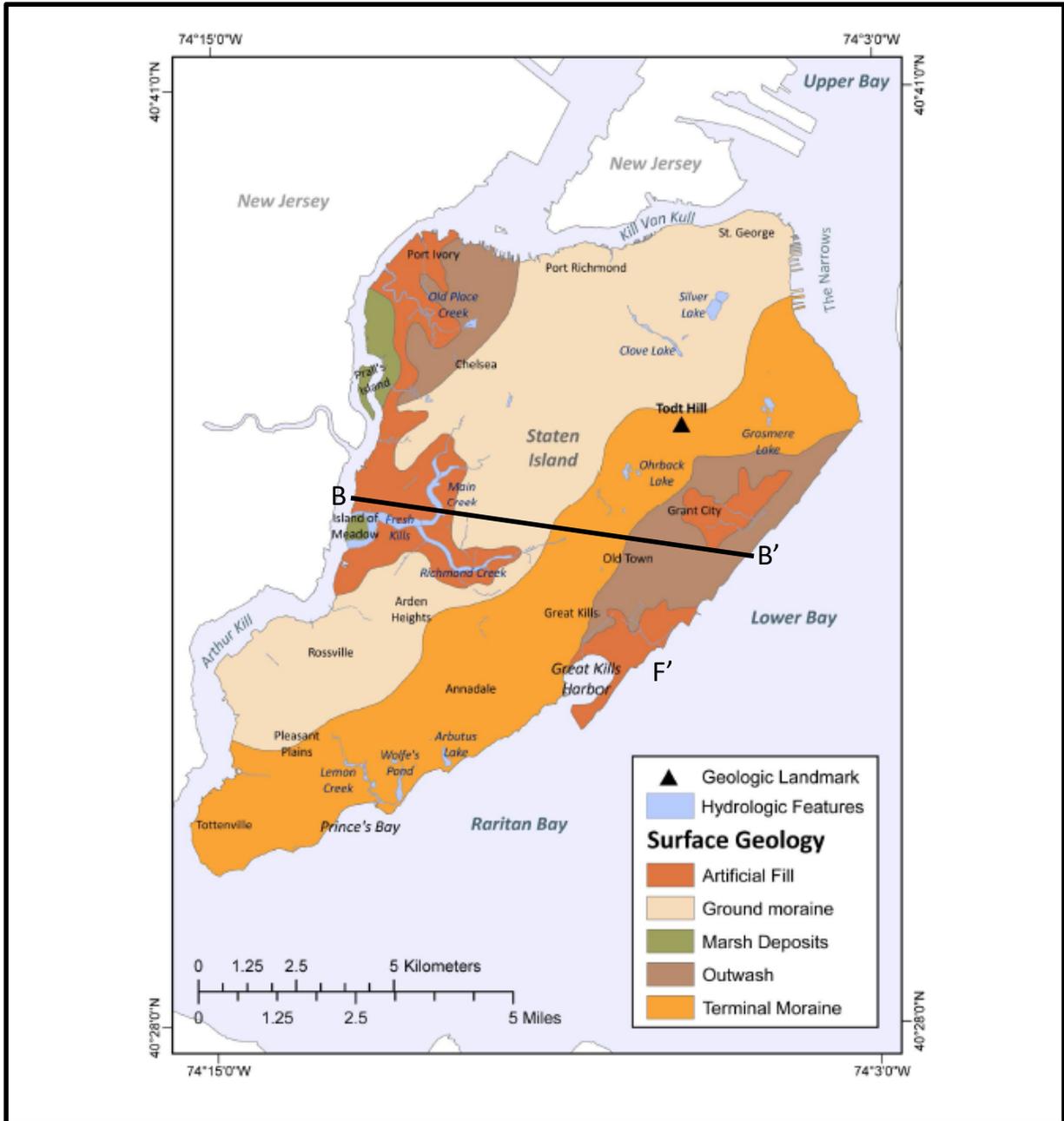
				
		DESIGNED BY	2011 Aerial Photograph Showing Site (Source: U.S.G.S./ National Agriculture Imagery Program)	
		JHG		
		DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	
		JSW	FIGURE 2-30	
CHECKED BY	Contract No. W912DR-13-D-0016		August 2017	
JHG				

**Figure 2-30. 2011 Aerial Photograph Showing Site**



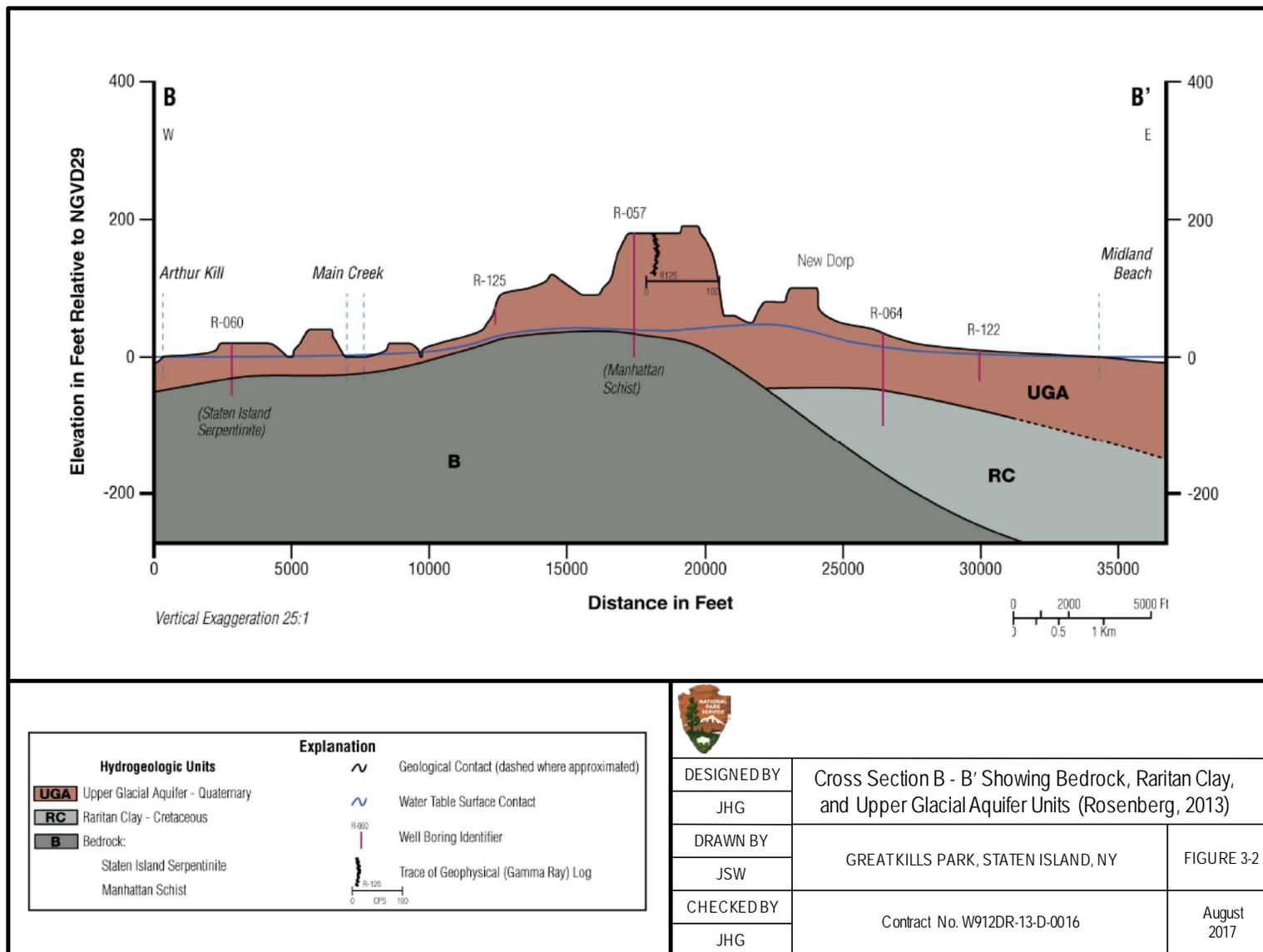
<ul style="list-style-type: none"> <li> Marine Zone</li> <li> Recreation Zone</li> <li> Active Beach Subzone</li> <li> Natural Zone</li> <li> Sensitive Resource Subzone</li> <li> Developed Zone</li> <li> NYC / Other Federal Agency Land</li> <li> City / County / State Park Land</li> </ul>			
	DESIGNED BY	NPS Preferred Alternative B Management Zones At Great Kills Park (NPS, 2014)	
	JHG		
	DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	
	JSW		
CHECKED BY	Contract No. W912DR-13-D-0016		
JHG			
		FIGURE 2-31	August 2017

**Figure 2-31. NPS Preferred Alternative B Management Zones at Great Kills Park**

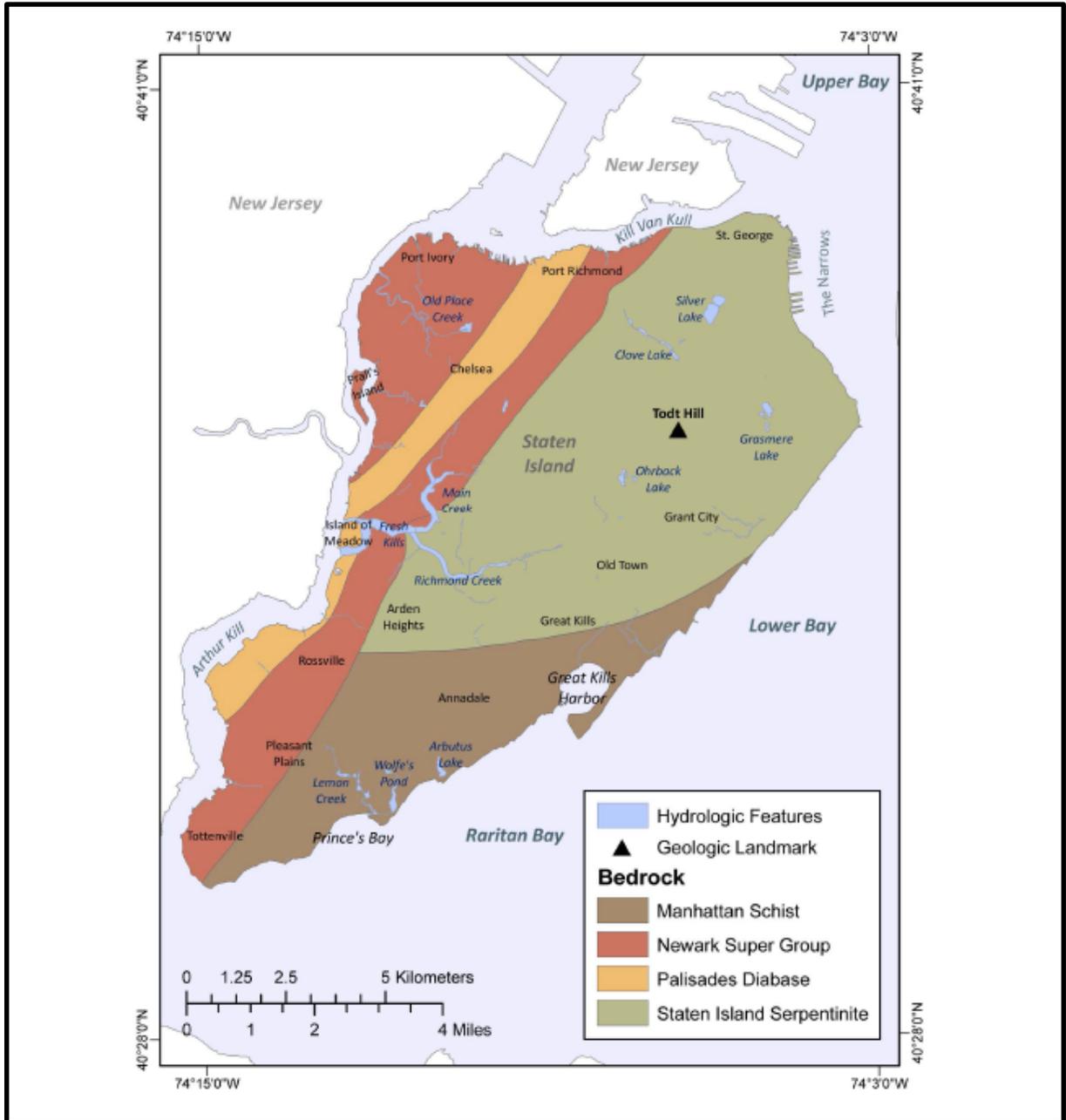


		DESIGNED BY		Surficial Geology of Staten Island (Rosenberg, 2013)	
		JHG			
		DRAWN BY		GREATKILLS PARK, STATEN ISLAND, NY	
		JSW		FIGURE 3- 1	
		CHECKED BY		Contract No. W912DR-13-D-0016	
		JHG		August 2017	

**Figure 3-1. Surficial Geology of Staten Island**

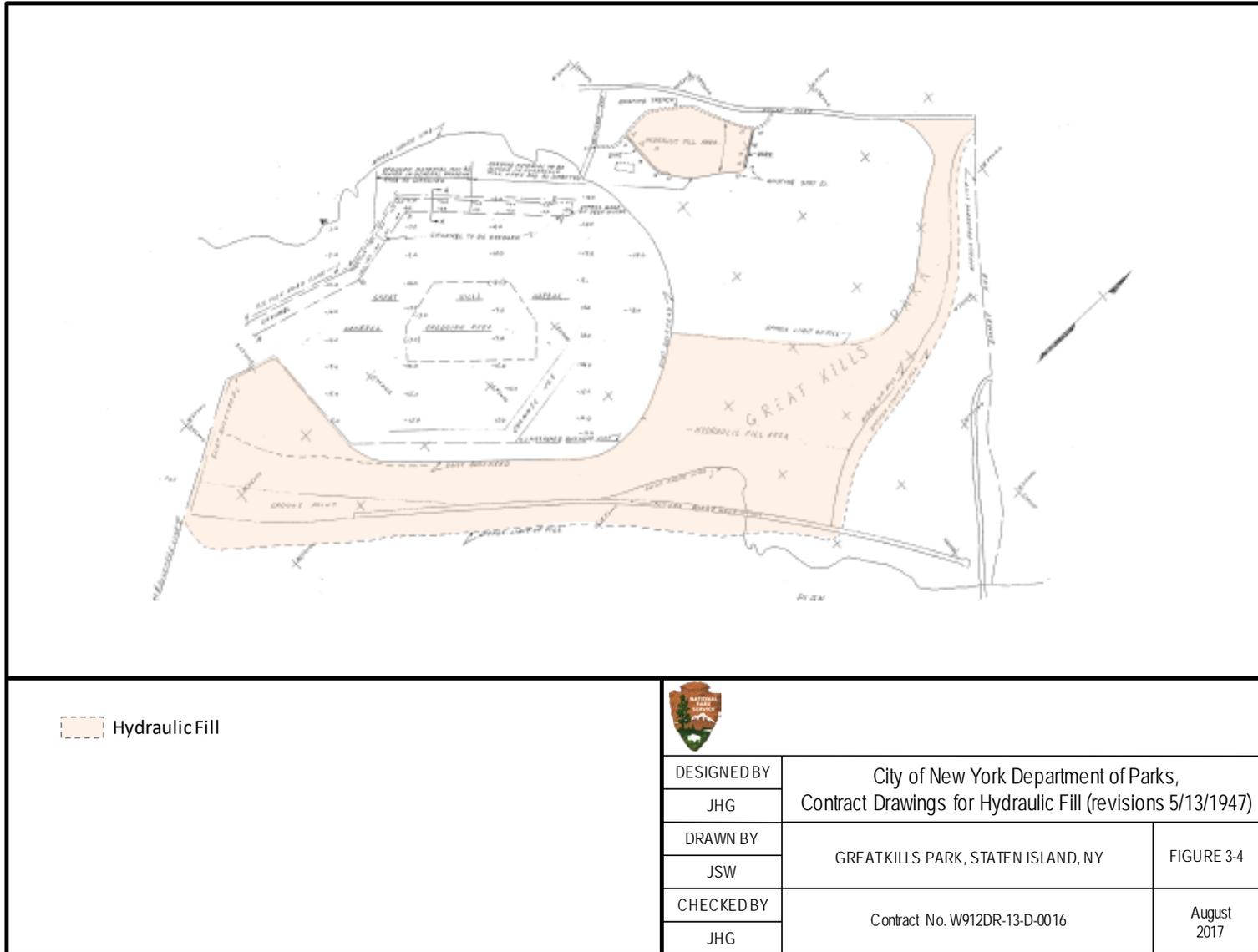


**Figure 3-2. Cross Section B-B' Showing Bedrock, Raritan Clay, and Upper Glacial Aquifer Units**

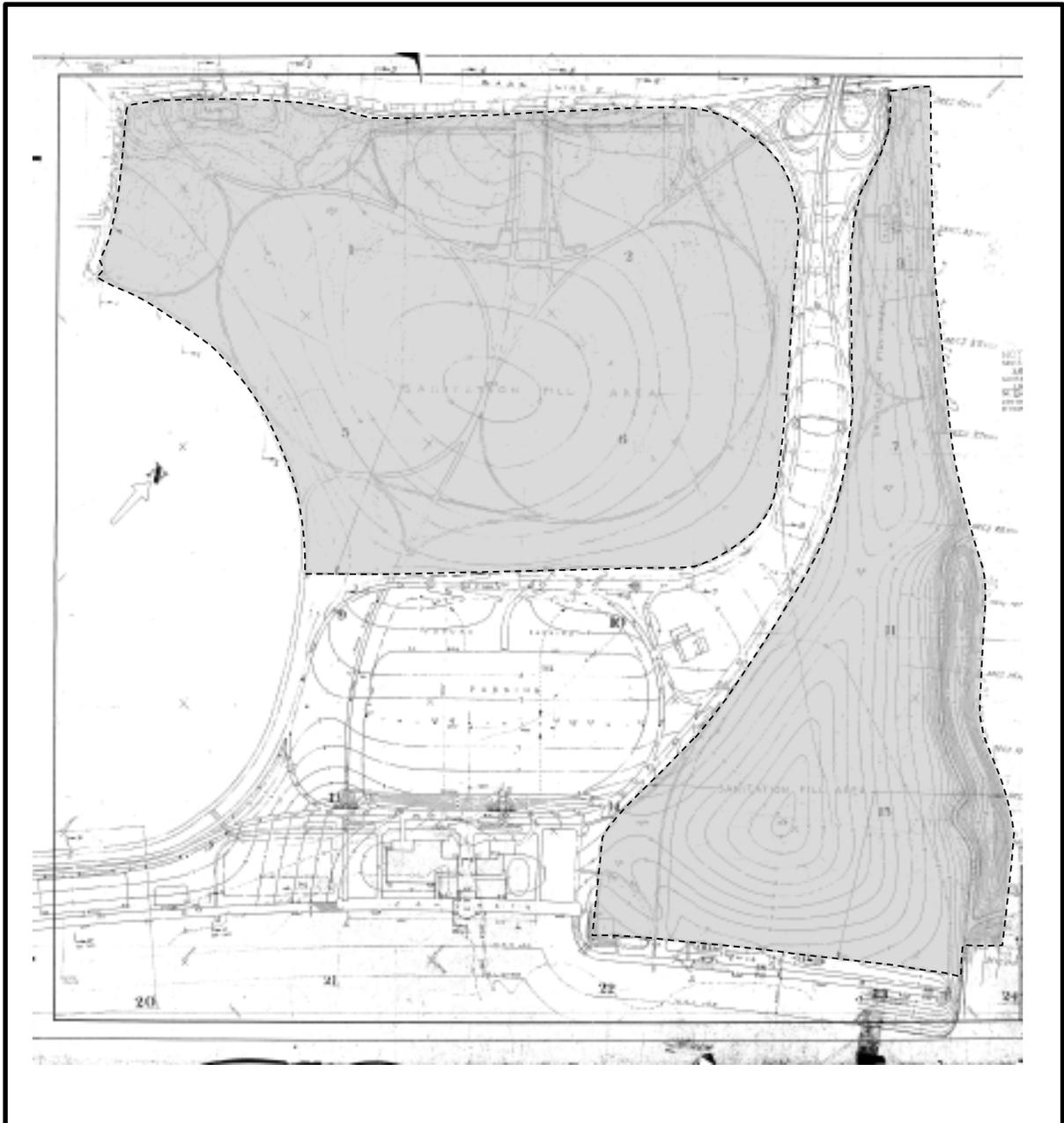


		DESIGNED BY		Bedrock Geology of Staten Island (Rosenberg, 2013)	
		JHG			
		DRAWN BY		GREATKILLS PARK, STATEN ISLAND, NY	
		JSW			
		CHECKED BY		Contract No. W912DR-13-D-0016	
		JHG			
				FIGURE 3-3	
				August 2017	

**Figure 3-3. Bedrock Geology of Staten Island**



**Figure 3-4. City of New York Department of Parks, Contract Drawings for Hydraulic Fill**



		City of New York Department of Parks, Grading Plan (Original 3/24/43 with rev through 5/8/48)	
		GREATKILLS PARK, STATEN ISLAND, NY	
DESIGNED BY	JHG	FIGURE 3-5	
DRAWN BY	JSW		
CHECKED BY	JHG	Contract No. W912DR-13-D-0016	
		August 2017	

**Figure 3-5. City of New York Department of Parks, Grading Plan**

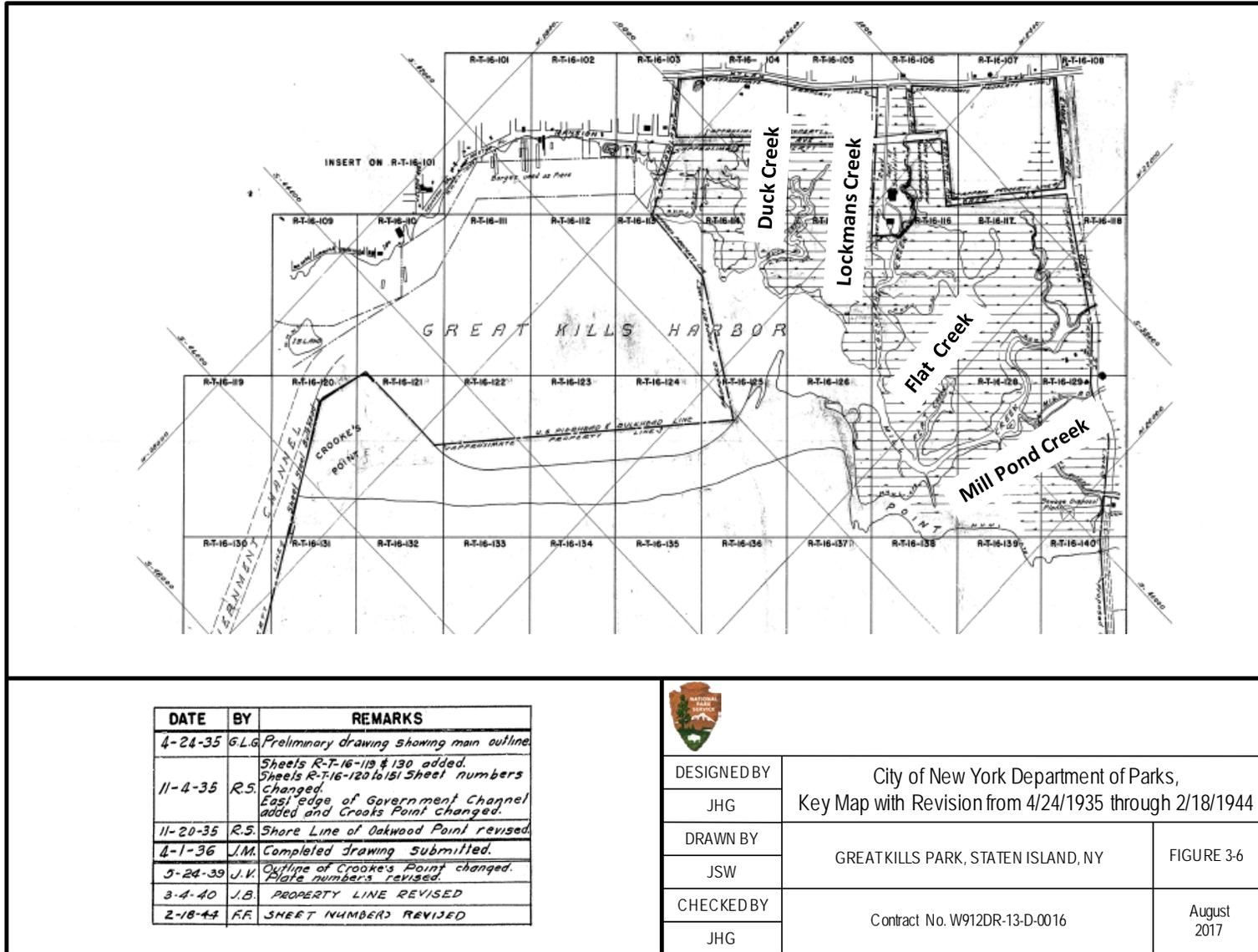
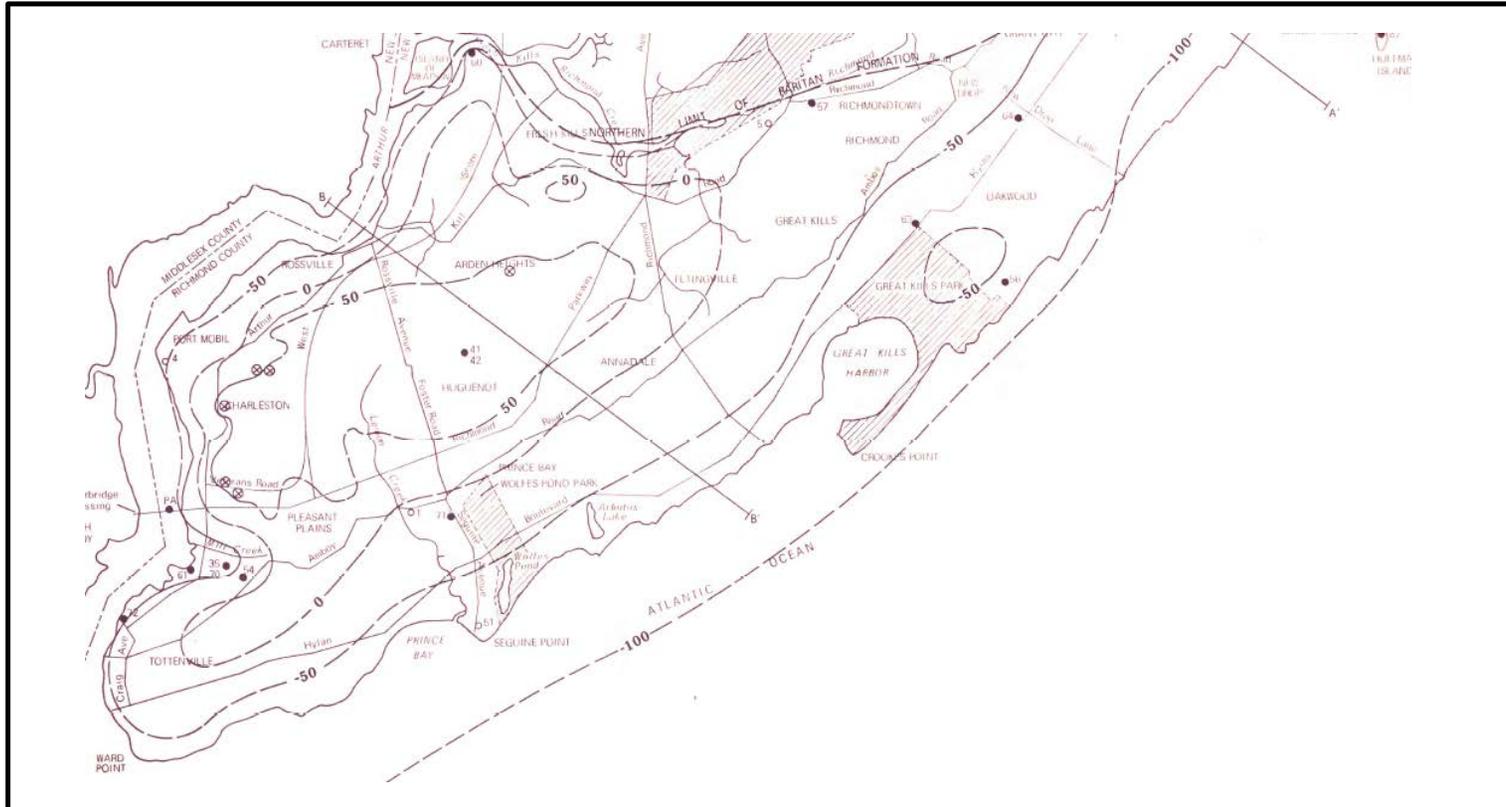


Figure 3-6. City of New York Department of Parks, Key Map with Revision from 4/24/1935 through 2/18/1944



Structure Contour shows altitude of upper surface of the Raritan Formation. Solid where approximately located and dashed where inferred. Contour interval 50 feet. Datum is sea level.

⊕ Outcrop of the Raritan Formation

Well or borehole. Solid circle symbol indicates penetration of Raritan Formation, open circle symbol indicates deep borehole did not reach formation

0 2 Miles



DESIGNED BY	Configuration of the Surface of the Raritan Formation (Source: Plate 3, Soren, 1988)	
JHG		
DRAWN BY	GREAT KILLS PARK, STATEN ISLAND, NY	FIGURE 3-7
JSW		
CHECKED BY	Contract No. W912DR-13-D-0016	August 2017
JHG		

**Figure 3-7. Configuration of the Surface of the Raritan Formation**



0 2,000 Feet

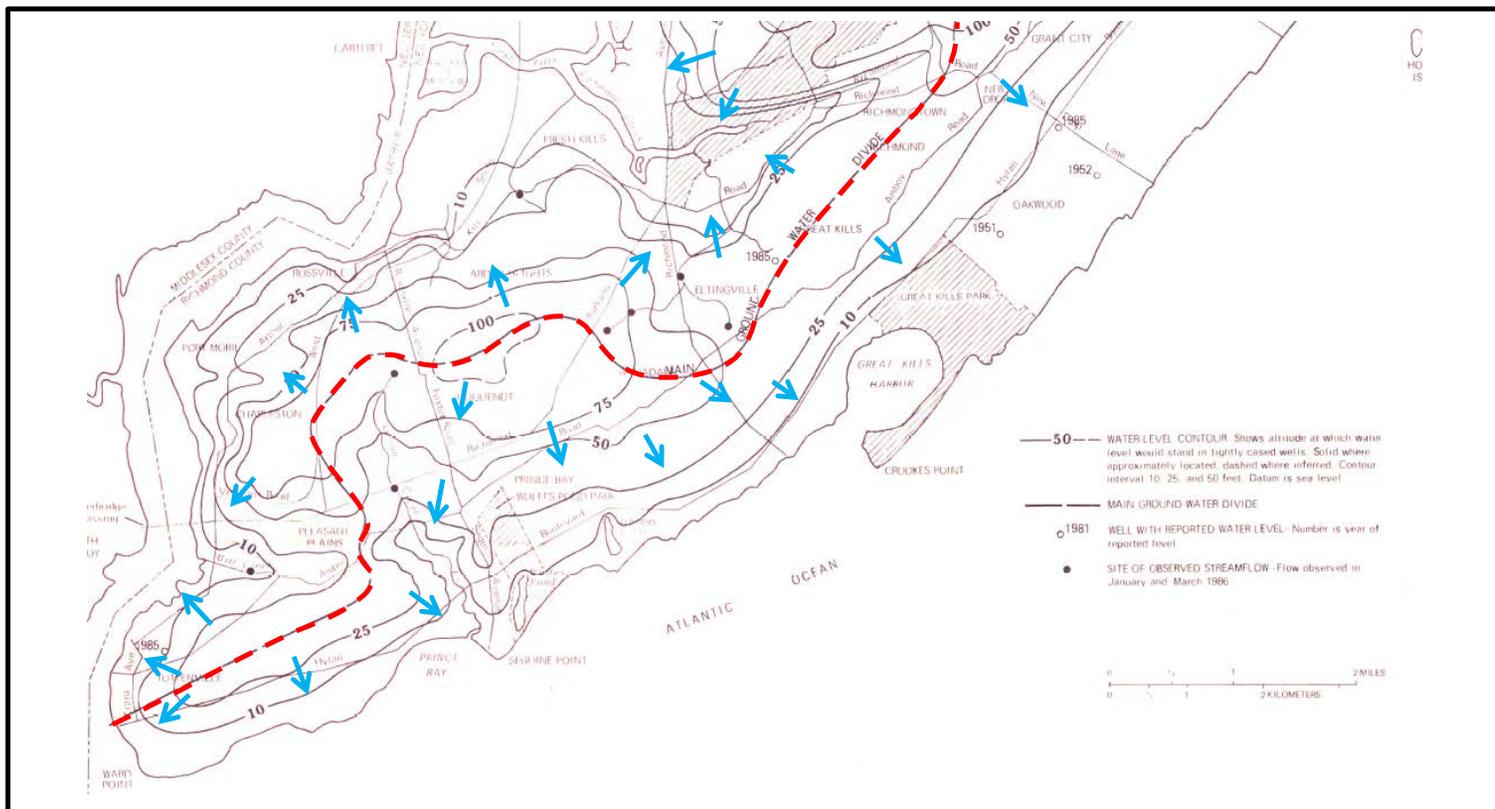
Scale

↑ North



DESIGNED BY	Custom Soil Map of the GKP ( <a href="http://websoilsurvey.sc.egov.usda.gov">http://websoilsurvey.sc.egov.usda.gov</a> )	
JHG		
DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	
JSW		
CHECKED BY	Contract No. W912DR-13-D-0016	
JHG		
	FIGURE 3-8	August 2017

**Figure 3-8. Custom Soil Map of GKP**



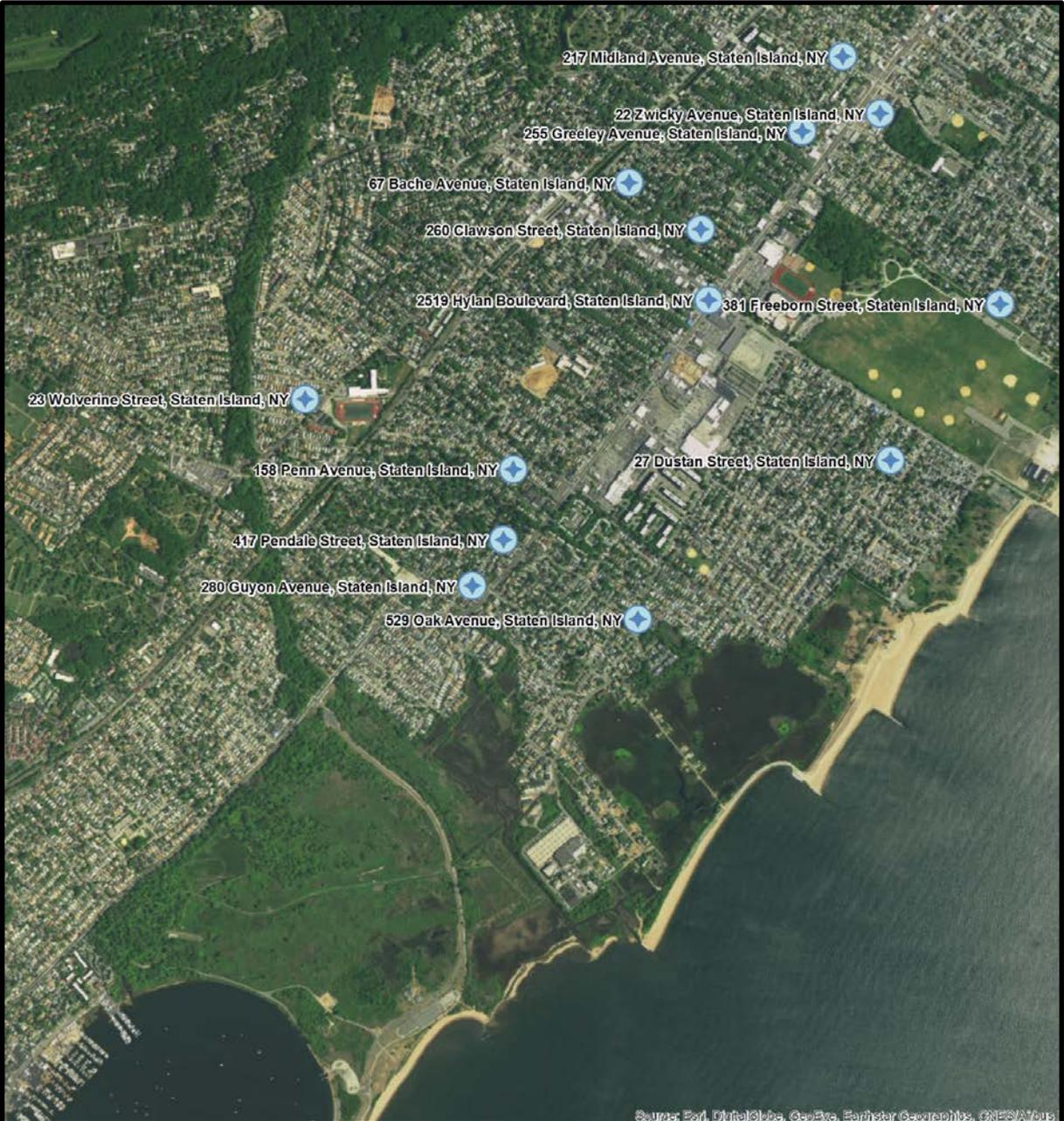
Water level contour shows altitude at which water level would stand in tightly cased wells. Solid where approximately located and dashed where inferred. Contour interval 10, 20, and 50 feet. Datum is sea level.

- Open circle is a well with reported water level. Number is year of reported level.
- Closed circle is observed stream flow (August and March 1986).
- ➔ Groundwater flow direction.
- Groundwater divide.

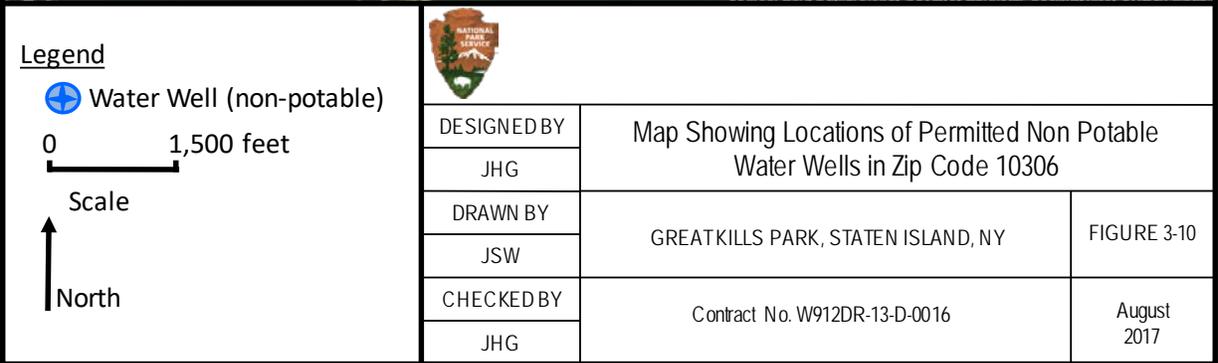
0 2 Miles

		Composite Shallow Groundwater Table Map (Source: Plate 3, Soren, 1988)	
		DESIGNED BY JHG	
		DRAWN BY JSW	GREAT KILLS PARK, STATEN ISLAND, NY
		CHECKED BY JHG	FIGURE 3-9
		Contract No. W912DR-13-D-0016	August 2017

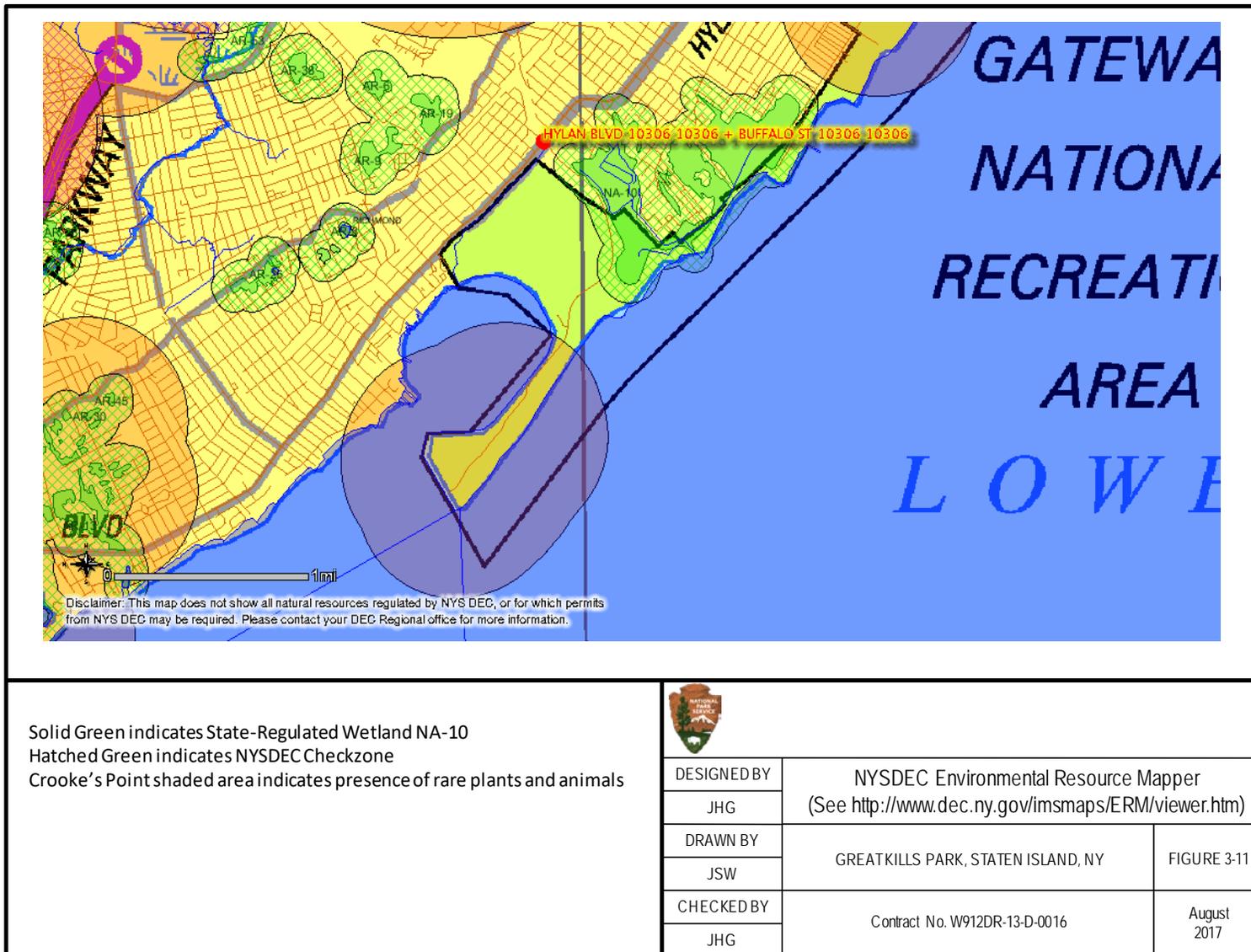
**Figure 3-9. Composite Shallow Groundwater Table Map**



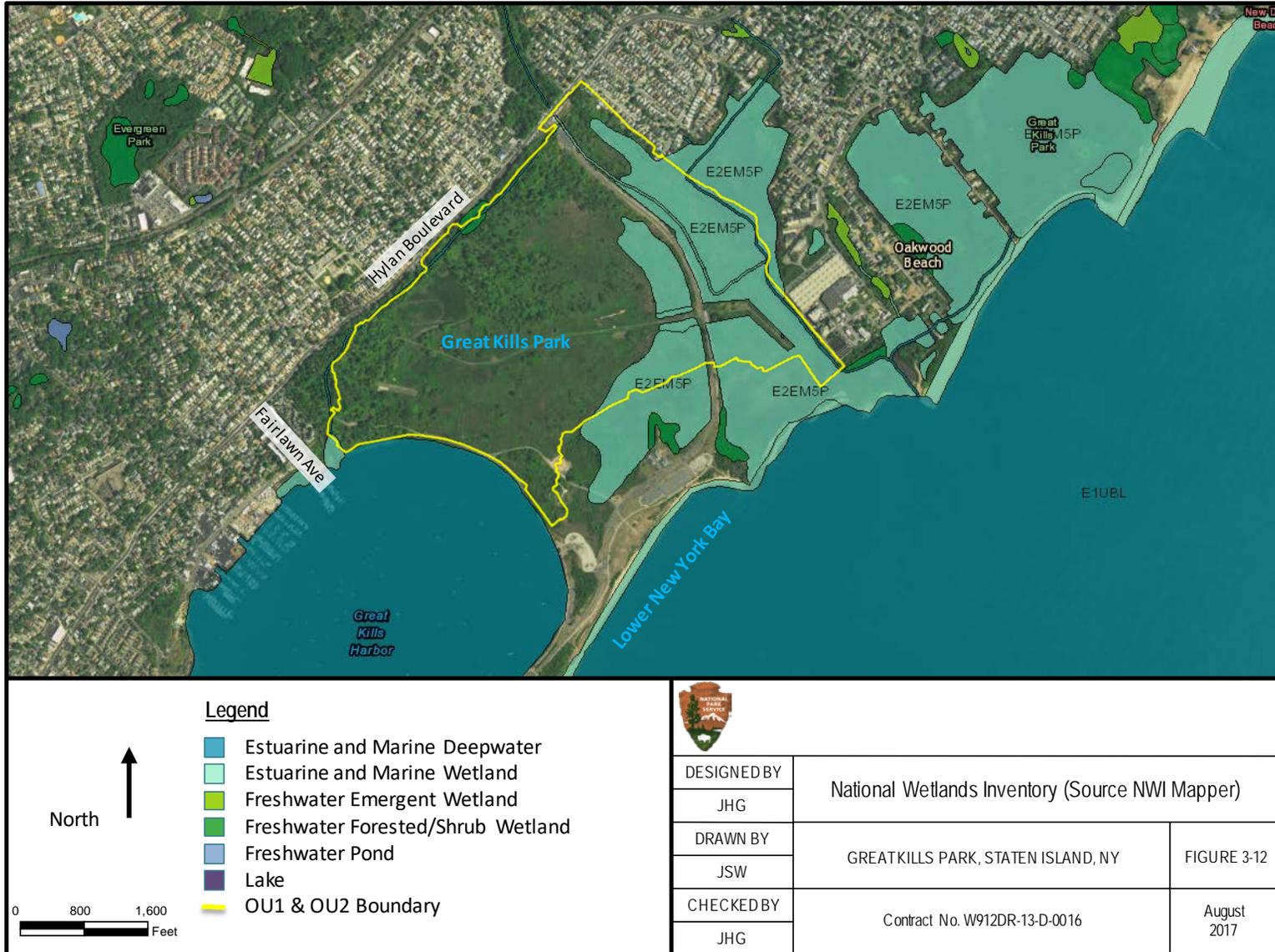
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus



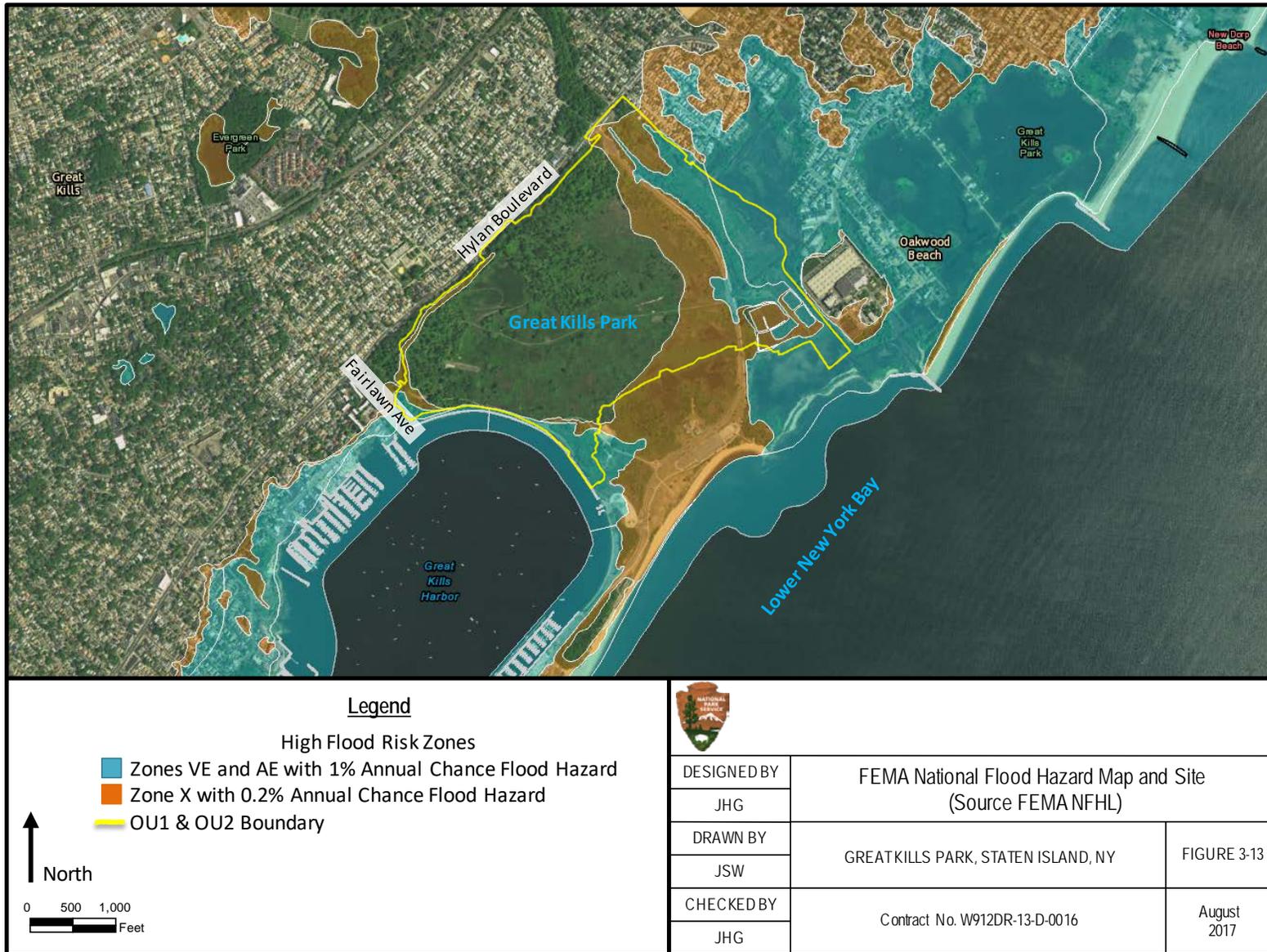
**Figure 3-10. Map Showing Locations of Permitted Non-Potable Water Wells in Zip Code 10306**



**Figure 3-11. NYSDEC Environmental Resource Mapper**



**Figure 3-12. National Wetlands Inventory**



**Figure 3-13. FEMA National Flood Hazard Map and Site**



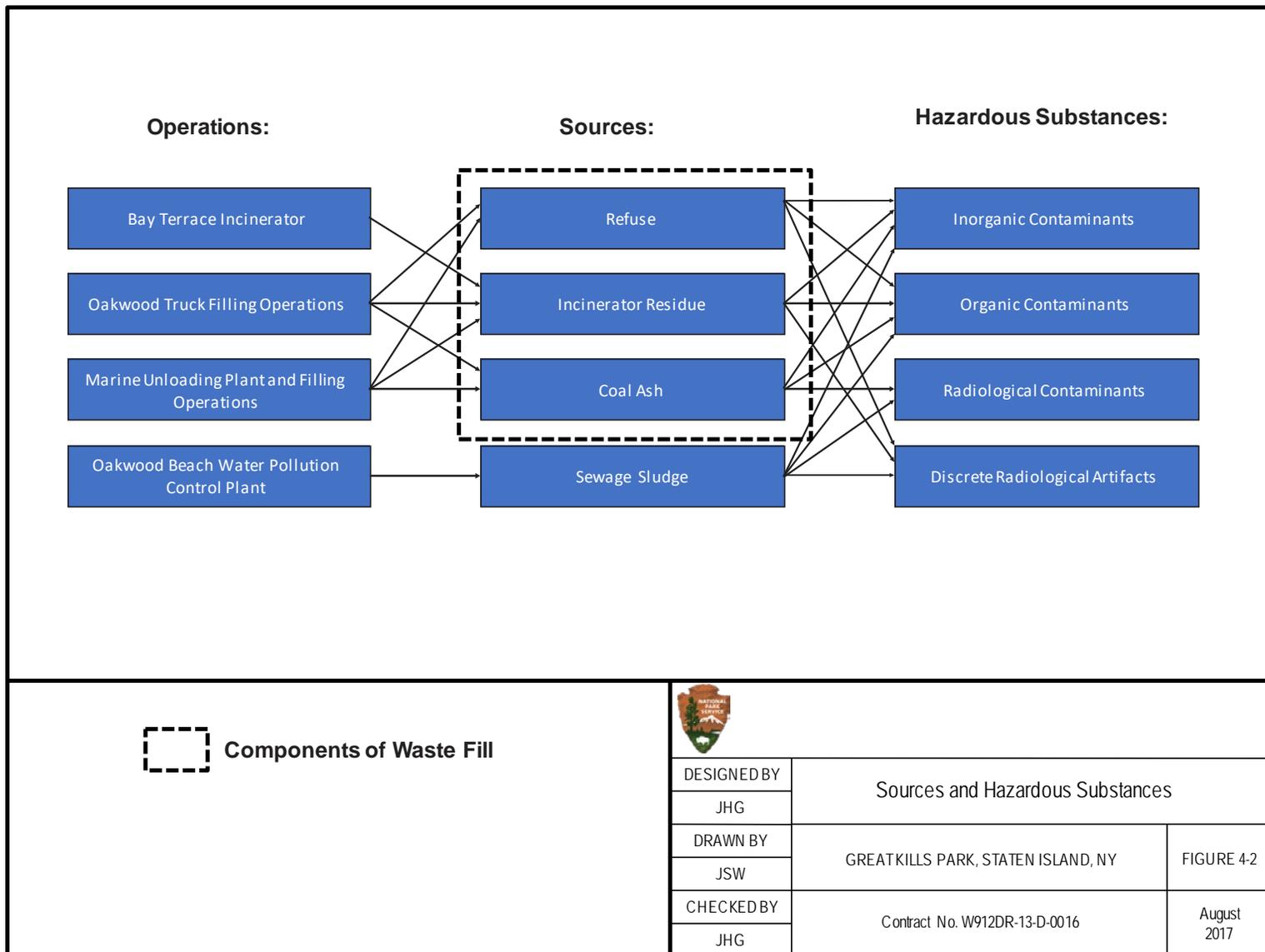
Legend		
	OU1 and OU2 Boundary	
<b>Japanese Knotweed Gravelbar</b>		
	Japanese Knotweed Gravelbar	
<b>Palustrine Forested Mineral Soil Wetlands</b>		
	Northeastern Pin Oak - Swamp White Oak Forest	
<b>Estuarine Intertidal</b>		
	North Atlantic Low Salt Marsh	
	Reed-grass Tidal Marsh	
<b>Marine Intertidal</b>		
	North Atlantic Coast Estuarine Intertidal Mud	
<b>Terrestrial Open Uplands</b>		
	Little Bluestem Old Field	
	North Atlantic Coast Backdune Grassland	
	North Atlantic Upper Ocean Beach	
	Northeastern Old Field	
	Northern Beachgrass Dune	
	Northern Tall Maritime Shrubland	
	Overwash Dune Grassland	
<b>Terrestrial Forested Uplands</b>		
	Early-Successional Woodland/Forest	
	Northeastern Modified Successional Forest	
	Successional Maritime Forest	
<b>Anderson II Categories</b>		
	Bay	
	Developed	
	Marine intertidal gravel/sand beach	
	Marine riprap/artificial shore	
	Paved road	

 Scale  North			
	DESIGNED BY	Vegetation Associations at the Site (modified from Edinger et al, 2008)	
	JHG		
	DRAWN BY	GREATKILLS PARK, STATEN ISLAND, NY	
	JSW	FIGURE 3-14	
CHECKED BY	Contract No. W912DR-13-D-0016		
JHG	August 2017		

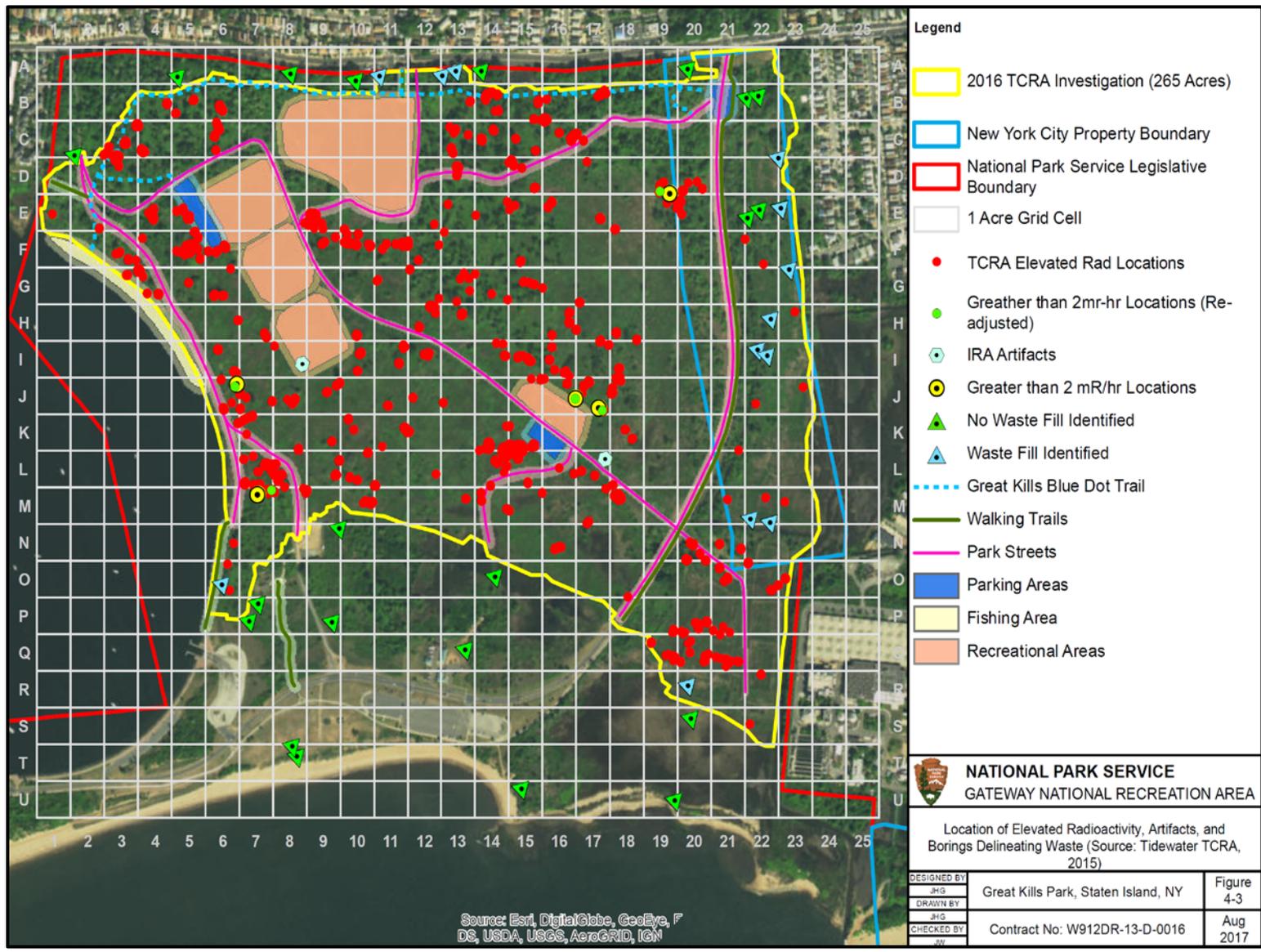
**Figure 3-14. Vegetation Associations at the Site**



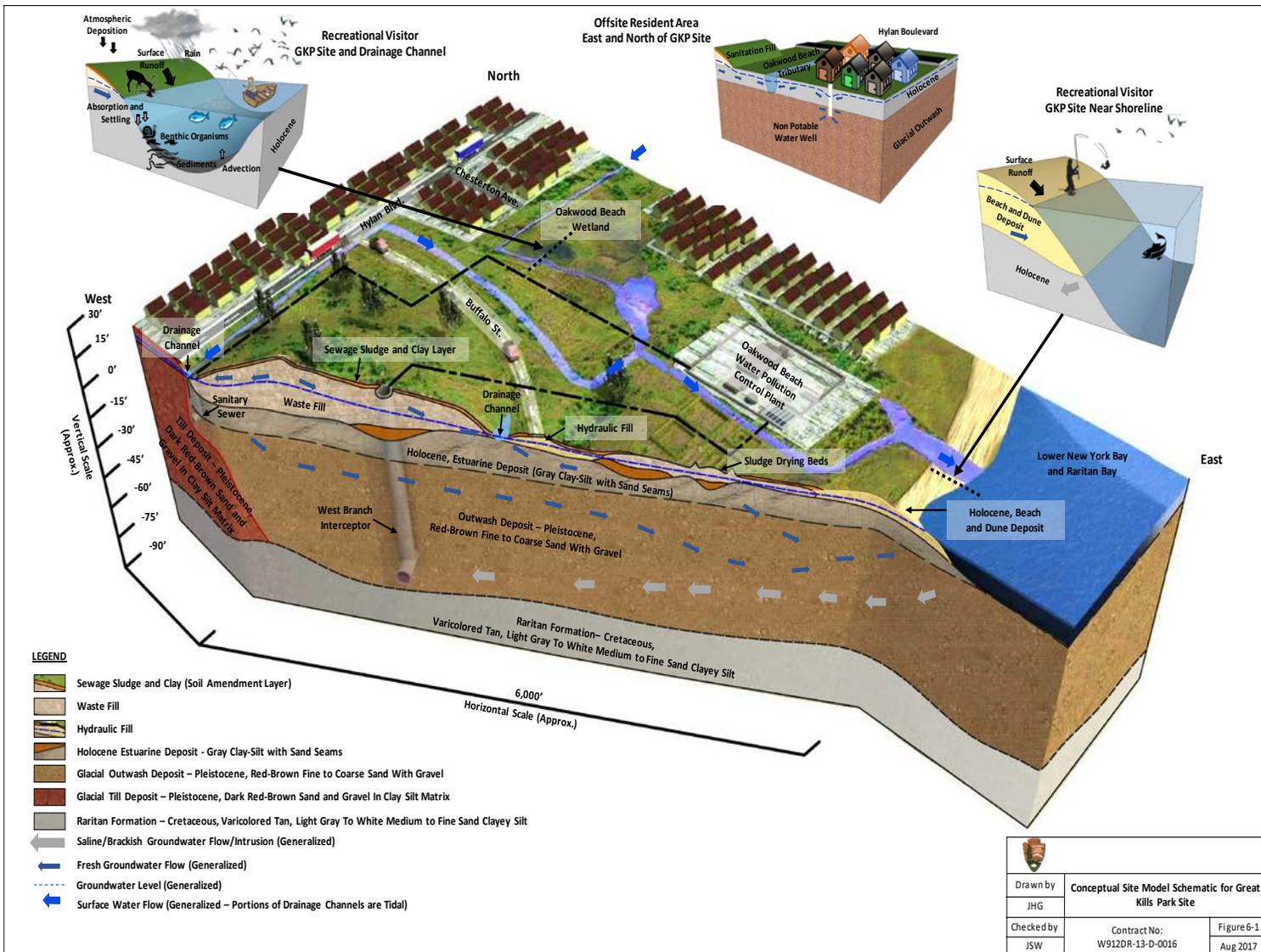
**Figure 4-1. Site Operations**



**Figure 4-2. Sources, and Hazardous Substances**



**Figure 4-3. Location of Elevated Radioactivity, Artifacts, and Borings Delineating Waste**



**Figure 6-1. Conceptual Site Model Schematic for Great Kills Park Site**



## **TABLES**

**Table 1-1. Summary of Information Sources**

No.	Source	Online	Provided Docs	Site Visit	Information Regarding
1	U.S. Environmental Protection Agency Headquarters	Y	NR	N	<ul style="list-style-type: none"> <li>• Operations of USRC, and Radium Chemical Company (RCC)<sup>20</sup> located in NY and NJ and disposal of radioactive wastes (radium) at Site</li> <li>• Cleanup of USRC and RCC sites.</li> <li>• USEPA files re Site</li> <li>• USEPA files RCC</li> </ul>
2	U.S. Environmental Protection Agency Region 2	Y	Y	N	<ul style="list-style-type: none"> <li>• Operations of USRC, and RCC located in NY and NJ and disposal of radioactive wastes (radium) at Site</li> <li>• Cleanup of USRC and RCC sites.</li> <li>• USEPA files re Site</li> </ul>
3	U.S. Nuclear Regulatory Commission	Y	NR	N	<ul style="list-style-type: none"> <li>• Operations of USRC and RCC located in NY and NJ</li> <li>• Management of orphan sources</li> <li>• Occurrence of Radium in Landfill</li> <li>• History of radium use in US</li> </ul>
4	U.S. Army Corps of Engineers, New York District	Y	NR	N	<ul style="list-style-type: none"> <li>• History of the Marine Park Project/GKP</li> <li>• Dredging Lower New York Bay and Ambrose Channel</li> <li>• USACE Great Kills Harbor Federal Navigation Project (initiated in 1927 and modified in 1938) and the dredging of the Great Kills Harbor (138 acre anchorage area) and Channel (1.9 miles) and placement and use of dredge material at Site</li> </ul>
5	U.S. Geological Survey	Y	NR	N	<ul style="list-style-type: none"> <li>• Historical aerial photographs</li> <li>• Historical topographic maps</li> <li>• Geological reports re Site and Staten Island</li> <li>• Groundwater use/wells (private/municipal)</li> </ul>

<sup>20</sup> Companies known to have manufactured products (including deck/personnel markers and medical devices) containing radium and or possessed uranium in the vicinity of the Site include the: United States Radium, Corporation (USRC); and Radium Chemical Company (RCC).

**Table 1-1. Summary of Information Sources**

No.	Source	Online	Provided Docs	Site Visit	Information Regarding
6	U.S. Department of Agriculture	Y	NR	N	<ul style="list-style-type: none"> <li>• Historical aerial photographs</li> <li>• Soil survey</li> </ul>
7	U.S. Library of Congress	Y	NR	Y	<ul style="list-style-type: none"> <li>• History of Marine Park Project/GKP</li> <li>• Operations of USRC, and RCC located in NY and NJ and disposal of radioactive wastes (radium) at Site</li> <li>• New York City Department of Sanitation Annual Reports and Waste Survey</li> <li>• New York City Department of Parks Annual Reports</li> <li>• New York City Department of Sanitation commissioned incinerators operations and disposal of waste including incinerator ash at Site</li> <li>• New York City commissioned WPCPs (Oakwood Beach and Port of Richmond WPCPs) operations and disposal of waste including WPCP sludge at Site</li> <li>• New York City Mayor’s Office, and Departments of Parks, Environmental Protection, Sanitation, Transportation, Buildings and Inspection, and Zoning and Borough of Richmond (a.k.a. Staten Island) and development GKP</li> </ul>
8	U.S. National Park Service	Y	Y	Y	<ul style="list-style-type: none"> <li>• GKP and Site (history and operations)</li> <li>• Contamination and waste disposal at Site</li> <li>• NPS Engineer Technical Information Center (ETIC) Documents re Site</li> <li>• Administrative record files</li> </ul>
9	Federal Emergency Management Agency	Y	NR	N	<ul style="list-style-type: none"> <li>• Flood insurance maps</li> <li>• Frequency of floods</li> </ul>
10	US Fish and Wildlife Service	Y	NR	N	<ul style="list-style-type: none"> <li>• Receptors re threatened and endangered species</li> <li>• Sensitive environments</li> </ul>

**Table 1-1. Summary of Information Sources**

No.	Source	Online	Provided Docs	Site Visit	Information Regarding
11	U. S Census Bureau	Y	NR	N	<ul style="list-style-type: none"> <li>• Receptors re potentially exposed populations (e.g., workers, residents, infants, children, schools, day care facilities) and information regarding demographics and land use</li> <li>• Population within 1 mile (soil pathway)</li> <li>• Number of people living within 200 feet of Site (soil pathway)</li> <li>• Schools or day care facilities within 200 feet of Site (soil pathway)</li> <li>• Population within 4 miles (air pathway)</li> </ul>
12	U.S Forest Service	Y	NR	N	<ul style="list-style-type: none"> <li>• Receptors re location of terrestrial sensitive environments including wetlands (tidal/non-tidal) streams/ponds (on site and within 4 miles (air pathway)</li> </ul>
13	National Oceanic and Atmospheric Administration	Y	NR	N	<ul style="list-style-type: none"> <li>• Climate re rainfall/precipitation</li> <li>• Frequency of floods</li> </ul>
14	NY State Dept. of Environmental Conservation	Y	NR	N	<ul style="list-style-type: none"> <li>• Operations of USRC, and RCC located in NY and NJ and disposal of radioactive wastes (radium) at Site</li> </ul>
15	New York State Geological Survey	Y	NR	N	<ul style="list-style-type: none"> <li>• Geology and history of Staten Island</li> <li>• Historical aerial photographs,</li> <li>• Historical topographic maps</li> <li>• Geological reports re Site and Staten Island</li> <li>• Groundwater use/wells</li> </ul>
16	NJ Dept. of Environmental Protection	Y	NR	N	<ul style="list-style-type: none"> <li>• Operations of USRC, and RCC located in NY and NJ and disposal of radioactive wastes (radium) at Site</li> </ul>
17	NY City Mayor's Office	Y	NR	N	<ul style="list-style-type: none"> <li>• Transportation and filling of the Site with waste</li> <li>• Transportation and filling of the Site with incinerator ash</li> <li>• Construction and operation of an incinerator at the Site</li> </ul>

**Table 1-1. Summary of Information Sources**

No.	Source	Online	Provided Docs	Site Visit	Information Regarding
18	NY City Dept. of Health	Y	Y	N	<ul style="list-style-type: none"> <li>Planning and development of the Marine Park Project including but not limited to installation of steel bulkhead and use of dredged sediment as fill at the Site</li> </ul>
19	NY City Dept. of Parks	Y	Y	N	<ul style="list-style-type: none"> <li>Transportation and disposal of sewage treatment plant sludge used as fill, cover or cap at the Site</li> </ul>
20	NY City Dept. of Sanitation	Y	Y	N	<ul style="list-style-type: none"> <li>Construction of and any upgrades to the Oakwood Beach wastewater treatment plant</li> <li>Construction and maintenance of park facilities, including but not limited to athletic facilities, utilities (sewer, water, electric), and roads, trails, etc.</li> </ul>
21	NY Public Library (City Hall Library – Chambers Street, NY)	Y	NR	Y	
22	Staten Island Historical Society	Y	Y	Y	<ul style="list-style-type: none"> <li>Historical records re GKP (see above)</li> </ul>
22	Staten Island Museum	Y	Y	Y	<ul style="list-style-type: none"> <li>Historical records re GKP (see above)</li> </ul>
23	Environmental Data Resources	Y	Y	N	<ul style="list-style-type: none"> <li>Historical records re GKP</li> </ul>

NR = Not requested. Y = Yes documents obtained online, produced or from Site Visit. N = No documents provided or provided on site.

**Table 1-2. Summary of Information Regarding Documents Downloaded From Worldwide Web (Sorted by Document Date Oldest to Youngest)**

Document Title	Date of Document	Comments re Content	Document Author	Author Organization	Information Category	Name	Date Accessed	Document URL	Researcher
Passaic Quadrangle	1/1/1900		USGS	U.S. Geological Survey	Site History	<a href="#">NJ Passaic 255441 1900 125000 geo.pdf</a>	12/17/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery
Staten Island Quadrangle	1/1/1900		USGS	U.S. Geological Survey	Site History	<a href="#">NJ Staten Island 255389 1900 62500 geo.pdf</a>	12/17/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery
Staten Island Quadrangle	1/1/1900	Date range was limited to 1900. Actual date of document is 1898.	USGS	U.S. Geological Survey	Site History	<a href="#">zzzNJ Staten Island 255388 1898 62500 geo.pdf</a>	12/17/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery
Passaic Quadrangle	1/1/1905		USGS	U.S. Geological Survey	Site History	<a href="#">NJ Passaic 255443 1905 125000 geo.pdf</a>	12/17/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery
Atlas of the City of New York, Borough of Richmond, Staten Island, Volume Two, Wards 4&5.	1/1/1917	Provides parcel information in the vicinity of Great Kills.	George W. Bromley	G.W. Bromley & Co.	Site History	<a href="#">1917 Bromley Atlas Cover Page.JPG</a>	1/1/1917	<a href="https://www.loc.gov/">https://www.loc.gov/</a>	Kyle Emery
Plate 24, Atlas if the City of New York, Borough of Richmond, Staten Island	1/1/1917		George W. Bromley	G.W. Bromley & Co.	Site History	<a href="#">1917 Bromley Plate 24 Ward 4 Borough of Richmond.JPG</a>	12/11/2015	<a href="https://www.loc.gov/">https://www.loc.gov/</a>	John Wyckoff
Staten Island Quadrangle	1/1/1932	1900 survey data with updated coast line data from 1925. Map was reproduced in 1932.	USGS	U.S. Geological Survey	Site History	<a href="#">NJ Staten Island 255397 1900 62500 geo.pdf</a>	12/17/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery

**Table 1-2. Summary of Information Regarding Documents Downloaded From Worldwide Web (Sorted by Document Date Oldest to Youngest)**

Document Title	Date of Document	Comments re Content	Document Author	Author Organization	Information Category	Name	Date Accessed	Document URL	Researcher
New York City Department of Parks Press Releases, 1/18/1934-7/31/1934	7/27/1934	7/27/34 re statement of progress at Marine Park.	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal; History	<a href="#">41861934_press_releases_part1.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/41861934_press_releases_part1.pdf">http://home2.nyc.gov/html/records/pdf/govpub/41861934_press_releases_part1.pdf</a>	John Wyckoff
The Report of the Department of Parks to August 1934	8/14/1934	Memorandum on New Construction by the Department of Parks During 1935 Which Cannot be Carried Out With Work Relief Funds. Former development plan was impractical and extravagant. Marine Park acquired in 1930 at a cost of \$681,500. Before the harbor is dredged the City is obligated to construct dock.	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal; History	<a href="#">4289annual_report_nyc_dept_parks_1934.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/4289annual_report_nyc_dept_parks_1934.pdf">http://home2.nyc.gov/html/records/pdf/govpub/4289annual_report_nyc_dept_parks_1934.pdf</a>	Kyle Emery
Plate 5 Location of Selected Wells and Borings in Richmond County, NY	12/31/1935	Location of borings and wells near GKP.	Perlmutter, N.M. and Arnow, T	Water Power and Control Commission	Hydrogeology	<a href="#">Perlmutter and Arnow 1953 GW Plate 5.pdf</a>	2/25/2016	<a href="https://www.loc.gov/">https://www.loc.gov/</a>	John Wyckoff
New York City Department of Parks Press Releases, 1936	11/19/1936	Work on the development of Marine Park resumes. New York City acquires title to 94 acres of private land on Oakwood Point; contract for sheet piling and etc. hydraulic dredge; 5,500 linear feet of steel sheet piling to be added to 2,300 feet of bulkhead placed on Cooke's Point.	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal;#History	<a href="#">41891936_press_releases.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/41891936_press_releases.pdf">http://home2.nyc.gov/html/records/pdf/govpub/41891936_press_releases.pdf</a>	John Wyckoff
Survey of Landfill Characteristics, New York City, As a Report on Official Project No. 65-1-97-1 W.P. SU-1 Federal Works Agency, Work Projects Administration for the City of New York	2/1/1941	Survey of the characteristics of five landfills, Baychester, Canarsie, Fairfield, Floyd Bennett, and Rikers Island.	New York City Department of Sanitation	New York City Department of Sanitation	Nature & Extent	<a href="#">Survey of Landfill Characteristics New York City.pdf</a>	2/25/2016	<a href="https://www.loc.gov/">https://www.loc.gov/</a>	John Wyckoff
New York City Department of Parks Press Releases, January - June 1941	4/28/1941	Plan between City and federal gov to provide 8 ft deep harbor and place hydraulic fill on south/east shore of bay. In 1934 bulkhead construction on Crooke's Point, 1936 City acquired meadowland. Plan calls for filling park now occupied by "an abandoned incinerator." Also includes 3/18/41	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal; History	<a href="#">41961941_press_releases_part1.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/41961941_press_releases_part1.pdf">http://home2.nyc.gov/html/records/pdf/govpub/41961941_press_releases_part1.pdf</a>	John Wyckoff

**Table 1-2. Summary of Information Regarding Documents Downloaded From Worldwide Web (Sorted by Document Date Oldest to Youngest)**

Document Title	Date of Document	Comments re Content	Document Author	Author Organization	Information Category	Name	Date Accessed	Document URL	Researcher
		release re geo-tech testing for bulkhead const.							
New York City Department of Parks Press Releases, July - Dec 1941	10/14/1941	Bids opened for construction of 3,400 ft of steal bulkhead a north end of Great Kills Harbor and 1.5 million cubic yards of sand. 12/29/1941 release describes that once filling at Soundview Park completed, scow dumping (for two years) will be transferred to Marine Park.	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal; History	<a href="#">41971941_press_releases_part2.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/41971941_press_releases_part2.pdf">http://home2.nyc.gov/html/records/pdf/govpub/41971941_press_releases_part2.pdf</a>	Kyle Emery
New York City Department of Parks Press Releases, 1942	9/17/1942	Several million additional yards of fill by Dept of Sanitation needed before development work can proceed. Funds for contract plan were released at the end of the war.	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal; History	<a href="#">41981942_press_releases.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/41981942_press_releases.pdf">http://home2.nyc.gov/html/records/pdf/govpub/41981942_press_releases.pdf</a>	Kyle Emery
New York City Department of Parks Press Releases, 1943	5/3/1943	War Production Board granted priority for materials for construction of timber bulkhead (to replace steel sheet) to eliminate need for critical materials.	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal; History	<a href="#">41991943_press_releases.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/41991943_press_releases.pdf">http://home2.nyc.gov/html/records/pdf/govpub/41991943_press_releases.pdf</a>	Kyle Emery
New York City Department of Parks Press Releases, January - June 1934	6/30/1943	This is an archive of press releases from January 10, 1943 through June 31, 1943 associated with Work Project Administration. Search the PDF using "Great Kill" to locate the May 3, 1943 Press Release "Soundview Park, the Bronx and Great Kills Park, Richmond.	U.S. National Park Service	U.S. National Park Service	Site Ops/Waste Disposal; Nature & Extent; Contaminants	<a href="#">1943-06-New York City Dept of Parks Press Release</a> <a href="#">41991943_press_releases.pdf</a>	8/28/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/41991943_press_releases.pdf">http://home2.nyc.gov/html/records/pdf/govpub/41991943_press_releases.pdf</a>	Kyle Emery
New York City Department of Parks Press Releases, 1946	10/28/1946	Contract drawings nearly finished for new beach and waterfront recreation area at Great Kills Park, Staten Island.	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal; History	<a href="#">42031946_press_releases.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/42031946_press_releases.pdf">http://home2.nyc.gov/html/records/pdf/govpub/42031946_press_releases.pdf</a>	John Wyckoff

**Table 1-2. Summary of Information Regarding Documents Downloaded From Worldwide Web (Sorted by Document Date Oldest to Youngest)**

Document Title	Date of Document	Comments re Content	Document Author	Author Organization	Information Category	Name	Date Accessed	Document URL	Researcher
Arthur Kill, NY, NJ 7.5min	1/1/1947		USGS	U.S. Geological Survey	Site History	<a href="#">NY Arthur Kill 136694 1947 24000_geo.pdf</a>	12/17/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery
The Narrows, NY, 7.5min	1/1/1947		USGS	U.S. Geological Survey	Site History	<a href="#">NY The Narrows 139982 1947 24000_geo.pdf</a>	12/17/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery
New York City Department of Parks Press Releases, 1947	4/17/1947	Contract to place hydraulic fill in Great Kills Park awarded to Standard Dredging Corporation to start work immediately. 3.5 million cubic yards, placed in marshland to provide firm soil foundation for improvements including beach, boardwalk, bathhouses, game areas, parking fields, picnic groves, roadways, walks and landscaped areas.	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal; History	<a href="#">42041947_press_releases.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/42041947_press_releases.pdf">http://home2.nyc.gov/html/records/pdf/govpub/42041947_press_releases.pdf</a>	John Wyckoff
New York City Department of Parks Press Releases, 1948	6/18/1948	Modest construction program for 1948 and 1949 includes second stage of improvements at Great Kills Beach including roadways, parking fields comfort station and maintenance building. 9/15/1948 three contracts provide for construction of drainage ditches, water mains, and two buildings (comfort stations and concessions). GKP open in summer of 1949 (map showing park features).	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal; History	<a href="#">42051948_press_releases.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/42051948_press_releases.pdf">http://home2.nyc.gov/html/records/pdf/govpub/42051948_press_releases.pdf</a>	Kyle Emery

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New York City Department of Parks Press Releases, 1949	6/30/1949	Formal opening - on a limited basis new bathing beach at GKP on 7/1. Provides data re department of sanitation work from 11/25/1944 through 7/8/1948. Over 5,751 barge loads containing 15,078,725 cubic yards of material. 1,200 scow loads of sand were used for cover. Oakwood truck fill was reclaimed by depositing material from Borough of Richmond collected in Sanitation trucks starting in 1934 until 8/21/1948 and consisted of over 4 million cubic yards. No dressing facility, bathhouse foundation being constructed, and parking for over 1,000 cars.	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal; History	<a href="#">42061949_press_releases.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/42061949_press_releases.pdf">http://home2.nyc.gov/html/records/pdf/govpub/42061949_press_releases.pdf</a>	John Wyckoff
New York City Department of Parks Press Releases, 1952	5/28/1952	Great Kills Park and Beach Opening. Bathhouse constructed with lockers and comfort stations, immediately to the north foundations have been built for concessions building, News release covers history from 1928 through 1940 involving acquisition of land, bulkheading, fill of 15.1 million cubic yards.	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal	<a href="#">42941952_press_releases_part1.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/42941952_press_releases_part1.pdf">http://home2.nyc.gov/html/records/pdf/govpub/42941952_press_releases_part1.pdf</a>	John Wyckoff
New York City Department of Parks Press Releases, 1953	5/22/1953	Total of 6,600 lockers and parking for 2,000 cars available at GKP. Attendance data for 1952 indicates 22,173 parking for season, over 198,000 season attendance from 5/24/1952 through 9/7/1952 (107 days).	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal; History	<a href="#">42091953_press_releases_part1.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/42091953_press_releases_part1.pdf">http://home2.nyc.gov/html/records/pdf/govpub/42091953_press_releases_part1.pdf</a>	John Wyckoff
Ground Water in Bronx, New York, and Richmond Counties With Summary Data on Kings and Queens Counties, New York City, New York, Ground Water Bulletin GW-32	12/31/1953	Geologic and hydrogeologic data for Staten Island, includes boring logs for wells near GKP.	Perlmutter, N.M. and Arnow, T	Water Power and Control Commission	Hydrogeology	<a href="#">Perlmutter and Arnow 1953 GW-32.pdf</a>	2/25/2016	<a href="https://www.loc.gov/">https://www.loc.gov/</a>	John Wyckoff

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Letter- Visit to U.S. Radium Company, Bloomsburg, Pennsylvania	3/26/1954	Includes notes on the waste generated at the Bloomberg PA USRC facility. Notes that USRC has a waste agreement with a "Radiological Services, of New York City".	U.S. Nuclear Regulatory Commission	U.S. Nuclear Regulatory Commission		<a href="http://pbadupws.nrc.gov/docs/ML033360590.pdf">ML033360590.pdf</a>	12/14/2015	<a href="http://pbadupws.nrc.gov/docs/ML033360590.pdf">http://pbadupws.nrc.gov/docs/ML033360590.pdf</a>	Kyle Emery
Arthur Kill, NY, NJ 7.5min	1/1/1955		USGS	U.S. Geological Survey	Site History	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">NY Arthur Kill 136696 1955 24000 geo.pdf</a>	12/17/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery
The Narrows, NY, 7.5min	1/1/1955		USGS	U.S. Geological Survey	Site History	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">NY The Narrows 139984 1955 24000 geo.pdf</a>	12/17/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery
Office Memorandum from J. W. Hitch US re Office Visit of USRC to Isotopes Extension on 12/17/1957	12/18/1957	Discuss USRC regarding lost deck marker and nature of the hazard involved. Examined one of the markers which indicated that marker was radioactive, containing Sr 90, and should be buried as a disposal method....Navy might have in controlling the use and possession of 300,000 markers.			USRC	<a href="http://adams.nrc.gov/wba/">120234.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	Kyle Emery
New York City Department of Parks Press Releases, 1959	6/26/1959	Dept of Parks announced first stage of construction of new Marina and will open to public on June 26, 1959. Facilities will include boat mooring floats, locker rentals and provision of gasoline and marine supplies.	New York City Department of Parks	NY City Dept. of Parks	Site Ops/Waste Disposal; History	<a href="http://home2.nyc.gov/html/records/pdf/govpub/42471959_press_releases.pdf">zzzzz42471959_press_releases.pdf</a>	12/14/2015	<a href="http://home2.nyc.gov/html/records/pdf/govpub/42471959_press_releases.pdf">http://home2.nyc.gov/html/records/pdf/govpub/42471959_press_releases.pdf</a>	Kyle Emery
US AEC Compliance Inspection Report of USRC Bloomsburg, PA	8/2/1961	Provides description of site activities and waste generated. USRC Brooklyn facility was relocated to the Bloomsburg Facility in 1948-1949.	U.S. Nuclear Regulatory Commission		USRC	<a href="http://adams.nrc.gov/wba/">012025.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	John Wyckoff
Arthur Kill, NY, NJ 7.5min	1/1/1966		USGS	U.S. Geological Survey	Site History	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">NY Arthur Kill 136698 1966 24000 geo.pdf</a>	12/17/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery

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The Narrows, NY, 7.5min	1/1/1966		USGS	U.S. Geological Survey	Site History	<a href="#">NY The Narrows 139986 1966 24000 geo.pdf</a>	12/17/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROO T&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROO T&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery
General History of the Jamaica Bay, Breezy Point, and Staten Island Units, Gateway National Recreation Area, New York, NY	10/31/1975	Provides history of GKP starting in 1930. Includes cites to three references: New York City Department of Parks, September 28, 1937, Improvement of Great Kills; New York Regional Plan Association, 1932, From Plan to Realty; New York City Department of Parks, 1950. The Reclamation of Park Areas by Sanitation Fill and Synthetic Soil.	Tony P. Wrenn Historic Preservation Consultant	U.S. National Park Service	Site Ops/Waste Disposal; Nature & Extent; Contaminants	<a href="#">WrennReport.pdf</a>	8/28/2015	<a href="http://www.nps.gov/parkhistory/online_books/gate/WrennReport.pdf">http://www.nps.gov/parkhistory/online_books/gate/WrennReport.pdf</a>	John Wyckoff
Plate 1 Geography of Staten Island and Locations of Selected Wells and Boreholes	12/31/1988	Shows several boreholes (56, 84 and 63) within close proximity of Great Kills Park.	Julian Soren	U.S. Geological Survey	Hydrogeology	<a href="#">plate-1.pdf</a>	1/27/2016	<a href="http://pubs.usgs.gov/wri/1987/4048/plate-1.pdf">http://pubs.usgs.gov/wri/1987/4048/plate-1.pdf</a>	John Wyckoff
Plate 2 Bedrock Geology of Staten Island and Configuration of Bedrock Surface	12/31/1988	Shows that the bedrock occurs between 300 and 375 feet below mean sea level.	Julian Soren	U.S. Geological Survey	Geology	<a href="#">plate-2.pdf</a>	1/27/2016	<a href="http://pubs.usgs.gov/wri/1987/4048/plate-2.pdf">http://pubs.usgs.gov/wri/1987/4048/plate-2.pdf</a>	John Wyckoff
Plate 3 Configuration of the Surface of the Raritan Formation on Staten Island	12/31/1988	Shows the top of the Raritan Formation occurs approximately 50 feet below mean sea level beneath the Great Kills Park.	Julian Soren		Geology	<a href="#">plate-3.pdf</a>	1/27/2016	<a href="http://pubs.usgs.gov/wri/1987/4048/plate-3.pdf">http://pubs.usgs.gov/wri/1987/4048/plate-3.pdf</a>	John Wyckoff
Plate 4 Composite Water-Table Map of Staten Island, 1936-1986	12/31/1988	Shows groundwater occurrence on Staten Island and that there is a southwest to northeast trending groundwater divide approximately 1 mile north of the site.	Julian Soren	U.S. Geological Survey	Groundwater	<a href="#">plate-4.pdf</a>	1/27/2016	<a href="http://pubs.usgs.gov/wri/1987/4048/plate-4.pdf">http://pubs.usgs.gov/wri/1987/4048/plate-4.pdf</a>	John Wyckoff
Geologic and Geohydrologic Reconnaissance of Staten Island, New York, U.S. Geological Survey Water Resources Investigation Report 87-4048	12/31/1988	Provides significant information re geology and hydrogeology including surficial deposits, bedrock and groundwater.	Julian Soren	U.S. Geological Survey	Hydrogeology	<a href="#">Staten Island Hydrogeology.pdf</a>	1/27/2016	<a href="http://pubs.usgs.gov/wri/1987/4048/report.pdf">http://pubs.usgs.gov/wri/1987/4048/report.pdf</a>	John Wyckoff
Superfund Record of Decision: Radium Chemical, NY	6/1/1990		U.S. Environmental Protection Agency	U.S. Environmental Protection Agency Headquarters		<a href="#">9100SKT2.pdf</a>	12/14/2015	<a href="http://nepis.epa.gov/Exe/ZyPDF.cgi/9100SKT2.PDF?Dockey=9100SKT2.PDF">http://nepis.epa.gov/Exe/ZyPDF.cgi/9100SKT2.PDF?Dockey=9100SKT2.PDF</a>	Kyle Emery

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EPA Superfund Record of Decision: Glen Ridge Radium Site	6/1/1990		U.S. Environmental Protection Agency	U.S. Environmental Protection Agency Headquarters	Superfund Information	<a href="#">9100SWXT.pdf</a>	12/11/2015	<a href="http://nepis.epa.gov/Exe/ZyPDF.cgi/9100SWXT.PDF?Dockey=9100SWXT.PDF">http://nepis.epa.gov/Exe/ZyPDF.cgi/9100SWXT.PDF?Dockey=9100SWXT.PDF</a>	Kyle Emery
The Regional Aquifer System Underlying the Northern Atlantic Coastal Plain	1/1/1992	A general description of the aquifer in the Atlantic Coast Plain Province.	Henry Trap, Jr.	U.S. Geological Survey	Hydrology	<a href="#">Aquifer Study of the Atlantic Coast Plain.pdf</a>	1/10/2016	<a href="http://pubs.usgs.gov/pp/1404a/report.pdf">http://pubs.usgs.gov/pp/1404a/report.pdf</a>	Kyle Emery
Affidavit of F. Costello In Matter of Safety Light Corporation et al before the Atomic Safety and Licensing Board	6/30/1992	Provides licensing history of USRC and corporate restructuring.	Francis M. Costello	U.S. Nuclear Regulatory Commission	USRC	<a href="#">021437.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	John Wyckoff
Environmental Characteristics of EPA, NRC, and DOE Sites Contaminated with Radioactive Substances	3/1/1993	Document created by USEPA, USNRC, and USDOE.	U. S. Environmental Protection Agency	U.S. Environmental Protection Agency Headquarters	Radiological Contamination	<a href="#">402-r-93-011.pdf</a>	12/11/2015	<a href="http://www.epa.gov/sites/production/files/2015-05/documents/402-r-93-011.pdf">http://www.epa.gov/sites/production/files/2015-05/documents/402-r-93-011.pdf</a>	John Wyckoff
Diffuse Norm Wastes, Waste Characterization and Preliminary Risk Assessment	5/1/1993	Complete chapter (4) on NORM in Coal Ash.	Dehmel, Jean-Claude, Vern C. Rogers	SC&A, Inc., and Rogers & Associates Engineering Corp.	Contaminants	<a href="#">Diffuse.pdf</a>	5/25/2016	<a href="http://nepis.epa.gov/">http://nepis.epa.gov/</a>	John Wyckoff
USEPA Superfund Record of Decision U.S. Radium Corporation, Operable Unit 2, Essex County New Jersey	8/29/1995	Provides information re cleanup of radium site, costs, cleanup levels and technologies.	U. S. Environmental Protection Agency	U.S. Environmental Protection Agency Region 2		<a href="#">9100S049.pdf</a>	12/9/2015	<a href="http://yosemite.epa.gov/opa/admpress.nsf/d10ed0d99d826b068525735900400c2a/1aad4509b5f605f0852571cc006484ec!opendocum">http://yosemite.epa.gov/opa/admpress.nsf/d10ed0d99d826b068525735900400c2a/1aad4509b5f605f0852571cc006484ec!opendocum</a>	John Wyckoff
Technology Screening Guide for Radioactively Contaminated Sites, EPA 402-R-96-017	11/1/1996	Summarizes technologies for sites contaminated with radium.	U. S. Environmental Protection Agency	U.S. Environmental Protection Agency Headquarters		<a href="#">402-r-96-017.pdf</a>	12/9/2015	<a href="http://www.epa.gov/sites/production/files/2015-05/documents/402-r-96-017.pdf">http://www.epa.gov/sites/production/files/2015-05/documents/402-r-96-017.pdf</a>	John Wyckoff
Radioactive Elements in Coal and Fly Ash	10/1/1997	Discussion concerning radioactive materials in coal and coal fly ash.	USGS	U.S. Geological Survey	Contaminants	<a href="#">FS-163-97.pdf</a>	1/19/2016	<a href="http://pubs.usgs.gov/fs/1997/fs163-97/FS-163-97.pdf">http://pubs.usgs.gov/fs/1997/fs163-97/FS-163-97.pdf</a>	Kyle Emery
The Narrows, NY, 7.5min	1/1/2000		USGS	U.S. Geological Survey	Site History	<a href="#">NY The Narrows_136951_1998_24000_geo.pdf</a>	12/17/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;care=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;care=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery
Refuse incinerator particulate emissions and combustion residues for New York City during the 20th century	6/15/2001	Provides significant data re New York City (NYC) Incinerators and Domestic Waste Combustors.	Walsh, D.C., S.N. Chillrud, H.J. Simpson, R.F. Bopp	Various	Contaminants	<a href="#">IncinerEmiss-NYC(Walsh2001).pdf</a>	5/25/2016	<a href="http://www.ncbi.nlm.nih.gov/pubmed/11432546">http://www.ncbi.nlm.nih.gov/pubmed/11432546</a>	John Wyckoff

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Soil Survey of Gateway National Recreation Area, New York, and New Jersey	12/31/2001	Provides additional information re fill on GKP.	U.S. Department of Agriculture, National Park Service, Cornell University, and New York City Soil and Water Conservation Dist.		Soil	<a href="#">Soil Survey of GATEWAY NATIONAL RECREATION AREA.pdf</a>	4/15/2016	Downloaded Document from Google Docs	John Wyckoff
New York - New Jersey Harbor Estuary Program, The Status of Shellfish Beds in New York - New Jersey Harbor Estuary	11/26/2002	Provides specific information re Great Kills Harbor and shellfish harvesting.	Cathy Yuhas	New Jersey Sea Grant College Extension Program/NY-NJ Harbor Estuary Program	Receptors	<a href="#">Yuhas, 2002, hepsshellfish.pdf</a>	7/13/2016	<a href="http://www.harborestuary.org/pdf/hepsshellfish.pdf">http://www.harborestuary.org/pdf/hepsshellfish.pdf</a>	John Wyckoff
Rutgers, US Radium Corporation, Special Collection	6/1/2003	Index of Special Collection which is available on site at the Rutgers Medical Library. Special Collection contains records connected to USRC and the "Radium Girls".	Rutgers University Medical Library			<a href="#">U.S. Radium Corporation - East Orange, NJ - Records, Ca.pdf</a>	12/16/2015	<a href="http://www.libraries.rutgers.edu/history_of_medicine/manuscripts/us_radium_corporation">http://www.libraries.rutgers.edu/history_of_medicine/manuscripts/us_radium_corporation</a>	Kyle Emery
Final Report, ISCORS Assessment of Radioactivity in Sewage Sludge: Radiological Survey Results and Analysis	11/1/2003	Study on radioactivity in sewage sludge.	Interagency Steering Committee on Radiation Standards (ISCORS), USNRC, USDOE, USEPA, NJDEP,	U.S. Nuclear Regulatory Commission	Sewage sludge and radioactivity	<a href="#">832-r-03-002.pdf</a>	1/28/2016	<a href="http://www.epa.gov/sites/production/files/2015-05/documents/832-r-03-002.pdf">http://www.epa.gov/sites/production/files/2015-05/documents/832-r-03-002.pdf</a>	John Wyckoff
Stigma: The Psychology and Economics of Superfund	7/1/2004	Provides summary of costs of cleanup of radium site in New Jersey.	William Schutz et al	Department of Applied Economics and Management, Cornell University	Site cleanup costs	<a href="#">ee-0486-01.pdf</a>	12/9/2015	<a href="http://yosemite.epa.gov/ee/epa/erm.nsf/vwan/ee-0486-01.pdf/\$file/ee-0486-01.pdf">http://yosemite.epa.gov/ee/epa/erm.nsf/vwan/ee-0486-01.pdf/\$file/ee-0486-01.pdf</a>	John Wyckoff
Ltr from P. Schual to R. McElvenny USR Chemicals Inc. re 107(A) Notice of Liability	1/20/2005	Provides brief history of USRC including its relocation from	U. S. Environment	U. S. Environmental Protection	USRC	<a href="#">020915.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	Kyle Emery

**Table 1-2. Summary of Information Regarding Documents Downloaded From Worldwide Web (Sorted by Document Date Oldest to Youngest)**

Document Title	Date of Document	Comments re Content	Document Author	Author Organization	Information Category	Name	Date Accessed	Document URL	Researcher
		Brooklyn, New York to Bloomsburg Pa and its restructuring.	al Protection Agency	Agency Region III					
New York City Zoning Map 34A	11/16/2005	Zoning Map for Part of GKP and surrounding area.	New York City Planning	New York City Department of City Planning	Demographics	<a href="#">map34a.pdf</a>	1/10/2016	<a href="http://www.nyc.gov/html/dcp/pdf/zoning/map34a.pdf">http://www.nyc.gov/html/dcp/pdf/zoning/map34a.pdf</a>	Kyle Emery
Superfund Program Proposed Plan, U.S. Radium Superfund Site	8/1/2006	Proposed Plan presents the preferred No Action remedy for ground water at the U.S. Radium Corp Superfund Site located in Essex County, NJ.	U. S. Environmental Protection Agency	U.S. Environmental Protection Agency Region 2		<a href="#">P1003I6X.pdf</a>	12/9/2015	<a href="http://nepis.epa.gov/Exe/ZyPDF.cgi?P1003I6X.PDF?Dockkey=P1003I6X.PDF">http://nepis.epa.gov/Exe/ZyPDF.cgi?P1003I6X.PDF?Dockkey=P1003I6X.PDF</a>	Kyle Emery
News Release From Region 2, EPA Cleans Up the U.S. Radium Site in Essex County	8/16/2006	Summarizes cleanup of USRC site in NJ and the removal of 135,000 tons of radium contaminated soil. Removal "prevented a ground water problem."	U. S. Environmental Protection Agency	U.S. Environmental Protection Agency Region 2		<a href="#">08_16_2006_EPA_Cleans_Up_the_U.S.pdf</a>	12/9/2015	<a href="http://yosemite.epa.gov/opa/admpress.nsf/d10ed0d99d826b068525735900400c2a/1aad4509b5f605f0852571cc006484ec!opendocum">http://yosemite.epa.gov/opa/admpress.nsf/d10ed0d99d826b068525735900400c2a/1aad4509b5f605f0852571cc006484ec!opendocum</a>	John Wyckoff
Health Consultation, Great Kills Park, Richmond County, Gateway National Recreation Area, National Park Services, Staten Island, New York	5/1/2007		Agency for Toxic Substances and Disease Registry	Agency for Toxic Substances and Disease Registry	Nature & Extent; Contaminants	<a href="#">2007-05-01 ATSDR - Health Consultation.pdf</a>	8/28/2015	<a href="http://www.nps.gov/gate/learn/management/upload/ATSDR_GATE_GK.pdf">http://www.nps.gov/gate/learn/management/upload/ATSDR_GATE_GK.pdf</a>	Kyle Emery
Final Preliminary Assessment Report, For Potential Radiological Contamination at Great Kills Park	8/1/2007		Michael Baker, Jr., Inc.	Michael Baker, Jr., Inc.	Site Ops/Waste Disposal; Nature & Extent; Contaminants	<a href="#">2007-08-01 Michael Baker Preliminary Assessment Report.pdf</a>	8/28/2015	<a href="http://www.nps.gov/gate/learn/management/upload/AR0000305_PA_Report-2.pdf">http://www.nps.gov/gate/learn/management/upload/AR0000305_PA_Report-2.pdf</a>	Kyle Emery
Radium Historical Items Catalog, Final Report	8/1/2008	Catalog of radium products. Helpful for identifying nature of products and associated manufacturers.	Buchholz, M.A., and M. Cervera	Oak Ridge Institute for Science and Education	Contaminant; Radium	<a href="#">ML100840118 Catalogue of Sources.pdf</a>	5/25/2016	<a href="http://pbadupws.nrc.gov/docs/ML1008/ML100840118.pdf">http://pbadupws.nrc.gov/docs/ML1008/ML100840118.pdf</a>	John Wyckoff
Interim Response Action Report, Radiological Material Removal and Disposal	11/1/2010		Cabrera Services, Inc.	Cabrera Services, Inc.	Site Ops/Waste Disposal; Nature & Extent; Contaminants	<a href="#">2010-11-01 Cabrera Services - Interim Response Action Report.pdf</a>	8/28/2015	<a href="http://www.nps.gov/gate/learn/management/upload/AR0000415_interiumreport.pdf">http://www.nps.gov/gate/learn/management/upload/AR0000415_interiumreport.pdf</a>	John Wyckoff
New York City Zoning Map 33D	1/18/2011	New York City zoning map for GKP and surrounding areas.	New York City Planning	New York City Department of City Planning	Demographics	<a href="#">map33d.pdf</a>	1/10/2016	<a href="http://www.nyc.gov/html/dcp/pdf/zoning/map33d.pdf">http://www.nyc.gov/html/dcp/pdf/zoning/map33d.pdf</a>	Kyle Emery
Arthur Kill, NY, NJ 7.5min	4/12/2011		USGS	U.S. Geological Survey	Site History	<a href="#">NY Arthur Kill 201104 12 TM_geo.pdf</a>	12/29/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROO T&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;carearea=%24ROO T&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery

**Table 1-2. Summary of Information Regarding Documents Downloaded From Worldwide Web (Sorted by Document Date Oldest to Youngest)**

Document Title	Date of Document	Comments re Content	Document Author	Author Organization	Information Category	Name	Date Accessed	Document URL	Researcher
Shoreline Change Monitoring At Gateway National Recreation Area 2010-2011 Annual Report	11/1/2011	This annual report documents the collection of shoreline position data and describes the short-term variation that has occurred during the period from Spring 2010 to Spring 2011 in the Gateway National Recreation Area, as called for in the Northeast Coastal and Barrier Network's protocol on shoreline monitoring (Psuty, et al., 2010).	Nobert P. Psuty	U.S. National Park Service		<a href="#">GATE_10-11_ShorelineChangeMonitoring_AnnualReport.pdf</a>	8/28/2015	<a href="https://irma.nps.gov/DataStore">https://irma.nps.gov/DataStore</a>	John Wyckoff
Coal Ash Material Safety	6/1/2012	Health Risk Based Evaluation of USGS Coal Ash Data. Provides information re metals in bottom ash.	Lisa Bradley	AECOM	Contaminants	<a href="#">ACAA_CoalAshMaterialSafety_June2012.pdf</a>	1/19/2016	<a href="https://www.aaa-usa.org/Portals/9/Files/PDFs/ACAA_CoalAshMaterialSafety_June2012.pdf">https://www.aaa-usa.org/Portals/9/Files/PDFs/ACAA_CoalAshMaterialSafety_June2012.pdf</a>	John Wyckoff
Coal Ash Material Safety Supplement A	6/1/2012	Supplement to the Coal Ash Material Safety Report.	Lisa Bradley	AECOM	Contaminants	<a href="#">ACAA_CoalAshMaterialSafety_June2012_Supplement.pdf</a>	1/20/2016	<a href="https://www.aaa-usa.org/Portals/9/Files/PDFs/ACAA_CoalAshMaterialSafety_June2012_Supplement.pdf">https://www.aaa-usa.org/Portals/9/Files/PDFs/ACAA_CoalAshMaterialSafety_June2012_Supplement.pdf</a>	Kyle Emery
New York City Zoning Map 33C	6/13/2012	Zoning map for GKP and surrounding area.	New York City Planning	New York City Department of City Planning	Demographics	<a href="#">map33c.pdf</a>	1/10/2016	<a href="http://www.nyc.gov/html/dcp/pdf/zoning/map33c.pdf">http://www.nyc.gov/html/dcp/pdf/zoning/map33c.pdf</a>	Kyle Emery
Arthur Kill, NY, NJ 7.5min	3/12/2013		USGS	U.S. Geological Survey	Site History	<a href="#">NY_Arthur_Kill_20130312_TM_geo.pdf</a>	12/29/2015	<a href="http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;care=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do">http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&amp;xcm=r3standardpitrex_prd&amp;care=%24ROOT&amp;layout=6_1_61_48&amp;uiarea=2)/.do</a>	Kyle Emery
Public Notice, Great Kills Harbor, Staten Island, New York, Federal Navigation Project, Maintenance Dredging	4/30/2013	The proposed dredging is expected to involve removal of up to approximately 315,000 CY of sand to be used to restore portions of the eroded shoreline of Staten Island including Crescent Beach and Wolfe's Pond Park.	U. S. Army Corps of Engineers, New York District	U.S. Army Corps of Engineers, New York District	Hydraulic Fill	<a href="#">MAINTENANCE DREDGING.pdf</a>	7/6/2016	<a href="http://www.nan.usace.army.mil/Portals/37/docs/harbor/Pubnot/GREAT%20KILLS%20HARBOR%202013%20-%20PUBLIC%20NOTICE%20PDF.pdf">http://www.nan.usace.army.mil/Portals/37/docs/harbor/Pubnot/GREAT%20KILLS%20HARBOR%202013%20-%20PUBLIC%20NOTICE%20PDF.pdf</a>	John Wyckoff
Inventory of coastal engineering projects in Gateway National Recreation Area. Natural Resource Technical Report	5/1/2013	Provides data regarding the history of: the coastal engineered structures at GKP, dredging of GKP harbor, filling of GKP, and shoreline evolution.	Kate Dallas	U.S. National Park Service	Site Ops/Waste Disposal; Nature & Extent; Contaminants	<a href="#">GATE_CEI_highres_nrss.pdf</a>	8/28/2015	<a href="https://irma.nps.gov/App/Reference/Profile/2195204">https://irma.nps.gov/App/Reference/Profile/2195204</a>	John Wyckoff
Ltr from H. Siegrist Cabrera Services to USNRC re Activities	5/17/2013	Notification of amendment.	Cabrera Services, Inc.		Remedial action	<a href="#">ML13149A308.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	John Wyckoff

**Table 1-2. Summary of Information Regarding Documents Downloaded From Worldwide Web (Sorted by Document Date Oldest to Youngest)**

Document Title	Date of Document	Comments re Content	Document Author	Author Organization	Information Category	Name	Date Accessed	Document URL	Researcher
at Temporary Job Site Utilizing USNRC Rad Material Lic									
Geotechnical Design Manual, Chapter 3, Geology of New York State	6/17/2013	Description of NYS Geology.	NYS DOT	NY City Dept. of Transportation	Geology	<a href="#">GDM_Ch-3_Geology_of_NY.pdf</a>	1/10/2016	<a href="https://www.dot.ny.gov/divisions/engineering/technical-services/geotechnical-engineering-bureau/geotech-engineering-repository/GDM_Ch-3_Geology_of_NY.pdf">https://www.dot.ny.gov/divisions/engineering/technical-services/geotechnical-engineering-bureau/geotech-engineering-repository/GDM_Ch-3_Geology_of_NY.pdf</a>	Kyle Emery
Ltr from H. Siegrist Cabrera Services to USNRC re Activities at Temporary Job Site Utilizing USNRC Rad Material Lic	7/19/2013	Notification of an amendment Cabrera Material Lic.	Cabrera Services, Inc.		Remedial action	<a href="#">ML13206A357.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	John Wyckoff
Ltr from H. Siegrist Cabrera Services to USNRC re Activities at Temporary Job Site Utilizing USNRC Rad Material Lic	10/22/2013	Written notification of an amendment to Cabrera Material Lic.	Cabrera Services, Inc.		Remedial action	<a href="#">ML13305A093.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	John Wyckoff
Oakwood Beach Drainage Plan	11/6/2013		New York City Department of Environmental Protection	New York City Department of Environmental Protection	Wetlands	<a href="#">oakwood-beach-watershed.pdf</a>	12/29/2015	<a href="http://www.nyc.gov/html/dep/pdf/reviews/midisland/oakwood-beach-watershed.pdf">http://www.nyc.gov/html/dep/pdf/reviews/midisland/oakwood-beach-watershed.pdf</a>	Kyle Emery
Public Notice, Great Kills Harbor, Staten Island, New York, Federal Navigation Project, Maintenance Dredging	12/17/2013	USACE proposes dredging of the Great Kills Harbor Federal Navigation Project. The project was last dredged in 2002/2003 with the removal of approximately 136,428 cubic yards of sand which was used for beach nourishment on Great Kills Beach, Gateway National Recreation Area.	U. S. Army Corps of Engineers, New York District	U.S. Army Corps of Engineers, New York District	Hydraulic fill	<a href="#">PN - GKH FY14.pdf</a>	7/6/2016	<a href="http://www.nan.usace.army.mil/Portals/37/docs/harbor/Pubnot/Dec%202013/PN%20-%20GKH%20FY14.pdf">http://www.nan.usace.army.mil/Portals/37/docs/harbor/Pubnot/Dec%202013/PN%20-%20GKH%20FY14.pdf</a>	John Wyckoff
Hydrogeology of Staten Island, New York, Final Report, MS Thesis, Stony Brook University, The Graduate School	12/31/2013	Shows geology and groundwater in vicinity of GKP. Good maps and cross sections.	Stephanie Rosenberg	Stony Brook University	Geohydrology	<a href="#">rosenberg.pdf</a>	1/27/2016	<a href="http://www.geo.sunysb.edu/reports/rosenberg.pdf">http://www.geo.sunysb.edu/reports/rosenberg.pdf</a>	John Wyckoff
Zoning Resolution: Article X: Special Purpose Districts, Chapter 7: Special South Richmond Development District	2/10/2014	Article describing the Development District adjacent to GKP.	New York City Planning	New York City Department of City Planning	Demographics	<a href="#">art10c07.pdf</a>	1/20/2016	<a href="http://www.nyc.gov/html/dcp/pdf/zoning/art10c07.pdf">http://www.nyc.gov/html/dcp/pdf/zoning/art10c07.pdf</a>	John Wyckoff
Ltr from H. Siegrist Cabrera Services to USNRC re Activities	2/10/2014	Written notification of change in scope and extension of work activity.	Cabrera Services, Inc.	Cabrera Services, Inc.	Remedial action	<a href="#">ML14069A172.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	Kyle Emery

**Table 1-2. Summary of Information Regarding Documents Downloaded From Worldwide Web (Sorted by Document Date Oldest to Youngest)**

Document Title	Date of Document	Comments re Content	Document Author	Author Organization	Information Category	Name	Date Accessed	Document URL	Researcher
at Temporary Job Site Utilizing USNRC Rad Material Lic									
Ltr from J. Moses USNRC to S Gavitt, Bureau of Environmental Radiation Protection re	3/20/2014	NRC comments re license and jurisdiction for cleanup of GKP.	U.S. Nuclear Regulatory Commission	U.S. Nuclear Regulatory Commission	Remedial action	<a href="#">ML14070A160.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	John Wyckoff
Ltr from L Chang NRC to K Cuzzolino NPS re Determination of Jurisdiction for Service Provider Activities at the Gateway National Recreation Area on Staten Island, New York	3/24/2014		U.S. Nuclear Regulatory Commission	U.S. Nuclear Regulatory Commission	Remedial Action	<a href="#">ML13346A428.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	John Wyckoff
Ltr from M. Roberts, NRC to H Siegrist re Notification for Utilizing NRC Lic	4/3/2014	NRC determination that the Great Kills Park site was not an area of exclusive Federal jurisdiction and thus planned work activities do not require an NRC license. Therefore, because the location of work activities has not changed, the change in scope of the planned activities does not require an NRC license. In our March 24, 2014 letter, NRC indicated that Cabrera Services, Inc. seek guidance from the State of New York's Agreement State Program to determine the regulatory requirements and authorizations needed for the work at Great Kills Park.	U.S. Nuclear Regulatory Commission	U.S. Nuclear Regulatory Commission	Remedial action	<a href="#">ML14100A326.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	Kyle Emery
New York City Region Fish Advisories	3/1/2015	Fish advisories for southeastern shore of Staten Island.	New York State Department of Health	NY State Dept. of Health	Receptors	<a href="#">New York City Region Fish Advisories.pdf</a>	7/13/2016	<a href="https://www.health.ny.gov/environmental/outdoors/fish/health_advisories/regional/new_york_city.htm">https://www.health.ny.gov/environmental/outdoors/fish/health_advisories/regional/new_york_city.htm</a>	John Wyckoff
Ltr from L. Camper, NRC to K. Cuzzolino, NPS re Role of USNRC at Gateway National Recreation Area on Staten Island, New York	4/7/2015	Provides NRC position on its jurisdiction over discrete sources of radium contamination at GKP.	U.S. Nuclear Regulatory Commission	U.S. Nuclear Regulatory Commission	Remedial action	<a href="#">ML15022A103.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	John Wyckoff
Trace Elements in Coal Ash	5/1/2015	Discussion of trace contamination in coal ash.	USGS	U.S. Geological Survey	Contaminants	<a href="#">fs2015-3037.pdf</a>	1/19/2016	<a href="http://pubs.usgs.gov/fs/2015/3037/pdf/fs2015-3037.pdf">http://pubs.usgs.gov/fs/2015/3037/pdf/fs2015-3037.pdf</a>	Kyle Emery

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Document Title	Date of Document	Comments re Content	Document Author	Author Organization	Information Category	Name	Date Accessed	Document URL	Researcher
Ltr from J. Nersesian, Superintendent, NPS to L. Camper, Director, Division of Decommissioning, Uranium Recovery and Waste Programs (NRC) re Role of USNRC at Great Kills Park Site, Staten Island, New York	6/12/2015	NPS response to NRC re approach for coordinating jurisdictional responsibilities regarding radium 226 at Great Kills Park.	U. S. National Park Service	U.S. National Park Service	Jurisdictional	<a href="#">ML15203A192.pdf</a>	1/18/2016	<a href="http://pbadupws.nrc.gov/docs/ML1520/ML15203A192.pdf">http://pbadupws.nrc.gov/docs/ML1520/ML15203A192.pdf</a>	John Wyckoff
Lt from K. Schmidt to K. Cuzzolino re Role of USNRC at GKP	7/2/2015	City believes an MOU between NPS and NRC is appropriate.	New York City Law Department	New York City Law Department	Remedial action	<a href="#">ML15295A415.pdf</a>	12/16/2015	<a href="http://adams.nrc.gov/wba/">http://adams.nrc.gov/wba/</a>	Kyle Emery
Gateway National Recreation Area Map	8/28/2015	Shows the three geographic units that comprise the Gateway National Recreation Area.	U. S. National Park Service	U.S. National Park Service		<a href="#">2-0-0 Gateway National Recreational Map.jpg</a>	8/28/2015	<a href="http://www.nps.gov/gate/index.htm">http://www.nps.gov/gate/index.htm</a>	John Wyckoff
Human Health and Environmental Damages from Mining and Mineral Processing Wastes	12/1/2015		U.S. Environmental Protection Agency	U.S. Environmental Protection Agency Headquarters		<a href="#">HHandEDamagesFromMiningandWastes.pdf</a>	12/16/2015	<a href="http://www3.epa.gov/epawaste/nonhaz/industrial/special/mining/minedock/damage/damage.pdf">http://www3.epa.gov/epawaste/nonhaz/industrial/special/mining/minedock/damage/damage.pdf</a>	Kyle Emery
Federal Agency Hazard Waste Compliance Docket	12/7/2015	USEPA Data re Facility ID, Name etc. Federal Facility ID is MDL3427 (March 18, 2013).	U. S. Environmental Protection Agency	U.S. Environmental Protection Agency Headquarters		<a href="#">Federal Agency Hazardous Waste Compliance Docket Cleanups at Federal Facilities US EPA.pdf</a>	12/9/2015	<a href="http://cumulis.epa.gov/supercpad/currentsites/csinfo.cfm?id=0200666">http://cumulis.epa.gov/supercpad/currentsites/csinfo.cfm?id=0200666</a>	John Wyckoff
Superfund Site Progress Profile for U.S. Radium Corp	12/9/2015	Summary of USEPA involvement at US Radium Corp. site.	U. S. Environmental Protection Agency	U.S. Environmental Protection Agency Region 2		<a href="#">Superfund Site Progress Profile Superfund Site Information US EPA for U.S. Radium Corporation.pdf</a>	12/9/2015	<a href="https://www3.epa.gov/">https://www3.epa.gov/</a>	Kyle Emery
Superfund Site Progress Profile, Great Kills Park (Gateway National Recreation Area)	12/9/2015	Provides informational details regarding site name, address, EPA ID NYN000200666 and lat and long.	U. S. Environmental Protection Agency	U.S. Environmental Protection Agency Headquarters		<a href="#">Superfund Site Progress Profile Superfund Site Information US EPA.pdf</a>	12/9/2015	<a href="https://www3.epa.gov/">https://www3.epa.gov/</a>	John Wyckoff
Site Information for Great Kills Park	12/9/2015		U.S. Environmental Protection Agency	U.S. Environmental Protection Agency Headquarters	Superfund Information	<a href="#">Superfund Site Progress Profile Superfund Site Information US EPA Great Kills Park.pdf</a>	12/10/2015	<a href="http://cumulis.epa.gov/supercpad/currentsites/csinfo.cfm?id=0200666">http://cumulis.epa.gov/supercpad/currentsites/csinfo.cfm?id=0200666</a>	Kyle Emery
Site Information for LI Tungsten Corp.	12/10/2015		U. S. Environmental Protection Agency	U.S. Environmental Protection Agency		<a href="#">Superfund Site Progress Profile Superfund Site Information US EPA Li Tungsten.pdf</a>	12/10/2015	<a href="http://cumulis.epa.gov/supercpad/currentsites/dsp_ssppSiteData1.cfm?id=0202972">http://cumulis.epa.gov/supercpad/currentsites/dsp_ssppSiteData1.cfm?id=0202972</a>	John Wyckoff

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Document Title	Date of Document	Comments re Content	Document Author	Author Organization	Information Category	Name	Date Accessed	Document URL	Researcher
				Agency Headquarters					
Site Information for Montclair/West Orange Radium Site	12/10/2015		U.S. Environmental Protection Agency	U.S. Environmental Protection Agency Headquarters	Superfund Information	<a href="#">Superfund Site Progress Profile Superfund Site Information US EPA montclair.pdf</a>	12/10/2015	<a href="http://cumulis.epa.gov/supercpad/CurSites/dsp_ssppSiteData1.cfm?id=0200997">http://cumulis.epa.gov/supercpad/CurSites/dsp_ssppSiteData1.cfm?id=0200997</a>	Kyle Emery
Report - Custom Soil Resource Report for Richmond County, New York	12/17/2015	Custom soil report created using the Web Soil Survey application made available by the USDA.	U.S. Department of Agriculture	U.S. Department of Agriculture	Current Conditions	<a href="#">20151217_0839250819_0_148_Soil_Report_GK_P_Soils+Hydric.pdf</a>	12/18/2015	<a href="http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm">http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm</a>	Kyle Emery
NYC Zoning - Zoning Districts - C3+C3A	1/1/2016	Description of NYC zoning C3 & C3A.	NYC Planning	New York City Department of City Planning	Demographics	<a href="#">NYC Zoning - Zoning Districts - C3+C3A.pdf</a>	1/10/2016	<a href="http://www.nyc.gov/cgi-bin/misc/pfprinter.cgi?action=print&amp;sitename=DCP&amp;p=1453306691000">http://www.nyc.gov/cgi-bin/misc/pfprinter.cgi?action=print&amp;sitename=DCP&amp;p=1453306691000</a>	Kyle Emery
NYC Zoning - Zoning Districts - M3	1/1/2016	Description of NYC zoning M3.	NYC Planning	New York City Department of City Planning	Demographics	<a href="#">NYC Zoning - Zoning Districts - M3.pdf</a>	1/10/2016	<a href="http://www.nyc.gov/cgi-bin/misc/pfprinter.cgi?action=print&amp;sitename=DCP&amp;p=1453306815000">http://www.nyc.gov/cgi-bin/misc/pfprinter.cgi?action=print&amp;sitename=DCP&amp;p=1453306815000</a>	Kyle Emery
NYC Zoning Districts R3-1	1/1/2016	Description of R3-1 Zoning in NYC.	NYC Planning	New York City Department of City Planning	Demographics	<a href="#">NYC Zoning - Zoning Districts - R3-1.pdf</a>	1/10/2016	<a href="http://www.nyc.gov/cgi-bin/misc/pfprinter.cgi?action=print&amp;sitename=DCP&amp;p=1453306348000">http://www.nyc.gov/cgi-bin/misc/pfprinter.cgi?action=print&amp;sitename=DCP&amp;p=1453306348000</a>	Kyle Emery
NYC Zoning - Zoning Districts - R3-2	1/1/2016	Description of NYC zoning R3-2.	NYC Planning	New York City Department of City Planning	Demographics	<a href="#">NYC Zoning - Zoning Districts - R3-2.pdf</a>	1/10/2016	<a href="http://www.nyc.gov/cgi-bin/misc/pfprinter.cgi?action=print&amp;sitename=DCP&amp;p=1453306444000">http://www.nyc.gov/cgi-bin/misc/pfprinter.cgi?action=print&amp;sitename=DCP&amp;p=1453306444000</a>	Kyle Emery
NYC Zoning - Zoning Districts - R3A	1/1/2016	Description of NYC zoning R3A.	NYC Planning	New York City Department of City Planning	Demographics	<a href="#">NYC Zoning - Zoning Districts - R3A.pdf</a>	1/10/2016	<a href="http://www.nyc.gov/cgi-bin/misc/pfprinter.cgi?action=print&amp;sitename=DCP&amp;p=1453306499000">http://www.nyc.gov/cgi-bin/misc/pfprinter.cgi?action=print&amp;sitename=DCP&amp;p=1453306499000</a>	Kyle Emery
NYC Zoning - Zoning Districts - R3X	1/1/2016	Description of NYC zoning R3X.	NYC Planning	New York City Department of City Planning	Demographics	<a href="#">NYC Zoning - Zoning Districts - R3X.pdf</a>	1/10/2016	<a href="http://www.nyc.gov/cgi-bin/misc/pfprinter.cgi?action=print&amp;sitename=DCP&amp;p=1453306639000">http://www.nyc.gov/cgi-bin/misc/pfprinter.cgi?action=print&amp;sitename=DCP&amp;p=1453306639000</a>	Kyle Emery
Annual Climatological Summary, Newark International Airport	1/4/2016	Annual Weather Reports for Newark International Airport from 1932 to 2015.	NOAA	National Oceanic & Atmospheric Administration	Past Site Conditions	<a href="#">Annual Report, Newark Airport, 2015-1932.pdf</a>	1/5/2016	<a href="http://www1.ncdc.noaa.gov/pub/orders/cdo/663096.pdf">http://www1.ncdc.noaa.gov/pub/orders/cdo/663096.pdf</a>	Kyle Emery
Environmental Remediation Database Details for Oakwood Beach WWTP Tank Information	1/13/2016	Includes info on 14 tanks (10 underground storage tanks (USTs) -	NYSDEC	NY State Dept. of	Oakwood Beach WPCP	<a href="#">Oakwood Beach WWTP UST-AST.pdf</a>	1/13/2016	<a href="http://www.dec.ny.gov/cfm/external/abs/details.cfm?&amp;ProgNo=2-456381">http://www.dec.ny.gov/cfm/external/abs/details.cfm?&amp;ProgNo=2-456381</a>	John Wyckoff

**Table 1-2. Summary of Information Regarding Documents Downloaded From Worldwide Web (Sorted by Document Date Oldest to Youngest)**

Document Title	Date of Document	Comments re Content	Document Author	Author Organization	Information Category	Name	Date Accessed	Document URL	Researcher
		5 in service, 5 out of service) and 4 aboveground tanks.		Environmental Conservation					
Fact Sheet-Great Kills Harbor, Staten Island	2/1/2016	The navigation channel was last maintenance dredged in Fiscal Year 2014, removing approximately 250,000 cubic yards of sand which was placed at the Historic Area Remediation Site (HARS) in the Atlantic Ocean.	U. S. Army Corps of Engineers, New York District	U.S. Army Corps of Engineers, New York District	Hydraulic fill	<a href="#">FACT SHEET-Great Kills Harbor, Staten Island, New York New York District Fact Sheet Article View.pdf</a>	7/6/2016	<a href="http://www.nan.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/487355/fact-sheet-great-kills-harbor-staten-island-new-york/">http://www.nan.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/487355/fact-sheet-great-kills-harbor-staten-island-new-york/</a>	John Wyckoff
New York City Hall Library Catalog Search, New York City Department of Sanitation Annual Report	2/29/2016	Note: Annual Reports from 2001 forward may also be found in PDF format at <a href="http://www.nyc.gov/records/govpub/home.shtml">www.nyc.gov/records/govpub/home.shtml</a> . No reports for 1940 to 1945, 1965 to 1995 in collection. No reports published from 1940 to 1945 due to World War II.	New York City Hall Library Online Catalog	NY City Dept. of Records	Site History	<a href="#">NYC Hall Library Catalog Search, NYC Sanitation Annual Reports.pdf</a>	2/29/2016	<a href="http://nyc.ml solutions.com/oasis/catalog/(S(amhf5155q0j34fmlb2f1ia45))/Default.aspx?installation=CityHall">http://nyc.ml solutions.com/oasis/catalog/(S(amhf5155q0j34fmlb2f1ia45))/Default.aspx?installation=CityHall</a>	Kyle Emery
Atlas of Staten Island New York, Richmond County, New York, Published by J.B. Beers & Co.		Atlas showing Great Kills area.	F. W. Beers	J.B. Beers & Co.	Site History	<a href="#">1874 Beers Atlas Cover Page.JPG</a>	12/11/2015	<a href="https://www.loc.gov/">https://www.loc.gov/</a>	Kyle Emery
1874 Atlas showing portion of Great Kills area.			F. W. Beers	J.B. Beers & Co.	Site History	<a href="#">1874 Beers John J. Crooke (Point).JPG</a>	12/11/2015	<a href="https://www.loc.gov/">https://www.loc.gov/</a>	John Wyckoff
Atlas of Staten Island New York, Richmond County, New York, Published by J.B. Beers & Co.		Atlas of 1887 showing Great Kills area.	J.B. Beers & Co.	J.B. Beers & Co.	Site History	<a href="#">1887 Beers Atlas Great Kills Area.JPG</a>	12/11/2015	<a href="https://www.loc.gov/">https://www.loc.gov/</a>	Kyle Emery
Atlas of Staten Island New York, Richmond County, New York, Published by J.B. Beers & Co.			J.B. Beers & Co.	J.B. Beers & Co.	Site History	<a href="#">1887 Beers Atlas Cover Page.JPG</a>	12/11/2015	<a href="https://www.loc.gov/">https://www.loc.gov/</a>	Kyle Emery
Atlas of Staten Island, Richmond County, New York Vol. 1			I.A. Lefevre	I.A. Lefevre	Site History	<a href="#">1894 Lefevre Atlas Cover Page 1.JPG</a>	12/11/2015	<a href="https://www.loc.gov/">https://www.loc.gov/</a>	John Wyckoff
Portion of Map Showing Great Kills Area		Portion of map showing Great Kills Area.	I.A. Lefevre	I.A. Lefevre	Site History	<a href="#">1894 Lefevre Plate showing Great Kills and Surrounding Development.JPG</a>	12/11/2015	<a href="https://www.loc.gov/">https://www.loc.gov/</a>	John Wyckoff
Historic American Engineering Record, Index to Photographs, U.S. Radium Corporation, Radium Crystallization Building HAER No. NJ-121-B			U. S. National Park Service	U.S. National Park Service		<a href="#">nj1645cap.pdf</a>	12/11/2015	<a href="http://lcweb2.loc.gov/master/pnp/habs/haer/nj/nj1600/nj1645/data/nj1645cap.pdf">http://lcweb2.loc.gov/master/pnp/habs/haer/nj/nj1600/nj1645/data/nj1645cap.pdf</a>	John Wyckoff

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U.S. Radium Corporation, Radium Crystallization Laboratory, Photographs Written Historical and Descriptive Data (HAER No. NJ-121-B)		Historic American Engineering Record (HAER).	U. S. National Park Service	U.S. National Park Service	Uranium ore processing at USRC	<a href="#">nj1645data.pdf</a>	12/11/2015	<a href="http://lcweb2.loc.gov/master/pnp/habshaer/nj/nj1600/nj1645/data/nj1645data.pdf">http://lcweb2.loc.gov/master/pnp/habshaer/nj/nj1600/nj1645/data/nj1645data.pdf</a>	John Wyckoff
A Historical Overview of Orphan Sources and Radioactivity in Scrap Metals		Important document regarding orphan sources and management and disposal of sources containing radium including discarding of radium with hospital trash burned in hospital incinerator.	J.O. Lubenau		Orphan Sources and Management	<a href="#">radium orphan sources paper.pdf</a>	1/12/2016	<a href="http://www.irpa.net/irpa10/cdrom/00476.pdf">http://www.irpa.net/irpa10/cdrom/00476.pdf</a>	John Wyckoff

**Table 1-3. Summary of Documents Obtained from Government and Non-Government Organizations (Sorted by Document Date Oldest to Youngest)**

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Resolution adopted by Board of Estimate and Apportionment	12/7/1911		New York City	12/18/2015		Property Acquisition, Jamaica Bay near Washington, Blvd and Borough of Queens	<a href="#">NYCGKRI00000241.pdf</a>	7/25/2016	John Wyckoff
Proceedings of the Board of Commissioners of the Land Office	12/31/1927		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000348.pdf</a>	1/14/2016	Kyle Emery
Acquisition of Crooke's Point Sec 4 Block 5000 Lot 1 and Resolution by Board of Estimate and Apportionment	11/21/1929		New York City	12/18/2015	Acquisition of 300 acres by New York City from Fairbanks Realty Corporation.	Property Acquisition	<a href="#">NYCGKRI00000337.pdf</a>	1/14/2016	Kyle Emery
Map Showing Staten Island Marine Park, At Great Kills and Boundary Streets and Closing and Discontinuing of Streets	4/17/1930		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00001383.pdf</a>	1/14/2016	Kyle Emery
Crooke's Point or S.I. Marine Park Sec 4 Block 5000 Lot	12/31/1930		New York City	12/18/2015	Schedule of Parcels showing Grantor, Amount, Date, Lot, Parcel, Date, Deed No., Acres, Block and Lot (Upland Acres only).	Property Acquisition	<a href="#">NYCGKRI00000322.pdf</a>	7/25/2016	John Wyckoff
Amended Map in the Application of the City of New York for a Grant of Land Under the Waters of Lower New York Bay and Great Kills	6/1/1931		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000389.pdf</a>	12/22/2015	John Wyckoff
Map Showing Proposed Modifications in the Boundaries of Staten Island Marine Park, and Proposed Modification of the Pierhead and Bulkhead Lines at Great Kills. also Showing Re-Established Lines of Mansion Ave., Grattan Ave., Baldwin Ave., and Bach St.	6/5/1931		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000395.pdf</a>	12/23/2015	John Wyckoff

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Property Card - GKP Parcel History	12/11/1931		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000234.pdf</a>	12/21/2015	John Wyckoff
Letters-Patent issued for 445.14527 acres underwater establishing a Marine Park and Bathing Beach.	3/31/1932		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000325.pdf</a>	1/14/2016	Kyle Emery
Map, Proposed Modifications in the Boundaries of the Staten Island Marine Park.	5/17/1932		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000382.pdf</a>	12/22/2015	John Wyckoff
Map in the Application of CNY for Grant of Land Under the Waters of the Lower New York Bay.	11/1/1933		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000381.pdf</a>	12/22/2015	John Wyckoff
Site Plan - Map of Staten Island Marine Park at Great Kills, S.I.	4/25/1934	NY City Dept. of Parks	NPS ETIC	12/9/2015	Shows land that was acquired for the creation of Marine Park and proposed use. Shows creeks and other minor islands at the time of plan creation.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62609_0001_of_000.pdf</a>	12/9/2015	Kyle Emery
Letters-Patent issues for 83.1434 Acres for establishing a Marine Park and Bathing Beach.	6/25/1934		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000318.pdf</a>	1/14/2016	Kyle Emery
R-16 History and Development of Marine Park	11/16/1934	NY City Dept. of Parks	New York City	12/18/2015	History of property acquisition from 1929 through 1934.	Property Acquisition	<a href="#">NYCGKRI00000251.pdf</a>	1/14/2016	Kyle Emery
Tax and Assess. Data re Lands to be acquired, Marine Park, Staten Island	12/31/1934		New York City	12/18/2015	Schedule of land acquisition listing (95.982) acreage to be acquired in 1934.	Property Acquisition	<a href="#">NYCGKRI00000331.pdf</a>	1/14/2016	Kyle Emery
Draft Tax and Assess Data re Lands to be acquired, Marine Park, Staten Island	12/31/1934		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000335.pdf</a>	12/22/2015	John Wyckoff
Marine Park - Richmond #16 - Park List	3/6/1935		New York City	12/18/2015	Present dates when three maps were adopted (1925 and 1931) with certain acreage (1,256).	Past Site Ops/Waste Disposal; Property Acquisition	<a href="#">NYCGKRI00000226.pdf</a>	12/21/2015	John Wyckoff
Marine Park - Richmond #16 - Park List	3/6/1935			12/18/2015	Attached is a June 24, 1935 ltr from R. Moses to Board of Estimate and Apportionment re acquisition of property for the Marine Park.	Property Acquisition	<a href="#">NYCGKRI00000313.pdf</a>	7/25/2016	John Wyckoff

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Marine Park - Richmond #16 - Park List	7/16/1935			12/18/2015	Property acquisition and maps adopted between 1925 and 1931.	Property Acquisition	<a href="#">NYCGKRI00000253.pdf</a>	1/14/2016	Kyle Emery
Lake Burying Grounds - Marine Park - Richmond	9/20/1935		New York City	12/18/2015	Exception deed clearly reserves property as a private cemetery for Lake Family and relatives. Parcel 4994 south of Hylan Blvd, between Spratt Ave and Hopkins Ave.	Property Acquisition	<a href="#">NYCGKRI00000310.pdf</a>	12/21/2015	John Wyckoff
Site Plan - City of New York, Department of Parks, Topographical Map, Marine Park, Boro of Richmond	10/22/1935	NY City Dept. of Parks	NPS ETIC	12/8/2015	Shows topographical data for areas along the western and northern edges of Great Kills Harbor. Page 3 has information concerning areas which are now Great Kills Park.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62523.pdf</a>	12/8/2015	Kyle Emery
Public Notice in Record re Department of Parks Authority to Purchase at Private Sale All Privately Owned Property within the Limits of the Boundaries of Marine Park Staten Island.	10/25/1935			12/18/2015	Marine Park was originally laid out as Crooke's Point Park on City map in 1925 but the map was amended park now contains 1,256 acres of which 394 are uplands and 862 are under water.	Property Acquisition	<a href="#">NYCGKRI00000308.pdf</a>	1/14/2016	Kyle Emery
Site Plan - Marine Park, Staten Island, Dredge Area & Fill Area	11/8/1935	NY City Dept. of Parks	NPS ETIC	12/9/2015	Shows areas which are to be dredged to create Great Kills Harbor and which areas are to be filled to create Great Kills Park.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">646_62607.pdf</a>	12/9/2015	Kyle Emery
Site Plan - City of New York, Department of Parks, Topographical Map, Marine Park, Boro of Richmond Part 2	3/24/1936	NY City Dept. of Parks	NPS ETIC	12/8/2015	Continuation of New York City Department of Parks topographical map of the area which will become GKP. All pages contain information pertinent to GKP.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62524.pdf</a>	12/8/2015	Kyle Emery
Site Plan - City of New York, Department of Parks, Key Map of Great Kills Park	3/31/1936	NY City Dept. of Parks	NPS ETIC	12/8/2015	Key map for the Topographical map that was created during the planning of Great Kills Park.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62536_0001_of_0000.pdf</a>	12/8/2015	Kyle Emery
City of New York Board of Estimate Resolution	7/25/1936		New York City	12/18/2015	Resolution approval of parcel of land as a site for park purposes.	Property Acquisition	<a href="#">NYCGKRI00000293.pdf</a>	4/28/2016	John Wyckoff
Pre-Landfill Conditions, Staten Island Unit/Great Kills Park	7/31/1936	U.S. National Park Service	NPS ETIC	12/8/2015	Sketch showing watershed area and Great Kills Harbor Marine Park.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">GATE_646_40233_B_0001_of_0000.pdf</a>	12/8/2015	John Wyckoff

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Site Plan - City of New York, Department of Parks, Index Map for Cross Sections, Marine Park	10/6/1936	NY City Dept. of Parks	NPS ETIC	12/8/2015	Includes the proposed bulkhead which is along the southern edge of the current Great Kills Harbor.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62535_0001_of_000.pdf</a>	12/8/2015	Kyle Emery
Ltr from L. C. Squire Right-of-Way Engineer to P. Windels, Corporation Counsel re Marine Park Acquisition.	10/16/1936		New York City	12/18/2015	List of owners of lands and premises involved in the proceeding to acquire the Marine Park.	Past Site Ops/Waste Disposal; Property Acquisition	<a href="#">NYCGKRI00000290.pdf</a>	1/14/2016	Kyle Emery
Commissioners of the Sinking Fund of the City of New York Resolution No. 15	10/22/1936		New York City	12/18/2015	Purchase price \$22,750.	Property Acquisition	<a href="#">NYCGKRI00000289.pdf</a>	1/14/2016	Kyle Emery
Ltr from R. Tarbox Acting Corporation Counsel to R. Moses re Application of the City of New York to Acquiring Title to Certain Real Property	11/30/1936	New York City, Law Department	New York City	12/18/2015	On November 23, 1936, Hon C. Lockwood signed an order condemning certain lands. The lands were acquired for park purposes. Per resolution of the Board of Est and App authorizing title to lands vested in the City of New York on Nov 23, 1936.	Property Acquisition	<a href="#">NYCGKRI00000285.pdf</a>	1/14/2016	Kyle Emery
Ltr from R. Moses to W. Carey Commissioner of Sanitation re Satisfied with requirement and conditions for Marine Park, Staten Island	6/22/1937		New York City	12/18/2015	R. Moses responds to Commissioner of Sanitation's June 1, 1937 ltr with requirements and conditions for release of property to the Commissioners of the Sinking Fund. Also release property under jurisdiction in connection with the incinerator.	Property Acquisition	<a href="#">NYCGKRI00000277.pdf</a>	1/14/2016	Kyle Emery
City of New York Board of Estimate Resolution for removal of structures and appurtenances.	6/16/1938		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000274.pdf</a>	7/25/2016	John Wyckoff
Preliminary Development Plan for Boat Basin	12/12/1938	NY City Dept. of Parks	National Park Service	5/15/2016	Shows proposed bulkhead and filling and shoreline.	Nature and Extent	<a href="#">GATE_646_62554A_[id53026].pdf</a>	5/15/2016	John Wyckoff
Property Card - GKP Parcel History (Marine Park)	3/4/1939		New York City	12/18/2015	Handwritten document and map showing parcels.	Property Acquisition	<a href="#">NYCGKRI00000232.pdf</a>	12/21/2015	John Wyckoff

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Museum Bulletin of the Staten Island Institute of Arts and Sciences	9/1/1939		New York City	12/18/2015	Provides and early history of Crooke's Point. "...Sand thieves forced Mr. Crooke to keep a watchman on the Point, see "Days Afield on Staten " and in the account of Mr. Crooke in our Proceedings, vol. III pp. 169-172, printed after his death in 1911.	Past Site Ops/Waste Disposal; Property Acquisition	<a href="#">NYCGKRI00000257.pdf</a>	1/14/2016	Kyle Emery
Site Plan - Marine Park of Richmond, Dept of Sanitation Fill, Dept of Parks City of New York	5/1/1940	NY City Dept. of Parks	NPS ETIC	12/9/2015	Shows the extent of the Department of Sanitation Fill at a time when the incinerator was active.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">GATE_646_62588_0001_of_000.pdf</a>	1/14/2016	Kyle Emery
Ltr from R. Moses to Board of Estimate re Request to release to the City all lands under water and include in Marine Park	6/10/1940	NY City Dept. of Parks	New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000273.pdf</a>	12/21/2015	John Wyckoff
Site Plan - Showing Park Area Available for Federal Fill under Joint Federal-City Dredging Project, Great Kills Marine Park	8/15/1940	NY City Dept. of Parks	NPS ETIC	12/9/2015	Shows areas to be dredged by the Joint Federal and City Dredging Project and areas to be filled. First notation of Federal Fill.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62610_0001_of_000.pdf</a>	1/28/2016	John Wyckoff
Map A in the Application for Grant of Lands under the Waters of Great Kills and Lower Bay in Marine Park	9/10/1940		New York City	12/18/2015	411.4151 LUW to be acquired from State. LUW acquired from State in 3/31/1932.	Property Acquisition	<a href="#">NYCGKRI00000384.pdf</a>	12/22/2015	John Wyckoff
Ltr from R. Moses to Board of Estimate re Authorization of payment for and acceptance for land under water	12/2/1940	NY City Dept. of Parks	New York City	12/18/2015	Includes application for grant of 411.4151 acres of land underwater in GK. Includes recapture clause re land granted to be used as park or revert back to the People of New York.	Property Acquisition	<a href="#">NYCGKRI00000263.pdf</a>	12/21/2015	John Wyckoff
Ltr from F. Bryan Corporation Counsel, City of New York, to R. Moses re Opinion that Procedure is Correct for authorization of \$229,000 for material dredged from Great Kills Harbor	12/25/1940	New York City, Law Department	New York City	12/18/2015		Past Site Ops/Waste Disposal; Dredging Great Kills Harbor	<a href="#">NYCGKRI00000271.pdf</a>	7/25/2016	John Wyckoff

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Site Plan - Contract Drawing for Test Borings for proposed Bridge and bulkhead wall from Fairlawn to Existing Steel Bulkhead Wall in Marine Park	3/5/1941	NY City Dept. of Parks	NPS ETIC	12/9/2015	Plan showing the location of Test Borings within GKP. Boring logs and related data not included in this document.	Past Site Ops/Waste Disposal	<a href="#">646_62699.pdf</a>	12/9/2015	Kyle Emery
Site Plan - Preliminary Grading Plan, Marine Park, Borough of Richmond	7/3/1941	NY City Dept. of Parks	NPS ETIC	12/9/2015	Hand written note of states "Gross Waste Fill - 16,464,582 c.y." Plan notes extent of waste fill.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">GATE_646_62594.pdf</a>	12/9/2015	Kyle Emery
Cross Sections Thru Proposed Fill - Dept. Of Sanitation, Marine Park, Borough of Richmond	7/25/1941	NY City Dept. of Parks	NPS ETIC	12/9/2015	Station numbers are identified on each page of the document; however, there is no station map attached.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">646_62590.pdf</a>	12/9/2015	Kyle Emery
Hand Written Notes re Chronology 1925 - 1941 of NY Board of Estimate Actions re Marine Park, Staten Island, Y	11/7/1941		New York City	12/18/2015	Chronologic summary.	Property Acquisition	<a href="#">NYCGKRI00000358.pdf</a>	1/14/2016	Kyle Emery
Marine Park, Richmond, Chronological Record of Actions by the Board of Estimate, the City Planning Commission and the City Council	8/10/1942		New York City	12/18/2015	Chronology from 1/29/1925 through 11/7/1941.	Property Acquisition	<a href="#">NYCGKRI00000254.pdf</a>	1/14/2016	Kyle Emery
Marine Park, Richmond, Chronological Record of Actions by the Board of Estimate, the City Planning Commission and the City Council	8/10/1942			12/18/2015	Chronology.	Property Acquisition	<a href="#">NYCGKRI00000375.pdf</a>	1/14/2016	Kyle Emery
Site Plan - Contract Drawing for Test Borings for Proposed Structures in Great Kills Park	2/24/1943	NY City Dept. of Parks	NPS ETIC	12/9/2015	Shows the topography of the site at the time of plan creation.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62702_0001_of000.pdf</a>	12/9/2015	Kyle Emery
Site Plan - Great Kills Park, Richmond, Grading Plan	3/20/1943	NY City Dept. of Parks	NPS ETIC	12/8/2015	Shows extent of Sanitary Fill within Great Kills Park.	Past Site Ops/Waste Disposal; Nature and Extent; Containment	<a href="#">GATE_646_62551_0002_of_000.pdf</a>	1/14/2016	Kyle Emery
Site Plan - Great Kills Park, Richmond, Grading Plan	3/29/1943	NY City Dept. of Parks	NPS ETIC	12/9/2015	Grading plan for Crooke's Point.	Past Site Ops/Waste Disposal	<a href="#">646_62604.pdf</a>	12/9/2015	Kyle Emery
Plan - Cross Sections for Sanitation Fill, Great Kills Park	3/29/1943	NY City Dept. of Parks	NPS ETIC	12/9/2015	Cross sections for the waste fill at Great Kills Park. No station map included.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">GATE_646_62591.pdf</a>	12/9/2015	Kyle Emery

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Site Plan - Contract Drawings for Dredging of Basin for Unloading Plant in Great Kills Park, Borough of Richmond	8/6/1943	NY City Dept. of Parks	NPS ETIC	12/9/2015	Shows the disposal area for dredged material as well as the existing waste fill.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">GATE_646_62703.pdf</a>	12/9/2015	Kyle Emery
Site Plan - Topographical Map of Great Kills Park	12/13/1943	NY City Dept. of Parks	NPS ETIC	12/9/2015	Topographical map with Bathymetric Lines.	Past Site Ops/Waste Disposal	<a href="#">62539.pdf</a>	12/9/2015	Kyle Emery
Site Plan - City of New York, Department of Parks, Hydrographic Map of Great Kills Park	12/15/1943	NY City Dept. of Parks	NPS ETIC	12/8/2015	Bathymetric maps of Great Kills Park.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62537.pdf</a>	1/14/2016	Kyle Emery
Site Plan - City of New York, Department of Parks, Topographical Map, Marine Park, Boro of Richmond	1/11/1944	NY City Dept. of Parks	NPS ETIC	12/8/2015	Topographical Maps of Great Kills Park.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62538.pdf</a>	12/8/2015	Kyle Emery
Adjustment of Sewer Manholes in Great Kills Park	1/15/1944	NY City Dept. of Parks	National Park Service	5/15/2016	Shows sewer manholes that required extensions due to filling.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62707 [id151155].pdf</a>	5/15/2016	John Wyckoff
Site Plan - Cross Sections, Fairlawn Avenue, Great Kills Park	3/24/1944	NY City Dept. of Parks	NPS ETIC	12/8/2015	Topographical Map near the intersection of Hylan and Fairlawn.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62540_0001_of_0000.pdf</a>	12/8/2015	Kyle Emery
Reconstruction of Sewer Manholes In Great Kills Park	5/11/1945	NY City Dept. of Parks	National Park Service	5/15/2016	Document, shows manholes that required reconstruction and extension due to filling.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">GATE_646_62546 [id152025].pdf</a>	5/15/2016	John Wyckoff
Department of Sanitation, City of New York 1946 Annual Report	12/31/1946	NY City Dept. of Sanitation	New York City	12/18/2015	Rpt (pages 31-35) 290 acres, 200 filled by 12/31/1946, 190 filled during 1945, and remaining 90. (Page 31). Expected to be filled by 1948. To be replaced by Fresh Kills Landfill. Photos of unloading ops.	Past Site Ops/Waste Disposal	<a href="#">NYCGKRI00000001.pdf</a>	12/21/2015	John Wyckoff
Site Plan - Contract Drawings for Hydraulic Fill in Great Kills Park	1/13/1947	NY City Dept. of Parks	NPS ETIC	12/8/2015	Figure delineates areas where hydraulic fill was to be placed.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">GATE_646_62547.pdf</a>	12/8/2015	Kyle Emery
Area Surrender to the Dr of Est on March 12, 1947	3/12/1947	NY City Dept. of Parks	New York City	12/18/2015	Map showing block 5065	Property Acquisition	<a href="#">NYCGKRI00000261.pdf</a>	1/14/2016	Kyle Emery

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City of New York, Department of Health, Bureau of Sanitary Engineering, Analysis of the Problems of Sanitary Landfills in New York City	8/1/1947	NY City Dept. of Sanitation	New York City	12/18/2015	Compare barge vs truck ops - barge ops have increased odors. GK used disinfectant dispersed from 6K gal trailer. Hydraulic fill used pipe placed across sanitary fill, caused fill to be uncovered. GK odors due to lack of prompt covering.	Past Site Ops/Waste Disposal	<a href="#">NYCGKRI00000017.pdf</a>	12/21/2015	John Wyckoff
Department of Sanitation, City of New York 1947 Annual Report	12/31/1947	NY City Dept. of Sanitation	New York City	12/18/2015	8 waterfront disposal stations provided 4,647,007 cu yds of ashes and other unburnable wastes for GK. Reclaimed acreage Oakwood and GK was 30 and 235 and amount of waste was 492.056 4,647,007 cu yds. Pages 25-29 and 35-36.	Past Site Ops/Waste Disposal	<a href="#">NYCGKRI00000007.pdf</a>	2/12/2016	John Wyckoff
City Planning Commission Report No. 4972 Committee on Acquisition and Disposition of City Property, Board of Estimate	3/24/1948		New York City	12/18/2015	Assignment of Block 5065, Lots 98 and 100 (14.9 acres) to Department of Parks of a former garage and incinerator site located east of Hylan Boulevard and south of Baldwin Avenue.	Past Site Ops/Waste Disposal; Property Acquisition	<a href="#">NYCGKRI00000270.pdf</a>	1/14/2016	Kyle Emery
Department of Sanitation, City of New York 1948 Annual Report	12/31/1948	NY City Dept. of Sanitation	New York City	12/18/2015	Fresh Kills Landfill ops at 1,500 acres started 4/21/1948. Approx 15,078,726 cu yds disposed at GK 11/25/44 - mid July 1948. From 1/48 - 78/48 2 million cu yds disposed of at GK. GK landfill stats for 1948, 47 and 46.	Past Site Ops/Waste Disposal	<a href="#">NYCGKRI00000032.pdf</a>	12/21/2015	John Wyckoff
Ltr from R. Moses to W. O'Dwyer, Mayor, New York City re Summary of Department of Parks Activities on Staten Island	7/1/1949	NY City Dept. of Parks	Administrative Record	12/2/2015	Provides contemporaneous early history of the GKP and surrounding area (sewage treatment plants).	Past Site Ops/Waste Disposal	<a href="#">AR0000008 LETTERNYCMAYO R.PDF</a>	12/18/2015	John Wyckoff

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Your Sanitation Department, An Introduction	12/31/1949	NY City Dept. of Sanitation	New York City	12/18/2015	Bureau of waste disposal has three divisions; destructors, (incinerators), marine operations, and fill operations. Efforts to incinerate more of city's combustible wastes. Construct five new incinerators and remodeling of several existing destructors.	Past Site Ops/Waste Disposal	<a href="#">NYCGKRI00000036.pdf</a>	12/21/2015	John Wyckoff
Department of Sanitation, City of New York 1949 Annual Report	12/31/1949	NY City Dept. of Sanitation	New York City	12/18/2015	467-acre portion of GK 1,256 acre oceanfront park was formally opened in August 49. Used orthodichloro-benzene as disinfectant 7.5 gallons per 1,000 gallons of water. 22,000 gallons used at various fills. Note GK photo of beach.	Past Site Ops/Waste Disposal	<a href="#">NYCGKRI00000041.pdf</a>	12/21/2015	John Wyckoff
Layout Map Showing the Location of Oakwood Beach Sewage Treatment Works Plant Site	3/6/1951	New York City Department of Public Works	New York City	12/18/2015	Oakwood Beach WPCP.	Oakwood WPCP	<a href="#">NYCGKRI00000403.pdf</a>	12/22/2015	John Wyckoff
Fresh Kills Landfill, Report to Mayor Impellitteri and the Board of Estimate	11/1/1951	NY City Dept. of Sanitation	New York City	12/18/2015	Provides a history of New York City wastes disposal. Before 1934 more than half of City refuse disposed of at sea. Supreme Court ordered New York City to stop the practice (sea disposal) and forced city to dispose of waste in landfills.	New York City waste disposal history	<a href="#">NYCGKRI00000044.pdf</a>	12/29/2015	John Wyckoff
Map Showing Change in the Lines of Great Kills Park, Located on the South Side of Emmet Ave., Opposite of Cedar Grove Ave, Section 21	4/28/1952		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000387.pdf</a>	12/22/2015	John Wyckoff
Site Plan - Hydraulic Fill at North End of Beach, Great Kills Park, Borough of Richmond	3/15/1954	NY City Dept. of Parks	NPS ETIC	12/9/2015	Shows area of beach nourishment with hydraulic fill.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62738.pdf</a>	12/9/2015	Kyle Emery
Contract No. 2 Structures and Equipment - Topography of Plant Site	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015	Provides site topography before Oakwood WPCP construction. Elevations suggest no prior filling.	Oakwood WPCP	<a href="#">NYCGKRI00003718.pdf</a>	1/14/2016	Kyle Emery

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Contract No. 2 Structures and Equipment - Plant Layout	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015		Oakwood WPCP	<a href="#">NYCGKRI00003719.pdf</a>	1/14/2016	Kyle Emery
Contract No. 2 Structures and Equipment - Relocated Drainage Ditch - Plan and Sections	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015	Relocated drainage ditch.	Oakwood WPCP	<a href="#">NYCGKRI00003720.pdf</a>	1/14/2016	Kyle Emery
Contract No. 2 Structures and Equipment - North and East Elevations	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015	Shows basement elevations below grade.	Oakwood WPCP	<a href="#">NYCGKRI00003725.pdf</a>	1/14/2016	Kyle Emery
Contract No. 2 Structures and Equipment - South and West Elevations	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015	Elevations.	Oakwood WPCP	<a href="#">NYCGKRI00003726.pdf</a>	1/14/2016	Kyle Emery
Contract No. 2 Structures and Equipment - Main Building Sections "E-E" and "D-D"	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015		Oakwood WPCP	<a href="#">NYCGKRI00003728.pdf</a>	1/14/2016	Kyle Emery
Contract No. 2 Structures and Equipment - Main Building Sections "H-H" and "J-J"	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015	Shows depth of basement/pump room.	Oakwood WPCP	<a href="#">NYCGKRI00003730.pdf</a>	1/14/2016	Kyle Emery
Contract No. 2 Structures and Equipment - Landscaping Planting Plan	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015	Shows planting plan adjacent to plan and marshland.	Oakwood WPCP	<a href="#">NYCGKRI00003754.pdf</a>	1/14/2016	Kyle Emery
Contract No. 2 Structures and Equipment - Main Building Screen Room Plans, Sections and Details	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015	Shows the interceptor into Main Building and Manhole 1 construction.	Oakwood WPCP	<a href="#">NYCGKRI00003761.pdf</a>	7/25/2016	John Wyckoff
Contract No. 2 Structures and Equipment - Outside Piping Plan	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015	Show location of influent line.	Oakwood WPCP	<a href="#">NYCGKRI00003770.pdf</a>	1/14/2016	Kyle Emery
Contract No. 2 Structures and Equipment - Main Building Pile Plan	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015	Shows influent pipe.	Oakwood WPCP	<a href="#">NYCGKRI00003804.pdf</a>	1/14/2016	Kyle Emery

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Contract No. 2 Structures and Equipment - Main Building Sections A-A and S-S	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015	Shows influent pipe and its configuration.	Oakwood WPCP	<a href="#">NYCGKRI00003809.pdf</a>	1/14/2016	Kyle Emery
Contract No. 2 Structures and Equipment - 54" Plant Outfall	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015	Outfall configuration.	Oakwood WPCP	<a href="#">NYCGKRI00003842.pdf</a>	1/14/2016	Kyle Emery
Contract No. 2 Structures and Equipment - Overflow Pipe and Raw Sewage Line	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015	Overflow and Sewage Line.	Oakwood WPCP	<a href="#">NYCGKRI00003843.pdf</a>	1/14/2016	Kyle Emery
Contract No. 2 Structures and Equipment Roads and Grades Drains - Plan & Profiles and Drainage Details	8/1/1954	New York City, Department of Public Works	New York City	12/18/2015		Oakwood WPCP	<a href="#">NYCGKRI00003848.pdf</a>	1/14/2016	Kyle Emery
Information for Bidders, Bid Agreement, Bonds and Specifications for the Construction of the Oakwood Beach Pollution Control Project	12/31/1954	New York City, Department of Public Works	New York City	12/18/2015	Partial document. Contract 2 provides for Structures and Equipment, Roads, Drains and Landscaping. Note Contract 1 deals with Oakwood Beach Interceptor Sewers (Not Included).	Oakwood WPCP	<a href="#">NYCGKRI00002851.pdf</a>	1/14/2016	Kyle Emery
Information for Bidders, Bid Agreement, Bonds and Specifications for the Construction of the Oakwood Beach Pollution Control Project	12/31/1954	New York City, Department of Public Works	New York City	12/18/2015	Detailed Specification - Contract 2 Structures and Equipment, Roads, Drains and Landscaping. Page 29 of 390 (of pdf or 342 of doc) provided details re Reinforced Concrete Influent Sewer.	Oakwood WPCP	<a href="#">NYCGKRI00003157.pdf</a>	12/23/2015	John Wyckoff
Utilization of Sewage Sludge for the Production of Topsoil, 1957 Annual Meeting, New York Sewage and Industrial Wastes Assn, New York, NY, January 17-18, 1957	1/18/1957	New York City, Department of Public Works	New York City	12/18/2015	GKP pumped sand coverings. Artificial topsoil at \$1,600/acre vs \$4,500 for natural soil. Expand facilities for sludge are planned for GKP. GK project differ Marine Park, centrifugal pumps will be mounted on sludge vessels instead of building on shore.	Past Site Ops/Waste Disposal; Sewage sludge use	<a href="#">NYCGKRI00000048.pdf</a>	7/25/2016	John Wyckoff
Contract No. 2 Record Drawing 54" Dia Outfall	5/1/1957	New York City, Department of Public Works	New York City	12/18/2015	Outfall.	Oakwood WPCP	<a href="#">NYCGKRI00003867.pdf</a>	12/28/2015	John Wyckoff

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Contract No. 2 Structures and Equipment - Overflow Pipe and Raw Sewage Line	8/1/1957	New York City, Department of Public Works	New York City	12/18/2015		Oakwood WPCP	<a href="#">NYCGKRI00003868.pdf</a>	1/14/2016	Kyle Emery
Site Plan - Construction of Athletic Fields in Great Kills Park Borough of Richmond	5/1/1958	NY City Dept. of Parks	NPS ETIC	12/9/2015	Includes grading plan for the athletic fields.	Past Site Ops/Waste Disposal	<a href="#">646_62709.pdf</a>	12/9/2015	Kyle Emery
Map- Athletic Field, Layout, Grading Drainage and Water Supply Plan	5/1/1958	NY City Dept. of Parks	New York City	12/18/2015		Past Site Ops/Waste Disposal	<a href="#">NYCGKRI00000378.pdf</a>	12/23/2015	John Wyckoff
Map- Athletic Field, Layout, Grading Drainage and Water Supply Plan	5/1/1958	NY City Dept. of Parks	New York City	12/18/2015		Past Site Ops/Waste Disposal	<a href="#">NYCGKRI00000379.pdf</a>	12/23/2015	John Wyckoff
Map- Athletic Field, Layout, Grading Drainage and Water Supply Plan	5/1/1958	Andrews & Clark Consulting Engineers	New York City	12/18/2015	Shows location of drainage catch basins and storm drainage conduits in athletic field area.	Utilities - Drainage	<a href="#">NYCGKRI00000411.pdf</a>	12/22/2015	John Wyckoff
Map- Athletic Field, Layout, Grading Drainage and Water Supply Plan	5/1/1958	Andrews & Clark Consulting Engineers	New York City	12/18/2015	Athletic field in the area SE of Hylan Blvd.	Utilities - Drainage	<a href="#">NYCGKRI00000412.pdf</a>	12/22/2015	John Wyckoff
Map- Athletic Field, Layout, Grading Drainage and Water Supply Plan	5/1/1958	Andrews & Clark Consulting Engineers	New York City	12/18/2015	Athletic Field in Area of SE of Hylan.	Utilities - Drainage	<a href="#">NYCGKRI00000413.pdf</a>	12/22/2015	John Wyckoff
Map- Athletic Field, Layout, Grading Drainage and Water Supply Plan	5/1/1958	Andrews & Clark Consulting Engineers	New York City	12/18/2015		Utilities - Drainage	<a href="#">NYCGKRI00000414.pdf</a>	12/22/2015	John Wyckoff
Property Card - GKP Parcel History	8/23/1962		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000236.pdf</a>	12/21/2015	John Wyckoff
Staten Island War Memorial Stadium	3/6/1965		New York City	12/18/2015	Shows baseball field and track.		<a href="#">NYCGKRI00000269.pdf</a>	12/21/2015	John Wyckoff
Schematic - Proposed Development For Great Kills Park	3/26/1965	NY City Dept. of Parks	NPS ETIC	12/9/2015	Proposed development plan shows some streams that were current to the date of creation.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62606_A_0001_of_0000.pdf</a>	12/9/2015	Kyle Emery

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New York City Environmental Protection Administration, Department of Water Resources, Bureau of Water Pollution Control, PW-136 Oakwood Beach WPCP Preliminary Plans	4/1/1969	Greeley and Hansen	New York City	12/18/2015	Plans show limit of fill near WPCP.	Oakwood WPCP	<a href="#">NYCGKRI00000792.pdf</a>	7/25/2016	John Wyckoff
PW136 - Oakwood Beach Pollution Control Project Extension	4/1/1969	Greeley and Hansen	New York City	12/18/2015		Oakwood WPCP	<a href="#">NYCGKRI00000807.pdf</a>	3/3/2016	John Wyckoff
PW136 - Oakwood Beach Pollution Control Project Extension	4/1/1969	Greeley and Hansen	New York City	12/18/2015	Page 14 of 16 shows Proposed 10-inch Force Main and Proposed 8'-0 x 5'-6" Interceptor. Important document.	Oakwood WPCP	<a href="#">NYCGKRI00000823.pdf</a>	3/3/2016	John Wyckoff
PW136 - Oakwood Beach Pollution Control Project Extension - Report on Preliminary Design	4/1/1969	Greeley and Hansen	New York City	12/18/2015		Oakwood WPCP	<a href="#">NYCGKRI00000839.pdf</a>	3/3/2016	John Wyckoff
PW136 - Oakwood Beach Pollution Control Project Extension - Report on Preliminary Design	4/1/1969	Greeley and Hansen	New York City	12/18/2015	Continuation of MYCGKRI00000839. Shows WPCP commenced treatment in 1958 and required upgrades due to population growth and effluent standards.	Oakwood WPCP	<a href="#">NYCGKRI00000852.pdf</a>	3/3/2016	John Wyckoff
PW136 - Oakwood Beach Pollution Control Project Extension - Report on Preliminary Design	4/1/1969	Greeley and Hansen	New York City	12/18/2015	Discusses Sludge Disposal. Sludge now discharged to the land area adjacent to the plant. Practice will not be continued and WPCP arrange for sludge disposal by barging.	Oakwood WPCP	<a href="#">NYCGKRI00000895.pdf</a>	3/3/2016	John Wyckoff
PW136 - Oakwood Beach Pollution Control Project Extension - Report on Preliminary Design	4/1/1969	Greeley and Hansen	New York City	12/18/2015	Appendix A - Shows elevations of force main and geotech borings.	Oakwood WPCP	<a href="#">NYCGKRI00000926.pdf</a>	12/22/2015	John Wyckoff
PW136 - Oakwood Beach Pollution Control Project Extension - Report on Preliminary Design	4/1/1969	Greeley and Hansen	New York City	12/18/2015	Appendix B - Laboratory Investigation.	Oakwood WPCP	<a href="#">NYCGKRI00000974.pdf</a>	12/22/2015	John Wyckoff
PW136 - Oakwood Beach Pollution Control Project Extension - Report on Preliminary Design	4/1/1969	Greeley and Hansen	New York City	12/18/2015	Appendix C - General Testing.	Oakwood WPCP	<a href="#">NYCGKRI00000981.pdf</a>	12/22/2015	John Wyckoff

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PW136 - Oakwood Beach Pollution Control Project Extension - Report on Preliminary Design	4/1/1969	Greeley and Hansen	New York City	12/18/2015	Appendix C - General Testing Continued.	Oakwood WPCP	<a href="#">NYCGKRI00001022.pdf</a>	12/22/2015	John Wyckoff
PW136 - Oakwood Beach Pollution Control Project Extension - Report on Preliminary Design	4/1/1969	Greeley and Hansen	New York City	12/18/2015	Appendix C - Tunnel Section I Glacial Till.	Oakwood WPCP	<a href="#">NYCGKRI00001032.pdf</a>	12/22/2015	John Wyckoff
PW136 - Oakwood Beach Pollution Control Project Extension - Report on Preliminary Design	4/1/1969	Greeley and Hansen	New York City	12/18/2015	Appendix E - Sheeting Stress.	Oakwood WPCP	<a href="#">NYCGKRI00001047.pdf</a>	1/25/2016	John Wyckoff
Oakwood Beach Water Pollution Control Project, Project Report	4/28/1969	Greeley and Hansen	New York City	12/18/2015	Proposed WPCP provides for first stage installation for average flow 40 mgd and enlargement of 80 mgd. Document is not complete.	Oakwood WPCP	<a href="#">NYCGKRI00000780.pdf</a>	7/25/2016	John Wyckoff
Staten Island War Memorial Sports Stadium, Topographic Map	10/17/1969	Norman Porter Associates	New York City	12/18/2015	Note includes Sewer Invert Elevations obtained from Plan and Profiles dated 10/27/1927. Invert depth range -9 to -11 feet below MSL.	Past Site Ops/Waste Disposal; Utilities - Sewer	<a href="#">NYCGKRI00000386.pdf</a>	7/25/2016	John Wyckoff
Reconstruction of Sewer Line East of Bath House	2/19/1970	NY City Dept. of Parks	National Park Service	5/15/2016	Note manholes present on northwest side of bath house discharge to harbor side.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62720_[id209341].pdf</a>	5/15/2016	John Wyckoff
Memorandum No. 2 On Geologic Features, Eltingville (Staten Island) Sewer Tunnel	4/23/1971	Johnson Soils Engineering Laboratory	New York City	12/18/2015	Appendix F - Cross sections show limits of AF - Artificial Fill.	Oakwood WPCP	<a href="#">NYCGKRI00001059.pdf</a>	3/3/2016	John Wyckoff
Memorandum No. 2 On Geologic Features, Eltingville (Staten Island) Sewer Tunnel	4/23/1971	Johnson Soils Engineering Laboratory	New York City	12/18/2015		Oakwood WPCP	<a href="#">NYCGKRI00001069.pdf</a>	3/3/2016	John Wyckoff
Memorandum No. 2 On Geologic Features, Eltingville (Staten Island) Sewer Tunnel	4/23/1971	Johnson Soils Engineering Laboratory	New York City	12/18/2015	II - Proposed Construction.	Oakwood WPCP	<a href="#">NYCGKRI00001071.pdf</a>	3/3/2016	John Wyckoff
Memorandum No. 2 On Geologic Features, Eltingville (Staten Island) Sewer Tunnel	4/23/1971	Johnson Soils Engineering Laboratory	New York City	12/18/2015	III - Geologic Conditions.	Oakwood WPCP	<a href="#">NYCGKRI00001073.pdf</a>	3/3/2016	John Wyckoff

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Memorandum No. 2 On Geologic Features, Eltingville (Staten Island) Sewer Tunnel	4/23/1971	Johnson Soils Engineering Laboratory	New York City	12/18/2015	IV Investigation.	Oakwood WPCP	<a href="#">NYCGKRI00001077.pdf</a>	3/3/2016	John Wyckoff
Memorandum No. 2 On Geologic Features, Eltingville (Staten Island) Sewer Tunnel	4/23/1971	Johnson Soils Engineering Laboratory	New York City	12/18/2015	V Soil and Foundation Conditions.	Oakwood WPCP	<a href="#">NYCGKRI00001081.pdf</a>	3/3/2016	John Wyckoff
Memo from F. Papay to J. Monasch re Oakwood Beach Water Pollution Control Plant in Borough of Richmond	6/28/1972		New York City	12/18/2015	3 acre parcel formerly part of GKP needed to expand WPCP capacity. Attached documents provide history of parcel and acquisition of land to constructing Oakwood WWT in 1956.	Oakwood WPCP	<a href="#">NYCGKRI00000365.pdf</a>	3/3/2016	John Wyckoff
Figure Showing Great Kills Unit and Public Areas	9/1/1973	U.S. National Park Service	NPS ETIC	12/8/2015	Schematic figure of GKP and public access areas (1973).		<a href="#">GATE_646_20009[195702].pdf</a>	12/8/2015	John Wyckoff
Site Plan - Topographic maps for Gateway National Recreation Area, New York, Great Kills Unit	9/1/1975	U.S. National Park Service	NPS ETIC	12/9/2015	Topographic maps which include Bathymetric lines for Great Kills Park. Some duplicate sheets exist within the document.	Past Site Ops/Waste Disposal	<a href="#">41004.pdf</a>	12/9/2015	Kyle Emery
General History of the Jamaica Bay, Breezy Point and Staten Island Units, Gateway National Recreation Area, New York, NY	10/31/1975	Tony P. Wrenn, Historic Preservation Consultant	New York City	12/18/2015	See pages 88 - 91.	Past Site Ops/Waste Disposal	<a href="#">NYCGKRI00000055.pdf</a>	1/14/2016	Kyle Emery
Parcel Map - Staten Island, Marine Park	1/2/1976		New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000240.pdf</a>	12/21/2015	John Wyckoff
Oakwood Beach Water Pollution Control Project West Branch Sewer Interceptor	7/1/1976	NY City Department of Water Resources	National Park Service	5/15/2016	Shows the west branch of the sewer intercepting Sewer.	Past Site Ops/Waste Disposal; Oakwood WPCP	<a href="#">GATE_646_113898A [id217127].pdf</a>	5/15/2016	John Wyckoff
Transmittal of Task Directive - Replace Steel Bulkhead	6/17/1982	U.S. National Park Service	National Park Service	5/15/2016	Document shows extensive deterioration of bulkhead and concerns regarding potential impacts due to releases from the former landfill.		<a href="#">GATE_646_D51 [id31704].pdf</a>	7/25/2016	John Wyckoff
Record Map, Great Kills Park R-16, Borough of Staten Island, Mapping and Acquisition of the Original Park	9/22/1982		New York City	12/18/2015	Historical summary of acquisitions.	Property Acquisition	<a href="#">NYCGKRI00000416.pdf</a>	12/22/2015	John Wyckoff

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Final Engineering report and Comprehensive Design For Seawall Rehabilitation	11/1/1982	U.S. National Park Service	National Park Service	5/15/2016	Bulkhead rehabilitation project.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_D121_[id30414].pdf</a>	5/15/2016	John Wyckoff
Comprehensive Design Shore Protection Study and Bath House	8/1/1983	U.S. National Park Service	National Park Service	5/15/2016	Shows historical shoreline and fill in vicinity of bath house, and peat layer. Nature of fill is not described.	Nature and Extent	<a href="#">GATE_646_41080_[id37546].pdf</a>	7/25/2016	John Wyckoff
Site Plan - Stone Groin & Beach Nourishment, Location within Park, Great Kills Park, Staten Island Unit, Gateway National Recreation Area	1/1/1984	U.S. National Park Service	NPS ETIC	12/8/2015	4 page document including: Cover Sheet, Plan Sheet, Borrow & Haul Route, Cross Sections of Beach Nourishment.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_41081.pdf</a>	1/14/2016	Kyle Emery
Site Plan - Alternative 3, Staten Island Unit, Great Kills Park	4/1/1984	U.S. National Park Service	NPS ETIC	12/8/2015	Site Plan showing proposed site structures and public areas.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_40239_0001_of_000.pdf</a>	12/18/2015	John Wyckoff
Site Plan - Alternative 4, Staten Island Unit, Great Kills Park	4/1/1984	U.S. National Park Service	NPS ETIC	12/8/2015	Site Plan showing proposed site structures and public areas.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_40240_0001_of_000.pdf</a>	12/18/2015	John Wyckoff
Site Plan - Alternative 5, Staten Island Unit, Great Kills Park	4/1/1984	U.S. National Park Service	NPS ETIC	12/8/2015	Site plan showing proposed site structures and public areas.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_40241_0001_of_000.pdf</a>	12/8/2015	Kyle Emery
Report Structural Engineering Services for the Beach and Bathhouse Facility at Gateway National Recreation Area	1/1/1985	Sidney M. Johnson and Associates	Administrative Record	12/2/2015	Summarizes field investigation (41 test pits, 4 monitoring wells and sampling) and nature and extent of garbage fill.	Nature and Extent	<a href="#">AR0000011_JOHNSONREPORT.PDF</a>	12/2/2015	John Wyckoff
Site Plan - The Uplands, Staten Island Unit, Great Kills Park	3/1/1985	U.S. National Park Service	NPS ETIC	12/8/2015	Site plan showing the delineation between the Uplands, Crooke's Neck, and Crooke's Point at GKP.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_40263_B_0001_of_0000.pdf</a>	12/8/2015	Kyle Emery
Site Plan - Alternative A, Preferred Alternative, Staten Island Unit/Great Kills Park	12/1/1985	U.S. National Park Service	NPS ETIC	12/8/2015	Shows structures and proposed public uses.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_40238_B_0001_of_0001.tif</a>	12/8/2015	John Wyckoff
WP-136 Oakwood Beach Water Pollution Control Project, West Branch Intercepting Sewer Alternative Study	2/1/1986		New York City	12/18/2015		Oakwood WPCP	<a href="#">NYCGKRI00001747.pdf</a>	7/27/2016	John Wyckoff

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Final Environmental Impact Statement for Phase III and Future Phases of the Oakwood Beach Water Pollution Control Project	8/1/1986	U.S. Environmental Protection Agency Region 2	New York City	12/18/2015		Oakwood WPCP	<a href="#">NYCGKRI00001793.pdf</a>	12/22/2015	John Wyckoff
Site Plan - Alternative III - No Action, Existing Conditions, Staten Island Unit, Great Kills Park	6/1/1988	U.S. National Park Service	NPS ETIC	12/8/2015	Site Plan showing existing conditions of site structures and public areas at the time of figure creation.	Past Site Ops/Waste Disposal	<a href="#">GATE 646 40261 C 0001 of 0001.pdf</a>	12/8/2015	Kyle Emery
SPDES Discharge Permit, Oakwood Beach WPCP and other Outfalls	9/30/1988		New York City	12/18/2015	Note outfalls re 001A, Plant Bypass, 002, Cindra Avenue - Great Kills.	Oakwood WPCP	<a href="#">NYCGKRI00002032.pdf</a>	12/22/2015	John Wyckoff
Site Plan - Wetlands, Staten Island Unit, Great Kills Park	9/1/1989	U.S. National Park Service	NPS ETIC	12/8/2015	Site Plan showing Wetlands as they were mapped in at the time of plan creation. Wetlands are mapped and a legend differentiates between wetland types.	Past Site Ops/Waste Disposal; Wetlands	<a href="#">GATE 646 40259 B 0001 of 0000.pdf</a>	12/8/2015	Kyle Emery
New York City Department of Environmental Protection Sludge Dewatering Facility Oakwood Beach WPCP	12/14/1989	Stone & Webster Engineering Corporation	New York City	12/18/2015	Borings beneath new dewatering building shows fill but not black fill (ash) etc.	Oakwood WPCP	<a href="#">NYCGKRI00002062.pdf</a>	12/22/2015	John Wyckoff
Report on Soils and Foundation Investigation For New York City, Department of Environmental Protection Dewatering Facilities, Oakwood Beach	12/14/1989	Stone & Webster Engineering Corporation	New York City	12/18/2015	Borings for facilities (1952) not available. 12 borings drilled to 77 to 102 feet bgs. Fill brown to red brown fine to coarse sand and sandy gravelly silt with trace of slag, cinder, asphalt, wood, brick, and glass... 15 to 18 ft thick.	Nature and Extent; Oakwood WPCP	<a href="#">NYCGKRI00002086.pdf</a>	1/14/2016	Kyle Emery
Amendment to the General Management Plan, Great Kills Park, Staten Island Unit, Gateway National Recreation Area	10/1/1990	U.S. National Park Service	Administrative Record	12/2/2015	Provides a description of park conditions and visitor use as well as the Park's natural resources including uplands, wetlands, shoreline, water quality, vegetation and wildlife.	Natural resource and park conditions	<a href="#">AR0000122 amendment GM P GK .pdf</a>	1/14/2016	Kyle Emery
Report - Amendment to the General Management Plan	10/1/1990	U.S. National Park Service	NPS ETIC	12/9/2015	Amendment to the 1979 GMP. Concerns the preservation of natural resources. Wetlands information included.	Past Site Ops/Waste Disposal	<a href="#">GATE D122.pdf</a>	12/9/2015	Kyle Emery

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Report - Subsurface Geotechnical Investigation, Great Kills Park, Staten Island, New York	5/22/1991	Lane, Frenchman and Associates	NPS ETIC	12/9/2015	Boring map and boring logs included.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">GATE_646_D242_0001pg.pdf</a>	12/9/2015	Kyle Emery
Site Plan - Proposed Plan, Staten Island Unit, Great Kills park, Gateway National Recreation Area, New York	9/1/1992	U.S. National Park Service	NPS ETIC	12/9/2015	A proposed site plan for Great Kills Park.		<a href="#">40290E.pdf</a>	12/9/2015	Kyle Emery
Site Plan - Topographic Map of Great Kills Park	9/30/1992	U.S. National Park Service	NPS ETIC	12/9/2015	Topographic maps of Great Kills Park.	Past Site Ops/Waste Disposal	<a href="#">41105A.pdf</a>	12/18/2015	John Wyckoff
Report - Environmental Permitting/Compliance Review, Great Kills Park, Staten Island, New York	10/1/1992	Cortell Associates	NPS ETIC	12/9/2015	Discusses permit needs for GKP to perform upgrades to the park. Conditions at the park are not discussed.	Past Site Ops/Waste Disposal	<a href="#">646_D149.pdf</a>	12/9/2015	Kyle Emery
Report - Environmental Assessment of Development, Great Kills Park, Gateway National Recreation Area, New York	11/1/1992	U.S. National Park Service	NPS ETIC	12/9/2015	Created under the General Management Plan (1979) for Gateway National Recreation Area. "Designed to provide for ... preservation and development ... significant natural and cultural features were adequately protected." Park history, including the sanitary landfill, is discussed.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">646_D144.pdf</a>	12/9/2015	Kyle Emery
Report - Hazardous Materials Sampling, Analysis, and Investigation, South Beach Center, Great Kills Park	2/5/1993	ERM Inc.	NPS ETIC	12/9/2015	Report for Asbestos and Lead based paint sampling.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_D223_0001pg.pdf</a>	5/16/2016	John Wyckoff
Site Plan - Great Kills Visitor Center	4/5/1993	French & Parrello Associates, P.A.	NPS ETIC	12/8/2015	Schematic Design showing the Great Kills Visitor Center as well as a Preliminary Pavement Section. Schematic Design shows both proposed and previously current features.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_41248.pdf</a>	1/14/2016	Kyle Emery

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Report - Preliminary Subsurface Exploration and Geotechnical Engineering Evaluation, Phase I Design, Great Kills Visitor Center, Staten Island, New York	4/12/1993	French & Parrello Associates, P.A.	NPS ETIC	12/9/2015	Report is Geotechnical. A map of test boring locations is provided in addition to descriptions of the borings. Environmental concerns are presented however they are not discussed.	Past Site Ops/Waste Disposal	<a href="#">646_D255.pdf</a>	1/14/2016	Kyle Emery
Report - Findings, Environmental Sensitive Materials, Bathhouse Demolition, Great Kills Park	6/1/1993	Langan Engineering and Environmental Services	NPS ETIC	12/9/2015	Soils are not discussed. Report discusses materials which were connected to the former bathhouse.	Past Site Ops/Waste Disposal	<a href="#">646_D257.pdf</a>	12/9/2015	Kyle Emery
Report of Findings of Environmental Sensitive Materials Bath House Demolition	6/1/1993	Langan Engineering and Environmental Services, Inc.	National Park Service	5/15/2016	Shows storm sewer and drains in bath house. Containers of fuel oil and other substances.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_D155_[id72191].pdf</a>	7/25/2016	John Wyckoff
Letter - Finding of No Significant Impact, Environmental Assessment for Development, Great Kills Park, Gateway National Recreation Area, New York	7/27/1993	U.S. National Park Service	NPS ETIC	12/9/2015	Discusses plan for the protection of natural resources of Great Kills Park. Includes a map of the wetlands within the park.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">646_D144A.pdf</a>	1/14/2016	Kyle Emery
Memo re Finding of No Significant Impact, Environmental Assessment for Development, Great Kills Park, Gateway National Recreation Area, New York	7/27/1993	U.S. National Park Service	Administrative Record	12/2/2015	FONSI and supporting documents: November 1992, Environmental Assessment for Development (EA). EA is based on 1979 General Management Plan (GMP); December 1989 Draft Amendment and Impact Analysis; and October 1990 Final Amendment.	Natural resource and park conditions	<a href="#">AR0000157_EA_developGreatKillsPark.pdf</a>	1/14/2016	Kyle Emery
Report on Lead Based Paint and Building Demolition	8/2/1993	Langan Engineering and Environmental Services, Inc.	National Park Service	5/15/2016	Provides information re management of lead based paint.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_D157_[id73047].pdf</a>	5/15/2016	John Wyckoff
Analytical Laboratory Report	8/31/1993	Analab Inc	National Park Service	5/15/2016		Past Site Ops/Waste Disposal	<a href="#">GATE_646_D179_[id75665].pdf</a>	5/15/2016	John Wyckoff

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Report - Subsurface Exploration and Geotechnical Engineering Evaluation Phase II Design Great Kills Visitor Center, Staten Island, New York	12/2/1993	French & Parrello Associates, P.A.	NPS ETIC	12/9/2015	Geotechnical report for the Great Kills Visitor Center. Boring Map and logs included.	Past Site Ops/Waste Disposal	<a href="#">646_D422.pdf</a>	12/9/2015	Kyle Emery
Report - Subsurface Exploration and Geotechnical Engineering Evaluation Phase II Design, Great Kills Visitor Center	12/2/1993	French & Parrello Associates, P.A.	NPS ETIC	12/9/2015	Includes boring logs and boring map.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">GATE_646_D243_0001pg.pdf</a>	12/9/2015	Kyle Emery
Lead Identification Survey Report	3/31/1994	Langan Engineering and Environmental Services, Inc.	National Park Service	5/15/2016	Lead based paint survey.		<a href="#">GATE_646_D179_[id75664].pdf</a>	5/15/2016	John Wyckoff
Report - Gateway National Recreation Area, Staten Island, Soils report	6/20/1994	U.S. National Park Service	NPS ETIC	12/9/2015	Includes boring map and soil boring data.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">GATE_646_D211_0001pg.pdf</a>	12/9/2015	Kyle Emery
Development Plan for Sewer Connection Permit	11/22/1994	U.S. National Park Service	National Park Service	5/15/2016	Shows proposed new site structures, police and maintenance buildings, environmental and educational center, and new parking areas at marina and beach center.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_41191_[id78598].pdf</a>	5/15/2016	John Wyckoff
Oakwood Beach Water Pollution Control Plant, Sampling and Analysis for Permit Compliance and Process Control at the New York Water Pollution Control Plants	1/1/1995	The City College of New York, Department of Civil Engineering	New York City	12/18/2015	Cover page and table of contents.	Oakwood WPCP	<a href="#">NYCGKRI00002549.pdf</a>	12/23/2015	John Wyckoff
Oakwood Beach Water Pollution Control Plant, Sampling and Analysis for Permit Compliance and Process Control at the New York Water Pollution Control Plants	1/1/1995	The City College of New York, Department of Civil Engineering	New York City	12/18/2015	Provides a summary of the WPCP history and processes.	Oakwood WPCP	<a href="#">NYCGKRI00002552.pdf</a>	12/23/2015	John Wyckoff
Recycled Base Evaluation, Great Kills Park Site Development/Demolition Report	2/1/1997	Federal Highway Administration	National Park Service	5/15/2016	Reviews NPS use of recycled demolition debris.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">GATE_646_D259_[id87433].pdf</a>	5/15/2016	John Wyckoff

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Site Plan - Great Kills Park, Sea Wall Survey, Staten Island, New York	4/1/1997	U.S. National Park Service	NPS ETIC	12/8/2015	Set of As-Constructed plans with Great Kills Harbor Sea Wall surveying data. Includes Sea Wall profile by Station.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_41250[163253].pdf</a>	12/8/2015	Kyle Emery
Property Card - GKP Parcel History	7/2/1997		New York City	12/18/2015	Includes history of parcel acquisition from purchase, condemnation, and grants. Notes March 1, 1974 largest portion of GKP (1989 ac) transferred to Gateway National Recreation Area with two additional acquisition in 1997.	Property Acquisition	<a href="#">NYCGKRI00000227.pdf</a>	1/14/2016	Kyle Emery
Site Plan - Great Kills Park, Swales	9/12/1997	French & Parrello Associates, P.A.	NPS ETIC	12/8/2015	Shows locations of borings and test pits along Great Kills Harbor near the Uplands to Crooke's Neck transition. Boring diagrams not included. Geological Cross Section included.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_41261.pdf</a>	2/1/2016	John Wyckoff
Great Kills Park R-16	12/31/1997		New York City	12/18/2015	Shows property boundary with acreage added versus demapped.	Property Acquisition	<a href="#">NYCGKRI00000229.pdf</a>	12/21/2015	John Wyckoff
Property Card - GKP Parcel History	12/31/1997		New York City	12/18/2015	Mentions sewer easement from Cedar Grove Avenue to the US Bulkhead line at foot of Ebbitts Street dated Oct 21, 1975.	Property Acquisition	<a href="#">NYCGKRI00000230.pdf</a>	7/25/2016	John Wyckoff
Report - Subsurface exploration and Geotechnical Engineering Evaluation, Great Kills Field Station, National Park Services, Staten Island, New York	6/22/1998	French & Parrello Associates, P.A.	NPS ETIC	12/9/2015	Geotechnical Report for the Education Field Station located in GKP. Boring map and descriptions are included.	Past Site Ops/Waste Disposal	<a href="#">646_D358.pdf</a>	12/9/2015	Kyle Emery
Site Plan - As-Constructed, Site Development and Demolition, Great Kills, Gateway National Recreation Area	1/1/1999	U.S. National Park Service	NPS ETIC	12/8/2015	Set of As-Built for construction which occurred prior to date of document? Document concerns areas near the uplands to Crooke's Neck transition. Plans originally issued on 11/01/1995. 54 pages.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_41186B[163262].pdf</a>	7/25/2016	John Wyckoff

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Site Plan - Gateway National Recreation Area, Great Kills Park, Staten Island Unit, Topographic Survey	7/22/1999	U.S. National Park Service	NPS ETIC	12/9/2015	Maps included give the station markers. Locations the maps depict is unclear.		<a href="#">41256.pdf</a>	12/9/2015	Kyle Emery
The Citywide Sludge Dewatering Facilities, Improvement Contract, (SM-80) Facility Inspection Report - Oakwood Beach WPC, Final	11/1/1999		New York City	12/18/2015	Cover page.	Oakwood WPCP	<a href="#">NYCGKRI00000423.pdf</a>	1/14/2016	Kyle Emery
Development and implementation of a flexible system for monitoring a created wetland (Great Kills Park, Staten Island, New York)	5/1/2002	Columbia University	U.S. National Park Service	12/11/2015	Provides information for constructed wetland on GKP.	Wetlands	<a href="#">ayers_thesis.pdf</a>	12/18/2015	John Wyckoff
City of New York - Department of Environmental Protection, Staten Island Wastewater Facilities Improvement Project, SI-FP-01, Subtask 3.6 - Records Management Report, Oakwood Beach Water Pollution Control Plant	8/1/2003		New York City	12/18/2015	Geo-tech and soil data (1937, 1971, 1989), Facility Plan (1969), Structures and Drains (1954) Project Plans (1952) 6 Disks.	Oakwood WPCP	<a href="#">NYCGKRI00000420.pdf</a>	7/25/2016	John Wyckoff
Ltr from R. Kelly, NYPD to G. Norton, DOI re NYPD concerns about radium-contaminated area and NPS long-term mitigation plan	3/29/2006	New York City Police Department	Administrative Record	12/2/2015	Presents history of radium discovery in 2005, and NPS May 2, 2006 ltr response from M. Bomar, NPS to R. Kelly. Refers to USEPA Region 02 Assessment - Great Kills Park Radiation Response Investigation.	2005 radium detection and 2006 response	<a href="#">AR0000223_224_LETTERS_NPS_NYPD.pdf</a>	1/14/2016	Kyle Emery
Combating Nuclear Terrorism, Federal Efforts to Respond to Nuclear and Radiological Threats and to Protect Emergency Response Capabilities Could be Strengthened	9/1/2006	U.S. Government Accountability Office	Administrative Record	12/2/2015	Provides disclosure of NYPD request for survey of New York City and identification of radium contamination.	2005 radium detection and 2006 response	<a href="#">AR0000228_GAOReport.pdf</a>	12/2/2015	John Wyckoff
News Reports from 09/26/2006 through 03/26/2007	9/26/2006	Various	Administrative Record	12/2/2015	News articles re initial 2005 discovery of radium detected at GKP and second discovery on or about March 6, 2007 on a parcel burned by wildfire.	2005 and 2007 radium detections	<a href="#">AR0000267_291_news_press_releases.pdf</a>	12/2/2015	John Wyckoff

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News Reports from 03/27/2007 through 04/13/2007	3/27/2007	Various	Administrative Record	12/2/2015	News articles regarding detection of radium and discovery of third radiation site (3/22/2007). Level of radiation is higher than two previous readings. Includes NPS press release.	2007 radium detection	<a href="#">AR0000292_299_news_press_releases.pdf</a>	1/14/2016	Kyle Emery
Limited Gamma Radiological Survey of Great Kills Park Public Access Areas	4/9/2007	New York City Department of Health and Mental Hygiene	Administrative Record	12/2/2015	DOHMH report on limited gamma radiological survey of public access areas including ball fields, Buffalo Street, hiking trail, picnic area, model flying club, fishing area, and road and parking areas.	2007 radium detection	<a href="#">AR0000300_NYCDOHMH_report.pdf</a>	1/14/2016	Kyle Emery
Ltr from D. Avrin, NPS to T. Paura, NYSDEC re NYSDEC review and comments of PA prepared by Michael Baker Jr., Inc.	7/8/2007	U.S. National Park Service	Administrative Record	12/2/2015	Also includes attached NPS letters to E. Daly, USEPA, and DOHMH requesting review and comment before June 22, 2007. Per recommendation of PA, NPS undertake TCRA to address site risks.	Response action	<a href="#">AR0000503_06082007_PA_agencyreview_letters.pdf</a>	12/2/2015	John Wyckoff
Final Preliminary Assessment Report for Potential Radiological Contamination at Great Kills Park, ECL Site No. 1589, Gateway National Recreation Area, Staten Island, New York	8/1/2007	Michael Baker Jr., Inc.	Administrative Record	12/2/2015	Includes information re radium background information, potential risks to exposure to Ra-226 in soil, cursory risk evaluation (ATSDR, 2007), conclusions and recommendations (remove Ra-226 soil and NPS screening protocol).	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">AR0000305_PA_Report.pdf</a>	12/2/2015	John Wyckoff
Ltr from J. O'Neil, Chase Environmental Group, Inc. to W. Fillingame, Cabrera Services re Radium Source Removal	1/9/2008	Chase Environmental Group, Inc.	Administrative Record	12/2/2015	Quote to remove, encapsulate and dispose of radium sealed sources.	Response action	<a href="#">AR0000543_ChaseEnvironmentalGroupRadiumSourceRemoval.pdf</a>	12/16/2015	John Wyckoff
Potential and Limitations of Herpetofaunal Restoration in an Urban Landscape	12/31/2008	U.S. National Archives (Beltsville, MD and Washington, DC)	NPS, Natural Resources Division	2/19/2016	List of species of reptiles and amphibians identified at Great Kills Park.	Natural Resources	<a href="#">Cook 2008 Chapter 32 Urban Herpetology.pdf</a>	2/19/2016	John Wyckoff

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Gateway News Release, Gateway Removing Radioactive Material Great Kills Park	1/8/2009	U.S. National Park Service	Administrative Record	12/2/2015	NPS announcement that NPS initiated removal of soil containing trace amounts of radioactive material from GKP. Project being done in conjunction with USACE, NYSDEC and USEPA.	Response action	<a href="#">AR0000382_news_pressreleases.pdf</a>	1/14/2016	Kyle Emery
Fact Sheet, Great Kills Park, Staten Island, New York	2/26/2009	U.S. National Park Service	Administrative Record	12/2/2015	Provides information on the discovery, investigation and removal of radioactive material from GKP.	Past Site Ops/Waste Disposal; Nature and Extent; Response action	<a href="#">AR0000383_factsheet.pdf</a>	12/2/2015	John Wyckoff
Ltr from B. Sullivan, NPS to E. Daly, USEPA Region II re Formally requests agency assistance	2/27/2009	U.S. National Park Service	Administrative Record	12/2/2015	Request USEPA assistance in characterizing the full nature and extent of potential radiological contamination over 35 acres of visitor use areas and to develop strategies for remediation.	Response action	<a href="#">AR0000506_Letter_GK_EPA_E_D_requestassistance.pdf</a>	12/2/2015	John Wyckoff
Ltr from B. Sullivan, NPS to E. Mosher USEPA Region II re Formally requests agency assistance	2/27/2009	U.S. National Park Service	Administrative Record	12/2/2015		Response action	<a href="#">AR0000508_Letter_GK_EPA_E_M_requestassistance.pdf</a>	12/2/2015	John Wyckoff
Gateway News Release, National Park Service Closes Great Kills Park Ball Fields	3/3/2009	U.S. National Park Service	Administrative Record	12/2/2015	Contractor under direction of USACE discovered additional areas of contamination buried under at least 12-inches below surface.	Past Site Ops/Waste Disposal; Nature and Extent; Response action	<a href="#">AR0000385_news_pressreleases.pdf</a>	1/14/2016	Kyle Emery
Ltr from B. Sullivan, NPS to J. DeFranco, DOHMH re Formally requests agency assistance	3/4/2009	U.S. National Park Service	Administrative Record	12/2/2015	NPS normally requests DOHMH assistance in characterizing the full nature and extent of potential radiological contamination over 35 acres of visitor use areas and to develop strategies for remediation.	Response action	<a href="#">AR0000510_Letter_GK_DOH_MH_JD_requestassistance.pdf</a>	12/18/2015	John Wyckoff
Ltr from B. Sullivan, NPS to J. Prud'Homme DOHMH re Formally requests agency assistance	3/4/2009	U.S. National Park Service	Administrative Record	12/2/2015	NPS formally requests DOHMH assistance in characterizing the full nature and extent of potential radiological contamination over 35 acres of visitor use areas and to develop strategies for remediation.	Response action	<a href="#">AR0000512_Letter_GK_DOH_MH_JPH_requestassistance.pdf</a>	12/2/2015	John Wyckoff

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Fact Sheet, Great Kills Park, Information on Radiation	7/1/2009	U.S. National Park Service	Administrative Record	12/2/2015	"Radium came from discarded medical treatment sources that were included in the sanitary fill material brought to site in 1940s."	Past Site Ops/Waste Disposal; Nature and Extent; Response action	<a href="#">AR0000396_factsheet.pdf</a>	12/16/2015	John Wyckoff
Memo re Meeting Minutes, Great Kills Park - Environmental contamination and its impact on emergency operations	7/30/2009	U.S. National Park Service	Administrative Record	12/2/2015	Provides planning information for emergencies - specifically wildfires to reduce exposure to contamination. Note GATE Fire Management Plan needs a FONSI to be completed by GATE Div. Nat Resources.	Response action	<a href="#">AR0000514_GK_Wildfirecommunity_minutes07302009.pdf</a>	1/14/2016	Kyle Emery
Ltr from J. Parker, NPS to J. Rooney re NPS response to visitor inquiry	9/23/2009	U.S. National Park Service	Administrative Record	12/2/2015	As part of the investigation process NPS will develop a Community Relations Plan... and an information repository will be established...and plan for remediation will be made available for public...	Response action	<a href="#">AR0000398_visitorletter.pdf</a>	1/14/2016	Kyle Emery
Staten Island Advance, Funds in hand for cleanup of radium at Great Kills Park	10/9/2009	Staten Island Advance	Administrative Record	12/2/2015	News article re NPS will receive \$500K from DOI to conduct secondary survey and develop a remediation plan, if need be.	Response action	<a href="#">AR0000399_401_factsheet_news.pdf</a>	1/14/2016	Kyle Emery
Great Kills Park, Borough of Staten Island - Community District 2 and 3 - R16 315.094 acres	12/8/2009		New York City	12/18/2015	New York City parkland.		<a href="#">NYCGKRI00000419.pdf</a>	12/22/2015	John Wyckoff
Fact Sheet, Great Kills Park Information on Radiation	2/12/2010	U.S. National Park Service	Administrative Record	12/2/2015	Investigation into the source of the radium contamination is ongoing. Sources of radium removed...affected areas still closed...Park has begun CERCLA process to develop EE/CA to determine nature... and choose preferred course of action to clean up site...	Response action	<a href="#">AR0000402_406_factsheets.pdf</a>	1/14/2016	Kyle Emery
Fact Sheet, Information on Radium Contamination	3/20/2010	U.S. National Park Service	Administrative Record	12/2/2015	Attached map includes area closed to visitor activities.	Past Site Ops/Waste Disposal; Nature and Extent; Response action	<a href="#">AR0000516_GATE_GK_RAD_Fact Sheet_032010_final.pdf</a>	12/2/2015	John Wyckoff

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Staten Island Advance, Half of Great Kills Park closed until further notice. Second Study of possible radium contamination will be conducted; contractor won't be in place until June, July	3/25/2010	Staten Island Advance	Administrative Record	12/2/2015		Response action	<a href="#">AR0000407_news.pdf</a>	12/2/2015	John Wyckoff
Staten Island Advance, Get the lead out - and the radium - feds urged, McMahon, recreation advocates seek to expedite cleanup of Great Kills Park	7/20/2010	Staten Island Advance	Administrative Record	12/2/2015		Response action	<a href="#">AR0000408_news_pressreleases.pdf</a>	7/25/2016	John Wyckoff
Memo from K. Cuzzolino NPS to D. Riedenback re EE/CA Approval Memorandum, Great Kills Landfill Site, Gateway National Recreation Area	10/14/2010	U.S. National Park Service	Administrative Record	12/2/2015	Summarizes NPS's response actions. Presence of radium-226 in surface and subsurface soils and groundwater poses threat to human health, flora and fauna by dermal contact, inhalation and/or ingestion. Presents criteria to support removal action at Site.	Past Site Ops/Waste Disposal; Nature and Extent; Response action	<a href="#">AR0000410_EECAapprovalmemo.pdf</a>	12/2/2015	John Wyckoff
Interim Response Action Report, Radiological Material Removal and Disposal, Great Kills Park, Staten Island, New York City, New York	11/1/2010	Cabrera Services, Inc.	U.S. National Park Service	8/28/2015		Past Site Ops/Waste Disposal; Nature and Extent; Containment; Response action	<a href="#">2010-11-01_Cabrera_Services_-_Interim_Response_Action_Report.pdf</a>	12/29/2015	John Wyckoff
Interim Response Action Report, Radiological Material Removal and Disposal, Great Kills Park, Staten Island, New York City, New York	11/1/2010	Cabrera Services, Inc.	Administrative Record	12/2/2015		Past Site Ops/Waste Disposal; Nature and Extent; Containment; Response action	<a href="#">AR0000415_interimreport.pdf</a>	12/2/2015	John Wyckoff
blog.silive.com, Another season lost at Gateway	12/20/2010	blog.silive.com	Administrative Record	12/2/2015			<a href="#">AR0000498_news.pdf</a>	12/2/2015	John Wyckoff
Staten Island Advance, Advance Editorial, Why so long, NPS, Our Opinion	12/27/2010	Staten Island Advance	Administrative Record	12/2/2015			<a href="#">AR0000500_news_pressreleases.pdf</a>	12/2/2015	John Wyckoff
Staten Island Advance, Your Opinion, Great Kills Cleanup Stalled by Bureaucracy, Not \$\$	1/10/2011	Staten Island Advance	Administrative Record	12/2/2015			<a href="#">AR0000502_news_.pdf</a>	12/2/2015	John Wyckoff

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Public Notice of Availability, NPS Announces the Availability of the Administrative Record File for the Great Kills Landfill Site, Gateway National Recreation Area, New York	4/21/2011	U.S. National Park Service		12/2/2015	Public notice in Staten Island Advance re Administrative Record.	Response action	<a href="#">AR0000519_AR PUBLIC NOTICE OF AVAILABILITY_Great Kills_042011.pdf</a>	1/14/2016	Kyle Emery
Ltr from L. Canzanelli, NPS to Interested Party re Public Notice of Administrative Record for Great Kills Landfill Site	4/21/2011	U.S. National Park Service	Administrative Record	12/2/2015	Recipients include Federal, State and Local Interested Parties. NPS utilizing CERCLA authorities to ensure all risks posed by the Site are appropriately addressed and that those parties responsible for Site conditions meet their legal obligations.	Response action	<a href="#">AR0000521_Interested Party Letter_Great Kills_04_2011.pdf</a>	12/2/2015	John Wyckoff
Index for Administrative Record, Great Kills Landfill	4/30/2011	U.S. National Park Service	Administrative Record	12/2/2015			<a href="#">GATE_GREATKILLS_ARINDEX_2011-04-30.pdf</a>	12/2/2015	John Wyckoff
Gateway News Release, Contract Awarded for First Phase of a Multi-Year Effort to Remediate Contamination at Great Kills Park, Staten Island	5/10/2011	U.S. National Park Service	Administrative Record	12/2/2015	Cabrera Services awarded contract by NPS through an Inter-Agency Agreement with USACE to investigate contamination. Cabrera was selected to develop an EE/CA Work Plan. Other plans to be developed include H&SP and Community Involvement Plan.	Response action	<a href="#">AR0000524_GKP radiation contract PR - final_052011.pdf</a>	7/25/2016	John Wyckoff
Public Notice - Great Kills Park Cleanup Begins with Community Involvement	7/1/2011	U.S. National Park Service	Administrative Record	12/2/2015		Response action	<a href="#">AR0000526_07_2011_public notice_CIP_SIAAdvance_final.pdf</a>	12/29/2015	John Wyckoff
Newsletter, Great Kills Park Cleanup	10/1/2011	U.S. National Park Service	Administrative Record	12/2/2015	Provides status of cleanup, NPS' "path" per Superfund's Step by Step Process and announces 10/27/2011 information Session for the Public.	Response action	<a href="#">AR0000527_102011_GreatKills Newsletter.pdf</a>	12/2/2015	John Wyckoff
Public Notice - Hear about Gateway's Continuing Efforts to Clean Up Contamination at Great Kills Park	10/12/2011	U.S. National Park Service	Administrative Record	12/2/2015		Response action	<a href="#">AR0000531_public notice_Mtg_SIAAdvance_final_20111012.pdf</a>	12/16/2015	John Wyckoff

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Document Title	Date of Document	Author's Organization	Document Source/Custodian	Date Doc Procured	Comments re Content	Categories of Information	File Name	Date Added to SharePoint	Researcher
Presentation, Status of Cleanup, Great Kills Park	10/26/2011	U.S. National Park Service	Administrative Record	12/2/2015	Includes historic maps and aerial photography (with landfill delineation and other features noted).	Past Site Ops/Waste Disposal; Nature and Extent; Response action	<a href="#">AR0000532_nps-GKP-EECA presentation_20111026.pdf</a>	12/2/2015	John Wyckoff
Sign In Sheet for October 27, 2011 Information Session re Great Kills Park Environmental Cleanup Project	10/27/2011	U.S. National Park Service	Administrative Record	12/2/2015			<a href="#">AR0000562_10272011_public mtg_signinsheets_redacted.pdf</a>	12/2/2015	John Wyckoff
Final Community Involvement Plan, Great Kills Park, Staten Island, New York	11/1/2011	Cabrera Services, Inc.	Administrative Record	12/2/2015	Summarizes community involvement activities.	Response action	<a href="#">AR0000572_112011Great_Kills_CIP_Final.pdf</a>	1/14/2016	Kyle Emery
Fact Sheet, Great Kills Park Information on Radiation	2/15/2012	U.S. National Park Service	Administrative Record	12/2/2015	Radium sources have been removed and additional areas have been identified in footprint of historic landfill. Plans for 2012 include conducting an investigation to identify all locations with elevated radiation readings.	Response action	<a href="#">AR0000607_GATE GK RAD Fact Sheet_02152012_final.pdf</a>	12/2/2015	John Wyckoff
Fact Sheet, Great Kills Park, Information on Radiation	3/22/2012	U.S. National Park Service	Administrative Record	12/2/2015	Plans for 2012 includes conducting a gamma survey to identify radiological contamination and removal action.	Response action	<a href="#">AR0000609_GATE GK RAD Fact Sheet_03222012_final.pdf</a>	12/18/2015	John Wyckoff
Technical Memorandum, Limited Gamma Radiation Walk-Over Surveys of Portions of the Multi-use Path, Great Kills Park Landfill Site, Staten Island, New York	6/7/2012	U.S. Army Corps of Engineers, Baltimore District	Administrative Record	12/2/2015	"...near surface soils in .... area of the multi-use trial (sic) are consistent with background gamma radiation, does not pose a significant human health risk under current use situations, and does not require closure to current park visitors."	Past Site Ops/Waste Disposal; Nature and Extent; Response action	<a href="#">AR0000612_Greak Kills Park Tech Memo - gamma walkover USACE Rev1.pdf</a>	7/25/2016	John Wyckoff
Agreement to Access Park Property	6/15/2012	New York City Parks and Recreation	Administrative Record	12/3/2015	Effective date of access agreement is 6/15/2012 until 6/30,2013 and may be renewed from 7/1/2013 through 12/1/2014. States access and use requirements on 20-acre city parcel.	Response action	<a href="#">AR0001443_Access agreement btwn NPS and NYC Parks GATE 1770-12-1015 Law 2012-032703 .pdf</a>	12/3/2015	John Wyckoff

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Action Memorandum from K. Cuzzolino, NPS to D. Reidenbach, NPS re CERCLA Time-Critical Removal Action at Great Kills Park, Gateway National Recreation Area, Staten Island, NY	6/22/2012	U.S. National Park Service	Administrative Record	12/2/2015	Provides justification (per 40CFR300.415(b)(1) and (2)(i -iii)) for TCRA involving radiological survey and removal of materials exhibiting radioactivity above background levels; and information on notice to NRC and NYS and ARARs for the TCRA.	Response action	<a href="#">AR0000905 Approvalmemo s igned.pdf</a>	12/16/2015	John Wyckoff
Ltr from D. Reidenbach, NPS to M. Grimm, US House of Reps re NPS response to 5/21/2012 Ltr	7/2/2012	U.S. National Park Service	Administrative Record	12/2/2015	TCRA enables NPS to identify additional radioactive sources and conduct removal of sources and associated contaminated soils. Marina, beach front, the multi-use path, the Education Field Station and Crooke's Point remain open to visitors.	Past Site Ops/Waste Disposal; Response action	<a href="#">AR0000914_070212_FY12-POPS-10584-GATE-complaints at Great Kills Park response.pdf</a>	12/2/2015	John Wyckoff
Technical Memorandum, Limited Gamma Walkover Survey and Dose Rate Survey of Bulkhead Road Area, Great Kills Park Site, Staten Island, New York	8/1/2012	U.S. Army Corps of Engineers, Baltimore District	Administrative Record	12/2/2015	Provides an overview of the history of radiological surveys - investigations. Conducted clearance and confirmatory gamma walkover surveys of certain locations and dose rate surveys.	Past Site Ops/Waste Disposal; Nature and Extent; Response action	<a href="#">AR0000916_Greak Kills Park Tech Memo with Appendix A Photos Rev. 20130201 (1).pdf</a>	7/25/2016	John Wyckoff
Fact Sheet, Information on Radium Contamination	1/1/2013	U.S. National Park Service	Administrative Record	12/3/2015	On 1/14/13 TCRA work began to identify/clean up radiological contamination... conducting a gamma survey of approx 220 acres filled with sanitary waste - locate and remove radioactive contaminants that present an imminent and substantial danger.	Response action	<a href="#">AR0001457_GATE GK RAD Fact Sheet_01282013_final.pdf</a>	12/3/2015	John Wyckoff
Final Site-Specific Health and Safety Plan, Time Critical Removal Action, Great Kills Park	1/1/2013	Tidewater, Inc.	Administrative Record	12/3/2015	Contaminants of potential concern include methane and Ra-226, natural Uranium, U-234, U-235, U -238 and progeny.	Response action	<a href="#">AR0001459_Great_Kills_Final_SSHP_20130107.pdf</a>	12/18/2015	John Wyckoff

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Final Time Critical Removal Action Accident Prevent Plan (APP), Great Kills Park, Staten Island, New York	1/1/2013	Tidewater, Inc.	Administrative Record	12/3/2015		Response action	<a href="#">AR0001547_Great_Kills_Final_APP_20130107.pdf</a>	12/3/2015	John Wyckoff
Final Time Critical Removal Action Radiation Protection Plan, Great Kills Park, Staten Island, New York	1/1/2013	Cabrera Services, Inc.	Administrative Record	12/3/2015	Includes info re Site Exposure Limits and ALARA Exposure Goals and identifies radiation work permits.	Response action	<a href="#">AR0001610_Great_Kills_Final_RPP_20130125a.pdf</a>	12/3/2015	John Wyckoff
Final Time Critical Removal Action Work Plan, Great Kills Park, Staten Island, New York	1/1/2013	Tidewater, Inc.	Administrative Record	12/3/2015	Includes section on data quality objectives (DQOs - defines study boundary) and ARARs for TCRA.	Response action	<a href="#">AR0001702_Great_Kills_TCRA_WP_Final_20130128_cw.pdf</a>	12/3/2015	John Wyckoff
Gateway News Release, Contract Awarded for Investigation and Clean Up of Contamination at Great Kills Park, Staten Island	1/10/2013	U.S. National Park Service	Administrative Record	12/3/2015			<a href="#">AR0001455_PR_GKP_TCRA_Jan2013.pdf</a>	12/18/2015	John Wyckoff
Ltr from J. Malleck USEPA Fed Facilities to K. Cuzzolino, NPS re Docket Update 25 Addition, Great Kills Landfill	2/25/2013	U.S. Environmental Protection Agency Region 2	Administrative Record	12/3/2015	GK Landfill added Fed Ag Haz Waste Compliance Docket on 11/6/12 FR. Site eligible for CERCLA Docket per Sec 103(c). EPA request compilation of PA/SI info re hazardous waste (not just rad) and affected pathways and targets. Request due 5/6/2014.	Response action	<a href="#">2013-02-25_EPA_Letter_to_NPS.pdf</a>	12/3/2015	John Wyckoff
Fact Sheet, Great Kills Park Update on Environmental Clean Up	3/1/2013	U.S. National Park Service	Administrative Record	12/3/2015	Notice to park users re radioactive materials.		<a href="#">2013-03-21_GKP_RAD_Fact_Sheet.pdf</a>	12/3/2015	John Wyckoff
Index for Administrative Record, Great Kills Landfill Update No. 1	3/1/2013	U.S. National Park Service	Administrative Record	12/2/2015			<a href="#">Admin_Record_Update_Index.pdf</a>	12/2/2015	John Wyckoff
Ltr from K. Cuzzolino, NPS to H. Shannon USEPA Reg II re NPS response to USEPA 2/25/2013 ltr	4/18/2013	U.S. National Park Service	Administrative Record	12/3/2015	NPS confirmed received EPA's letter to NPS Env. Compliance and Response Branch and USDOJ Office of Solicitor. NPS will respond in greater detail.	Response action	<a href="#">2013-04-18_Response_letter_to_EPA_re_docket_listing.pdf</a>	1/14/2016	Kyle Emery

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Fact Sheet, Information on Radium Contamination	5/1/2013	U.S. National Park Service	Administrative Record	12/3/2015	Radium came from discarded materials. On Monday, January 14, 2013, field work began to identify and clean up the radiological contamination... This project will include conducting a gamma survey of approximately 220 acres.	Response action	<a href="#">2013-05-17. GK RAD Fact Sheet final.pdf</a>	12/18/2015	John Wyckoff
Fact Sheet, Information on Radium Contamination	8/1/2013	U.S. National Park Service	Administrative Record	12/3/2015	Due to impacts from Hurricane Sandy completion of the vegetation clearing has been delayed. Contractors will be back on site in September to finish the clearing and surveying.	Response action	<a href="#">2013-08-19. GK RAD Fact Sheet final.pdf</a>	12/3/2015	John Wyckoff
blog.silive.com, Radiation at Staten Island's Great Kills Park more widespread than initially thought	9/23/2013	blog.silive.com	Administrative Record	12/3/2015			<a href="#">2013-09-23. Staten Island Live.pdf</a>	12/18/2015	John Wyckoff
blog.silive.com, Wider and faster cleanup is needed at Staten Island's poisoned park	9/25/2013	blog.silive.com	Administrative Record	12/3/2015			<a href="#">2013-09-25. Staten Island Live editorial.pdf</a>	12/18/2015	John Wyckoff
Fact Sheet, Information on Radium Contamination	11/1/2013	U.S. National Park Service	Administrative Record	12/3/2015	Due to Hurricane Sandy vegetation clearing delayed. Expect to complete field work this winter. Action only address hotspots that pose greatest risk. Next phase will be a Remedial Investigation Feasibility Study.	Response action	<a href="#">2013-11-14. GK RAD Fact Sheet final.pdf</a>	12/3/2015	John Wyckoff
Great Kills Park (GKP) Site Photographs: Site Security 6/9/2013 - 11/04/2013	11/4/2013	U.S. National Park Service	Administrative Record	12/3/2015			<a href="#">2013-11-04. Great Kills Park (GKP) Site Photographs Site Security.pdf</a>	12/3/2015	John Wyckoff
The New York Times, Radiation Cleanup at Park On Staten Island to Take Years	11/25/2013	The New York Times	Administrative Record	12/3/2015			<a href="#">2013-11-25. New York Times.pdf</a>	12/3/2015	John Wyckoff

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Fact Sheet, Information on Radium Contamination	12/1/2013	U.S. National Park Service	Administrative Record	12/3/2015	Phase will identify and address areas with highest radioactivity at or near surface. NPS will undertake RI/FS to determine if contaminants pose a risk and to evaluate the effectiveness of various alternatives. RI/FS planning will begin this spring.	Response action	<a href="#">2013-12-23. GK RAD Fact Sheet DEC2013 final.pdf</a>	12/3/2015	John Wyckoff
Ltr from M. Grimm, US House of Representatives to S. McCarthy NPS, re Urge swift action to address concerns at GKP	12/13/2013	U.S. House of Representatives	Administrative Record	12/3/2015			<a href="#">2013-12-13. letter GRIMM to NPS.pdf</a>	12/18/2015	John Wyckoff
blog.silive.com, Great Kills Park radiation hot spots '200 times' greater than normal; Staten Island's Grimm calls for public forum	12/16/2013	blog.silive.com	Administrative Record	12/3/2015	Hot spots ... have radiation readings on contact of "200 times typical [normal] background for this area," said Kathleen Cuzzolino....additional tests have not shown radiation in areas that remain open to park visitors.		<a href="#">2013-12-16. Staten Island Live.pdf</a>	12/3/2015	John Wyckoff
Ltr from J. Nersesian, NPS to J. Malleck USEPA re NPS Follow-up to 4/18/2013 NPS letter	12/20/2013	U.S. National Park Service	Administrative Record	12/3/2015	NPS completed PA satisfying CERCLA Sec 120(d). Since then NPS implemented removal action, initiated an EE/CA, and initiated a TCRA to be completed in 2014. NPS also established Admin Rec. and Community Involvement Plan.	Response action	<a href="#">2013-12-20. letter NPS to EPA.pdf</a>	12/18/2015	John Wyckoff
blog.silive.com, Clean up Great Kills Park: Response to radiation is too slow	12/22/2013	blog.silive.com	Administrative Record	12/3/2015			<a href="#">2013-12-22. Staten Island Live editorial.pdf</a>	12/3/2015	John Wyckoff
Fact Sheet, Information on Radium Contamination	2/1/2014	U.S. National Park Service	Administrative Record	12/3/2015	NPS learned radiological contamination more widespread in fill and is not limited to buried discrete hot spots. NPS to initiate comprehensive investigation to characterize nature and extent of radiological contamination and evaluate remedy alternatives.	Response action	<a href="#">2014-02-01. GKP RAD Fact Sheet.pdf</a>	12/3/2015	John Wyckoff

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Document Title	Date of Document	Author's Organization	Document Source/Custodian	Date Doc Procured	Comments re Content	Categories of Information	File Name	Date Added to SharePoint	Researcher
Email from K. Cuzzolino NPS to E. Daly USEPA et al re Site visit to Great Kills Park February 26th	2/14/2014	U.S. National Park Service	Administrative Record	12/3/2015	Site visit on 2/26/2014. 10am - 11:30am: Overview of project history, current status, future plans and 11:30am - 12:30pm: Site tour.	Response action	<a href="#">2014-02-14. GovtAgency_StatusMeeting_DOI_E-Mail_invite_agenda.pdf</a>	12/18/2015	John Wyckoff
Status Update for Gov't Agencies	2/26/2014	Tidewater, Inc.	Administrative Record	12/3/2015			<a href="#">2014-02-26. GovtAgency_StatusMeeting_Attendance.pdf</a>	12/3/2015	John Wyckoff
NPS Presentation, Great Kills Park, Project Status Update	2/26/2014	U.S. National Park Service	Administrative Record	12/3/2015	Aerial photos show progress filling, location of radiological contamination and TCRA field work.	Nature and Extent; Response action	<a href="#">2014-02-26. GovtAgency_StatusMeeting_presentation.pdf</a>	12/3/2015	John Wyckoff
News Release, Gateway National Recreation Area re Great Kills Park Radiation Update, Wood Chipping to begin at Great Kills Park, Staten Island	3/4/2014	U.S. National Park Service	Administrative Record	12/7/2015	Cutting back vegetation and moving fallen trees impeding radiological survey in closed area on March 3. NPS monitor noise level so it does not exceed New York City Noise Code requirements.	Response action	<a href="#">2014-03-04. Press Release Great Kills Park wood chipping_final.pdf</a>	12/18/2015	John Wyckoff
Email from C. Gray, Tidewater to K. Cuzzolino, NPS re Protocol for when we find people in the closed area of GKP	3/27/2014	Tidewater, Inc.	Administrative Record	12/7/2015	Email string re Trespassers in GKP closed areas, and procedures for dealing with same.	Response action	<a href="#">2014-03-27. EMAIL Tidewater to Cuzzolino_RE-GKPClosure-ViolationProtocol.pdf</a>	1/14/2016	Kyle Emery
US Park Police Incident Record re Trespassing, GKP Ball field	3/27/2014	U.S. National Park Service	Administrative Record	12/7/2015			<a href="#">2014-03-27. USPP Incident Record_RE-GKPClosure-Violation_Redacted.pdf</a>	1/14/2016	Kyle Emery
Report - GATE, Final General Management Plan, Environmental Impact Statement	4/1/2014	U.S. National Park Service	U.S. National Park Service	12/16/2015		Current Operations	<a href="#">GATE Final GMP-EIS All Chapters April 2014.pdf</a>	12/16/2015	Kyle Emery
Report - GATE, Final General Management Plan, Environmental Impact Statement, Appendices	4/1/2014	U.S. National Park Service	U.S. National Park Service	12/16/2015		Current Operations	<a href="#">GATE Final GMP-EIS Appendices - April 2014.pdf</a>	12/16/2015	Kyle Emery
Report - GATE, Final General Management Plan, Environmental Impact Statement, Chapter 1	4/1/2014	U.S. National Park Service	U.S. National Park Service	12/16/2015		Current Operations	<a href="#">GATE Final GMP-EIS Chapter 1 Foundation for PlanningApril.pdf</a>	12/16/2015	Kyle Emery

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Report - GATE, Final General Management Plan, Environmental Impact Statement, Chapter 2	4/1/2014	U.S. National Park Service	U.S. National Park Service	12/16/2015		Current Operations	<a href="#">GATE Final GMP-EIS Chapter 2 Management Alternatives April 2.pdf</a>	12/16/2015	Kyle Emery
Report - GATE, Final General Management Plan, Environmental Impact Statement, Chapter 3	4/1/2014	U.S. National Park Service	U.S. National Park Service	12/16/2015		Current Operations	<a href="#">GATE Final GMP-EIS Chapter 3 Affected Environment April 2014.pdf</a>	12/16/2015	Kyle Emery
Report - GATE, Final General Management Plan, Environmental Impact Statement, Chapter 4	4/1/2014	U.S. National Park Service	U.S. National Park Service	12/16/2015		Current Operations	<a href="#">GATE Final GMP-EIS Chapter 4 Environmental Consequences Apri.pdf</a>	12/16/2015	Kyle Emery
Report - GATE, Final General Management Plan, Environmental Impact Statement, Chapter 5	4/1/2014	U.S. National Park Service	U.S. National Park Service	12/16/2015		Current Operations	<a href="#">GATE Final GMP-EIS Chapter 5 Consultation and Coordination A.pdf</a>	12/16/2015	Kyle Emery
Report - GATE, Final General Management Plan, Environmental Impact Statement, Chapter 6	4/1/2014	U.S. National Park Service	U.S. National Park Service	12/16/2015		Current Operations	<a href="#">GATE Final GMP-EIS Chapter 6 Comments and Responses April 20.pdf</a>	12/16/2015	Kyle Emery
Report - GATE, Final General Management Plan, Environmental Impact Statement, Executive Summary	4/1/2014	U.S. National Park Service	U.S. National Park Service	12/16/2015		Current Operations	<a href="#">GATE Final GMP-EIS Executive Summary - April 2014.pdf</a>	12/16/2015	Kyle Emery
Community Fact Sheet, Great Kills Park Site	5/1/2014	U.S. National Park Service	Administrative Record	12/7/2015	Provide summary of site history, nature of contamination (radium), potential safety and health risks, current status and community involvement.	Response action	<a href="#">2014-05-15c. Public Info Session- GKP handout FactSheet final .pdf</a>	12/18/2015	John Wyckoff
Frequently Asked Questions, Great Kills Park Site	5/1/2014	U.S. National Park Service	Administrative Record	12/7/2015	Contamination more widespread than thought in 2005 - a few areas to 265 acres. Over 200 locations w/ elevated activity. Radiation not airborne. Staten Island groundwater not used for drinking. GKP groundwater not tested for radioactivity.	Response action	<a href="#">2014-05-15f. Public Info Session- GKP handout FAQ final.pdf</a>	12/7/2015	John Wyckoff

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Media Advisory, Gateway National Recreation Area, Open House about Contamination and Closed Areas at Great Kills Park on May 15, 2014	5/7/2014	U.S. National Park Service	Administrative Record	12/7/2015	Open house.	Response action	<a href="#">2014-05-07. Public Info Session-GKP_Media Advisory.pdf</a>	1/14/2016	Kyle Emery
Agenda National Park Service Briefing of Elected Officials (5/14/2014) Great Kills Park CERCLA Site	5/14/2014		Administrative Record	12/7/2015	Agenda - Goals and Structure, Site History and NPS Response Actions, Preliminary Findings of TCRA, and Next Steps (RI/FS).	Response action	<a href="#">2014-05-14b. Elected Officials Briefing agenda.pdf</a>	1/14/2016	Kyle Emery
blog.silive.com, National Park Service holds informational Great Kills Park Meeting on radioactive area, plans remedial excavations	5/15/2014	blog.silive.com	Administrative Record	12/7/2015	Public meeting. Last meeting in 2012. Park closed since 2009, NPS to target areas with highest radiation for police, ambulance and fire trucks to pass through...NPS hopes to have field work completed so plans.. for permanent remedies....	Response action	<a href="#">2014-05-14a. Staten Island Live.pdf</a>	1/14/2016	Kyle Emery
Great Kill Park Timeline 1900, 1933-1934, 1948	5/15/2014	U.S. National Park Service	Administrative Record	12/7/2015	Historical topography maps (2) and aerial photograph (1948).	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">2014-05-15g. Public Info Session-GKP_poster_Timeline 1.pdf</a>	1/14/2016	Kyle Emery
Great Kill Park Timeline 1949-1972, 1972 and 2005	5/15/2014	U.S. National Park Service	Administrative Record	12/7/2015		Past Site Ops/Waste Disposal; Nature and Extent; Containment	<a href="#">2014-05-15h. Public Info Session-GKP_poster_Timeline 2.pdf</a>	12/7/2015	John Wyckoff
Poster. Radiation, Radioactivity and Risk Assessment	5/15/2014	U.S. National Park Service	Administrative Record	12/7/2015	Summary and presentation of radiation, radioactivity and risk information.		<a href="#">2014-05-15o. Public Info Session-GKP_poster_Radiation.pdf</a>	12/18/2015	John Wyckoff
blog.silive.com, Great Kills Park? An year now: Feds lag on radiation (editorial)	5/20/2014	blog.silive.com	Administrative Record	12/7/2015			<a href="#">2014-05-20. Staten Island Live editorial.pdf</a>	12/7/2015	John Wyckoff
Great Kills Park Total Survey Coverage	5/21/2014	U.S. National Park Service	Administrative Record	12/7/2015	Shows area covered by radiological survey.	Nature and Extent; Response action	<a href="#">2014-05-15i. Public Info Session-GKP_poster_Total Survey Coverage.PDF</a>	12/7/2015	John Wyckoff
Gateway National Recreation Area – CERCLA Process Timeline for Site	5/21/2014	U.S. National Park Service	Administrative Record	12/7/2015	Shows CERCLA process and work completed and estimated timeline for future response actions.	Response action	<a href="#">2014-05-15j. Public Info Session_posterCERCLAprcess .pdf</a>	12/7/2015	John Wyckoff

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Great Kills Park, Public Usage Areas and Associated Radiological Dose Rates	5/21/2014	U.S. National Park Service	Administrative Record	12/7/2015	Radiological dose rates for identified areas.	Nature and Extent	<a href="#">2014-05-15k. Public Info Session-GKP_poster_PublicUsageAreasandAssocRadose.pdf</a>	12/7/2015	John Wyckoff
Landfill Delineation and Locations Requiring Additional Investigation	5/21/2014	U.S. National Park Service	Administrative Record	12/7/2015	Provides location of municipal solid waste, elevate rad locations, and artifact location. Key document	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">2014-05-15l. Public Info Session-GKP_poster_Landfill Delineation and Locations Requiring Additional Invest.pdf</a>	12/7/2015	John Wyckoff
National Park Service Actions, Great Kills Park	5/21/2014		Administrative Record	12/7/2015	Summary of NPS Response actions during 2007, 2009, 2011, and 2012.	Past Site Ops/Waste Disposal; Response action	<a href="#">2014-05-15m. Public Info Session-GKP_poster_NPSresponseactions.pdf</a>	1/14/2016	Kyle Emery
Gateway Management Plan and Environmental Impact Statement Record of Decision	6/11/2014	U.S. National Park Service	U.S. National Park Service	3/9/2016	Provides ROD for selection of Alternative B.	Risk assessment and land use	<a href="#">GATE_GMP_ROD_JUNE2014.pdf</a>	3/9/2016	John Wyckoff
Ltr from J. Nersesian, NPS to A. Raddant DOI re Notification of Natural Resource Trustees	10/10/2014	U.S. National Park Service	Administrative Record	12/7/2015	1 of 6 letters to DOI, NOAA, NPS NER, NYSDEC, NYSDEC-RD, U.S. Fish and Wildlife Service (USFWS) to notify trustee: re natural resource damages from releases of hazardous substances and that NPS has initiated negotiations with responsible party per CERCLA 104(b)(2) and 122(j)(l).	Response action	<a href="#">2014-10-10a. NPS 104(b)(2) notification letter to DOI.pdf</a>	1/14/2016	Kyle Emery
Results of Waste Fill Investigation, Great Kills Park	11/19/2014	U.S. National Park Service	Administrative Record	12/7/2015		Nature and Extent	<a href="#">2014-11-19. Enclosed Chesterton Ave Map.pdf</a>	12/18/2015	John Wyckoff
Ltr from J. Nersesian NPS to A. Lanza re Chesterton Avenue investigation and fill material delineation	11/19/2014	U.S. National Park Service	Administrative Record	12/7/2015	1 of 15 letters to elected officials and neighbors notifying them of the results of NPS Chesterton investigation.	Nature and Extent; Response action	<a href="#">2014-11-19a. NPS letter to Elected Officials RE Chesterton Ave Lanza.pdf</a>	7/25/2016	John Wyckoff
US Park Police Incident Record re Larceny	1/9/2015	U.S. Park Police	Administrative Record	12/7/2015	Chain link fence around radiation storage container missing.		<a href="#">2015-01-09. USPP Incident Record_RE-GKPClosure-Larceny Redacted.pdf</a>	12/7/2015	John Wyckoff

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Remedial Administrative Record Index	6/30/2015	U.S. National Park Service	Administrative Record	12/7/2015	AR 0000001 to AR 0001757.		<a href="#">Remedial ARIndex 2015-06-30.pdf</a>	12/7/2015	John Wyckoff
Ltr from J. Nersesian, NPS to H. Stein, Env Law Div New York City re Historical documents for Phase One Remedial Investigation	9/4/2015	U.S. National Park Service	U.S. National Park Service	11/6/2015	NPS Document Request to New York City.		<a href="#">letter docrequest NPStoNYC_09042015.pdf</a>	1/14/2016	Kyle Emery
NPS Protocol for the Selection and Use of Ecological Screening Values for Radionuclides	1/1/2016	U.S. National Park Service	U.S. National Park Service	3/9/2016	In a SLERA, ESVs are used in the selection of COPECs for each medium of concern and as inputs into quantitative risk estimates for screening level ecological risk characterization.	Eco risk	<a href="#">NPS Protocol for the Selection and Use of Ecological Screening Values for Radionuclides.pdf</a>	3/9/2016	John Wyckoff
NPS Protocol for the Selection and Use of Ecological Screening Values for Non-Radiological Analytes	2/18/2016	U.S. National Park Service	U.S. National Park Service	3/9/2016		Eco risk	<a href="#">NPS Protocol for the Selection and Use of the Ecological Screening Values for Non-Radiological Analytes.pdf</a>	3/9/2016	John Wyckoff
Staten Island Non-Potable Well Permits within 10306 Zip Code	5/20/2016	NY City Dept. of Health	New York City, Department of Health and Mental Hygiene	7/8/2016	DOHMH re FOIL Request #2016FR01118 re Staten Island Zip Code 10306 Non-Potable wells permits.	Groundwater Use	<a href="#">Copy of Staten Island 10306 non-potable well permit (2).xls</a>	7/8/2016	John Wyckoff
Email from C Anhouse to J. Wyckoff re FOIL Control No. 2016FR01861 Response	7/7/2016	NJ Dept. of Health	New York City, Department of Health and Mental Hygiene	7/8/2016	Email indicates that there are no wells in the adjacent Zip Code 10308.	Groundwater Use	<a href="#">FOIL Control No. 2016FR01861 Response.pdf</a>	7/8/2016	John Wyckoff
Great Kills Landfill 1944 -1948		U.S. National Park Service	Administrative Record	12/2/2015	Provides NPS summary of activities conducted between 1944 and 1948. Does not include references and is undated.	Past Site Ops/Waste Disposal	<a href="#">AR0000001_REPORT_GKLAND FILLHISTORY.pdf</a>	12/2/2015	John Wyckoff
Ltr from M. Grimm, US House of Representatives to J. Jarvis, NPS, re Unresolved situation at GKP		U.S. House of Representatives	Administrative Record	12/2/2015	Request that CERCLA be observed and the Assessment/study be begun immediately.	Response action	<a href="#">AR0000611_052112_FY12-POPS-10584-GATE-complaints at Great Kills Park.pdf</a>	1/14/2016	Kyle Emery
Aerial Photographs of Great Kills Park			NPS ETIC	12/8/2015	Date and Author unknown. Shows GKP and adjacent areas.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_41152.pdf</a>	12/8/2015	Kyle Emery

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Topographical Map of Marine Park			NPS ETIC	12/8/2015	Topographical Map of Marine Park. Area shown is what will become the North Eastern Corner of GKP. Figure shows both Topographic and Bathymetric lines.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62526_0001_of_000.tif</a>	12/8/2015	Kyle Emery
Topographical Map of Marine Park			NPS ETIC	12/8/2015	Topographic map of Crooke's Point and Crooke's Neck. Figure shows both Topographical and Bathymetric lines.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62526_0002_of_000.tif</a>	12/8/2015	Kyle Emery
Site Plan - Showing Existing and Proposed Areas of Fill and Dredging		NY City Dept. of Parks	NPS ETIC	12/9/2015	Shows existing shorelines and previous dredging and fill. No date available. Extent of filling shown did not occur.		<a href="#">GATE_646_62587_0001_of_000.pdf</a>	12/9/2015	Kyle Emery
Site Plan - Plan of Filling and Grading for Marine Park		NY City Dept. of Parks	NPS ETIC	12/9/2015	Shows areas which are to be filled and dredged in the vicinity of Great Kills Harbor.	Past Site Ops/Waste Disposal	<a href="#">GATE_646_62589_0001_of_000.pdf</a>	12/9/2015	Kyle Emery
Great Kills Park Timber Bulkhead		U.S. National Park Service	National Park Service	5/15/2016	Reviews the condition of the bulkhead and provides comments regarding its poor condition when the City transferred the Park to NPS.	Past Site Ops/Waste Disposal; Nature and Extent	<a href="#">GATE_646_D196_[id148886].pdf</a>	5/15/2016	John Wyckoff
Portion of Sanborn		Library of Congress	Sanborn	12/15/2015	Portion of Sanborn.		<a href="#">July 1885, Richmond Borough of NYC.pdf</a>	12/15/2015	John Wyckoff
Technical Description - Application for Grant of State Land Under Water in Marine Park, Great Kills, and Lower Bay, Borough of Richmond			New York City	12/18/2015		Property Acquisition	<a href="#">NYCGKRI00000329.pdf</a>	12/22/2015	John Wyckoff
Map showing acres acquired for GKP (1256) and surrounding area.			New York City	12/18/2015	Map summary of acreage acquired by New York City.	Property Acquisition	<a href="#">NYCGKRI00000363.pdf</a>	12/22/2015	John Wyckoff
Great Kills PK/R16, Oakwood Beach and New Dorp Beach		NY City Dept. of Parks	New York City	12/18/2015	Landfill/L-U-W 2008.7 acres LUW 120.7 acres. Authorized by B of E. Boundaries extend beyond BH line but not to PH line.	Property Acquisition	<a href="#">NYCGKRI00000364.pdf</a>	1/14/2016	Kyle Emery

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Map Showing Staten Island Marine Park at Great Kills and Boundary Streets			New York City	12/18/2015	Shows LUW and Upland Acquisitions.	Property Acquisition	<a href="#">NYCGKRI00000385.pdf</a>	1/14/2016	Kyle Emery
Plan Showing New Location for Drainage Ditch No. 4 and Two New Catch Basins on Hylan Boulevard.			New York City	12/18/2015	Difficult to read.	Utilities - Drainage	<a href="#">NYCGKRI00000401.pdf</a>	7/25/2016	John Wyckoff
Oakwood Beach Water Pollution Control Plant Operation and Maintenance Manual Introduction			New York City	12/18/2015	Intro - Not complete.	Oakwood WPCP	<a href="#">NYCGKRI00001113.pdf</a>	12/22/2015	John Wyckoff
Oakwood Beach Water Pollution Control Plant Operation and Maintenance Manual Introduction			New York City	12/18/2015	Table of Contents.	Oakwood WPCP	<a href="#">NYCGKRI00001116.pdf</a>	12/22/2015	John Wyckoff
Oakwood Beach Water Pollution Control Plant Operation and Maintenance Manual Introduction			New York City	12/18/2015	Description of Wastewater Treatment Facility - Provides history of WPCP.	Oakwood WPCP	<a href="#">NYCGKRI00001133.pdf</a>	12/23/2015	John Wyckoff
Oakwood Beach Water Pollution Control Plant Operation and Maintenance Manual Introduction			New York City	12/18/2015	Exhibits.	Oakwood WPCP	<a href="#">NYCGKRI00001151.pdf</a>	12/23/2015	John Wyckoff
Oakwood Beach Water Pollution Control Plant Operation and Maintenance Manual Introduction			New York City	12/18/2015	Operation and Control of Unit Processes.	Oakwood WPCP	<a href="#">NYCGKRI00001160.pdf</a>	12/22/2015	John Wyckoff
Oakwood Beach Sewage Treatment Works, Projects Plans - Plant Layout		New York City, Department of Public Works	New York City	12/18/2015	Shows outfall and influent locations (Cedar Grove Road).	Oakwood WPCP	<a href="#">NYCGKRI00003929.pdf</a>	12/29/2015	John Wyckoff

**Table 2-1. Summary of the Analysis of Historic Maps, Aerial Photographs, and Plans,  
Great Kills Park, Staten Island, New York**

<b>Source</b>	<b>GKP Changes</b>	<b>Surrounding GKP Area Changes</b>
1874, J.B. Beers & Co., Atlas of Staten Island, Richmond County New York	Map shows extensive barrier or spit of land labeled John J. Crooke present with small creek labeled Bass Creek. No Structures are located on spit. The water area between the spit and mainland is labeled "Great Kill." Extensive wetlands are mapped adjacent to the Great Kill.	Surrounding parcels on mainland show subdivision indicative of multiple landowners.
1887, J.B. Beers & Co., Atlas of Staten Island, Richmond County, New York	Map shows two structures and road or trail on the spit of land labeled John J. Crooke. Crooke land holdings include the spit and a portion land near what is today the Park and Fairlawn Ave. Extensive wetlands are mapped adjacent to the Great Kill ( <b>Figure 2-2</b> ). Cole owned several parcels in the vicinity of Bay Terrace Incinerator.	Staten Island Railroad (northeast to southwest) is present and property subdivision extends eastward from railroad to Great Kill and wetland and what is today Oakwood Beach.
1894, I. A. Lefevre, Castleton, Atlas of Staten Island, Richmond County, New York	1894 atlas similar to the 1887 atlas, however new features include South Side Boulevard, (a.k.a. Hylan Boulevard) and Keegans Lane (a.k.a. Fairlawn Avenue). Two structures are located near the intersection of Keegans Lane and Side Boulevard. Creeks mapped include Duck Creek and Mill Pond Creek (a.k.a. Oakwood Beach West Drainage) and Bass Creek. Oyster Island is present in the center of Great Kill. One structure is shown on spit which encompasses 150 acres. Emmet Avenue is present. Offshore bulkhead boundary is defined. ( <b>Figure 2-3</b> ).	Adjacent planned development is shown with street grid for Brendan and Oakwood.
1898 15 Minute Topographic Quadrangle of Staten Island, New York (Note 1900 15 Minute Topographic Map and the 1905 30 Minute Topographic Map do not show any significant differences from the 1898 map).	Map shows isolated structures at the end of three roads that extend from the (Amboy Road) northwest to southeast to the wetlands associated with Great Kills ( <b>Figure 2-4</b> ). Two structures are present on Crooke's Point.	Staten Island Railroad is present north of the site. Oakwood is being developed. Wetlands are shown and are bifurcated by a road that traverses northeast to southwest to Great Kills with three structures.

**Table 2-1. Summary of the Analysis of Historic Maps, Aerial Photographs, and Plans,  
Great Kills Park, Staten Island, New York**

<b>Source</b>	<b>GKP Changes</b>	<b>Surrounding GKP Area Changes</b>
1917 G.W. Bromley and Co. Atlas of the City of New York, Borough of Richmond, Staten Island Wards 4 & 5.	Mapped shoreline and creeks reflect significant shoreline and wetland loss (due to erosion). Crooke's Point is 30 acres and an island separated from the mainland and Oakwood Beach. Drainages include Duck Creek, Lockmans Creek, and Mill Pond Creek. The offshore bulkhead boundary is defined on the map. Development includes street grid for the Whitlock Development ( <b>Figure 2-5</b> and <b>Figure 2-6</b> ) west of Emmet Ave. Adjacent to South Side Boulevard are four structures and a small pond ( <b>Figure 2-6</b> ). Bay Terrace is shown between Duck and Lockmans Creek. Former Crooke parcels now labeled Willard Realty Co.	Oakwood Beach street grid is developed including expanded road network including Kissam and Ocean Avenues (both are present today in Oakwood Beach). There are four structures located northeast of Mill Pond Creek (a.k.a. West Oakwood Beach Drainage) ( <b>Figure 2-5</b> ).
1925 15 Minutes Topographic Quadrangle of Staten Island, New York	Map similar to the 1917 atlas and shows significant shoreline and wetland loss ( <b>Figure 2-7</b> ). Road network and structures unchanged from 1898 map.	Adjacent development in 1925 is consistent with development shown in the 1898 topographic map.
Map of Staten Island Marine Park Showing Approved Boundaries	Map shows a similar road network as 1917 atlas, however South Side Boulevard is now named Hylan Boulevard and Mansion and Grattan Avenues, and Bach Street are shown intersecting Emmet Avenue. Map shows parcel division adjacent to the location of Bay Terrace Incinerator and New York City Department of Sanitation Parcel. The boundary of the Staten Island Marine Park is defined by Fairlawn Avenue, Hylan Boulevard, and Emmet Avenue. Map shows parcels on land and underneath water that comprise the Marine Park ( <b>Figure -2-7</b> ).	
1935 New Steel Bulkhead Extension, Marine Park Development, New York City, Boro of Richmond, Department of Parks.	Drawing ( <b>Figure 2-9</b> ) shows the installation of a 5,500 foot long steel bulkhead joining Crooke's Point (Island) to Oakwood Beach. Sheet pile length is 25 feet (4 feet extends above Mean Sea Level (MSL) and 21 feet extends below MSL. The bottom of the harbor is estimated at 6.4 feet below MSL. New bottom (after dredging is proposed to be 11 feet below MSL.	
1935-1936 Topographic	Shows Hylan Boulevard, Fairlawn Ave, and	

**Table 2-1. Summary of the Analysis of Historic Maps, Aerial Photographs, and Plans,  
Great Kills Park, Staten Island, New York**

<b>Source</b>	<b>GKP Changes</b>	<b>Surrounding GKP Area Changes</b>
Map Portion of Marine Park (103, 104, and 105).	Mansion Ave ( <b>Figure 2-10</b> ). There is sanitary sewer and easement shown beneath Mansion Avenue. Wetland area has numerous constructed linear drainage ditches to drain the wetland to Great Kills Harbor and creeks, (Duck, Lockmans and Mill Creeks). There is a small pond located at the intersection of Fairlawn Avenue and Hylan Boulevard. There is a 2 story stucco house with garage northeast of Fairlawn Avenue. There is a drainage pipe that accepts drainage north of Hylan Boulevard and carries it beneath Hylan Boulevard and discharges to a ditch that drains to Duck Creek.	
1935-1936 Topographic Map Portion of Marine Park (106, 107, and 108).	Map shows road network on Staten Island Marine Park including Mansion and Grattan Avenues and Bach Street that intersects Emmet Avenue ( <b>Figure 2-11</b> ). Map shows extensive network of drainage ditches in marsh wetland. Map shows debris fill beneath the parcel that is occupied by Bay Terrace Incinerator. Two gas pumps are located adjacent to Hylan Boulevard. One pump is located northwest of Bay Terrace Incinerator on (south side of Hylan Boulevard). The second gas pump is located on north side of Hylan Boulevard at the intersection of Buffalo Street.	
1937 Sanborn Insurance Map.	Map shows the Bay Terrace Incinerator and Garage ( <b>Figure 2-12</b> ) present in what is today the north central portion of the Site. The Sanborn indicates the incinerator was constructed in 1926. Sanborn Map provides details regarding the construction of both structures and sanitation operations and the presence of gasoline tank.	
1940 Aerial Photograph (EDR Proprietary Aerial Viewpoint).	Shows Bay Terrace Incinerator and Garage with fill to the south into marsh. Aerial photograph shows extensive drainage ditch network in marsh ( <b>Figure 2-13</b> ).	
1947 Arthur Kill and The Narrows, 7.5	Shows the location of the Bay Terrace Incinerator, the spit or Crooke's Point has	Oakwood Beach shows increased development with more

**Table 2-1. Summary of the Analysis of Historic Maps, Aerial Photographs, and Plans,  
Great Kills Park, Staten Island, New York**

<b>Source</b>	<b>GKP Changes</b>	<b>Surrounding GKP Area Changes</b>
Minute Quadrangle Maps.	been restored with construction of bulkhead and replenishment of sand along beach ( <b>Figure 2-14</b> ). Manson Avenue and associated streets are not shown. Shows three structures adjacent (south side of) Hylan Boulevard.	expansive road grid and construction of few structures.
1949 Aerial Photograph, U.S. Coastal and Geodetic Survey (C&GS).	Shows Site completely filled and graded with Buffalo Street and Beach Parking and three drainages (Northwest-Southwest Drainage Channel, Hylan Northeast to Southwest Drainage Channel; and Unnamed Northeast to Southwest Drainage Channel. ( <b>Figure 2-15</b> ). Aerial also shows the locations of the unloading plants, the mooring booms extending into the harbor, and an outbuilding near what is today is Fairlawn Avenue.	Surrounding development consistent with earlier maps and drawings.
1951 Aerial Photograph, EDR Proprietary Aerial, Viewpoint.	Shows similar Site features as 1949 aerial photograph, however, beach parking lot is paved and beach facilities. Bathhouse and Concessions Facility are present. Graded site showing increased but spotty vegetation ( <b>Figure 2-16</b> ).	Surrounding development consistent with earlier maps, aerials and drawings.
1954 Aerial Photograph, U.S. Geological (Very light and little contrast).	Shows similar Site features as 1949 and 1951 aerial photographs, however, beach parking lot is paved and Beach facilities (Bathhouse and Concessions Facility are present. Graded site showing increase but spotty vegetation ( <b>Figure 2-17</b> ). Oakwood Beach Creek is well defined and appears to have been graded to its current configurations.	Surrounding development consistent with earlier maps, aerials and drawings.
1955 Historical 7.5 Minute Topographic Quadrangle, Arthur Kill and Narrows Maps.	Shows site drainage and wetlands and small pond near intersection of Fairlawn and Hylan Boulevard ( <b>Figure 2-18</b> ). The map also shows the Buffalo Street extends the length of Crooke's Point and the Beach Bathhouse Facility and three other structures located southeast of Bathhouse. There is also a small rectangular pond in the vicinity of the former sludge drying beds.	Oakwood Beach Water Pollution Control Plant is present. Dash road network in the northeast for Chesterton Avenue, Fairbanks Avenue, Montreal Avenue and Malone Avenue and Pental Street.
1956 Bulkhead Repairs. Limits of repair area revised (1958).	Shows repairs to steel bulkhead ( <b>Figure 2-19</b> ).	
May 1958 Contract	The general notes specify that, [W]here	

**Table 2-1. Summary of the Analysis of Historic Maps, Aerial Photographs, and Plans,  
Great Kills Park, Staten Island, New York**

<b>Source</b>	<b>GKP Changes</b>	<b>Surrounding GKP Area Changes</b>
Drawings for the Construction of the Athletic Field in area southeast of Hylan Boulevard, opposite Redgrave and Kevin Avenues: Contract No. R-16-157 (62709).	excavation exposes the waste fill the contractor shall remove the waste fill to a depth of 6-inches below subgrade for seeded and paved areas and 18-inches for curbs, drainage pipes and drainage structures and backfilled with clean material. The athletic facilities included baseball field, softball field, football field with running track and associated track field areas (pole vault, high jump etc.). Certain infield ball field areas were to be “skinned,” sodded, and outfield areas surfaced with top soil and seeded. The field has an underdrain system with a network of surface water catch basins connected via corrugated pipe with discharge to the drainage channel parallel to Hylan Boulevard.	
1961 Historical Aerial Photograph, EDR Proprietary Aerial Viewpoint.	Shows similar site features as earlier aerial photographs and historical topographic maps with the exception of recent installation (in 1958) of the one baseball field and one softball field and track in the northwestern portion of the Site ( <b>Figure 2-20</b> ). Vegetation appears to be increasing on the GKP landfill area.	Structure present near what is today Chesterton Avenue, north of Site. Few structures constructed north of Hylan Boulevard.
1966 Historical Aerial Photograph U.S. Geological Survey.	Shows similar site features as 1961 Historical Aerial Photograph ( <b>Figure 2-21</b> ). Site surface is altered with the construction of trails and surface grading and filling southeast of the track and field area. Wetland/Sewer line (diagonal) Road is present. The unnamed northeast to southwest drainage channel north of beach parking lot appears to be graded over and discharge to Great Kills Harbor is not present. Trails or roads near bulkhead are present.	Significant residential development north of Hylan Boulevard (northwest of GKP) and Chesterton Avenue (north of Site).
1966 Historical 7.5 Minute Topographic Quadrangle Arthur Kill and The Narrows Maps.	Confirms site structures and shown on earlier aerial photographs and maps. Sludge drying beds are present west of the Oakwood Beach Water Pollution Control Plant ( <b>Figure 2-22</b> ). Map confirms that the unnamed northeast to southwest drainage channel north of the beach parking lot is no longer present.	Continued development north of Hylan Boulevard and north of Site in vicinity of Chesterton Avenue.

**Table 2-1. Summary of the Analysis of Historic Maps, Aerial Photographs, and Plans,  
Great Kills Park, Staten Island, New York**

<b>Source</b>	<b>GKP Changes</b>	<b>Surrounding GKP Area Changes</b>
1966 Drawing Showing Beach Nourishment Between Emmet Avenue and Bathhouse	Shows beach nourishment areas northeast of bathhouse ( <b>Figure 2-23</b> ).	
1975 Historical Aerial Photograph (EDR).	Shows continued site grading in the area of the Education Field Station and the installation of the four additional baseball/softball fields ( <b>Figure 2-24</b> ). A sludge drying bed is present near east margin of aerial photograph. Trail and road network near bulkhead is more defined than earlier aerial photographs. Shows grading in area of (what is today the) model airplane field.	
1981 Historical 7.5 Minute Topographic Quadrangle Arthur Kill and the Narrows Maps.	Similar surface features as earlier maps and photographs ( <b>Figure 2-25</b> ). Additional changes include Nichols Marina docks and Park is renamed Gateway National Recreation Area. Includes boundary (south of Buffalo Street) between City Property and GKP. Sludge Drying Beds are shaded purple indicating removal from service.	Map shows new/upgraded Oakwood Beach Water Pollution Control Plant Building and expansion of Chesterton Avenue neighborhood into the Oakwood Beach West Drainage Area.
1984 Historical Aerial Photograph U.S. Geological Survey.	Shows site features similar to earlier maps and photographs. Site trails include bulkhead road ( <b>Figure 2-26</b> ). Trail and road network along Bulkhead is well defined and consistent with current configuration.	Fully developed north of Hylan Boulevard and Chesterton Avenue.
1991 Historical Aerial Photograph, U.S. Geological Survey, Digital Orthophoto Quadrangle.	Shows site features similar to earlier maps and photographs however Education Field Station and associated parking area is present. Model airplane field area and parking are clearly defined. New expanded parking for Nichols Marina and boat ramp is present ( <b>Figure 2-27</b> ).	No apparent difference since 1984.
2006 Historical Aerial Photograph, U.S. Geological Survey, National Agriculture Imagery Program (NAIP).	Beach Bathhouse no longer present on beach. Beach parking and Buffalo Street have been reconstructed and are in their current configuration. Ranger Station and associated parking present north of Buffalo Street and Beach Parking Area ( <b>Figure 2-28</b> ).	No apparent differences since 1984.
2009 Historical Aerial Photograph, U.S. Geological Survey, NAIP.	Similar to 2006 but vegetation appears to be increasing on athletic field and model airplane field areas. Likely reflects NPS's restriction of Site access due to elevated detections of	No apparent differences since 1984.

**Table 2-1. Summary of the Analysis of Historic Maps, Aerial Photographs, and Plans,  
Great Kills Park, Staten Island, New York**

<b>Source</b>	<b>GKP Changes</b>	<b>Surrounding GKP Area Changes</b>
	radioactivity ( <b>Figure 2-29</b> ). No other changes noted since 2006.	
2011 Historical Aerial Photograph, U.S. Geological Survey, NAIP.	Similar to 2006 and 2009 and increased vegetation obscuring former field areas ( <b>Figure 2-30</b> ).	No apparent differences since 1984.

**Table 3-1. Summary of 2010 Population Data within 4 Tracts Adjacent to GKP**

<b>Census Tract Number</b>	<b>Area (square miles)</b>	<b>Number of Residents</b>	<b>Location</b>
156.03	0.4	4,265	Southwest
132.03	0.4	5,433	Southwest to West
132.04	0.4	4,843	Northwest to North
128.06	0.4	3,158	North to Northeast

**Table 3-2. Summary of Schools Located Near GKP**

<b>School Name and Address</b>	<b>Description<sup>21</sup></b>	<b>Neighborhood, District, Distance, and Direction</b>
IS 024 Myra S. Barnes 225 Cleveland Avenue, Staten Island, NY	Grades 6 through 8 1,288 Students	Great Kills, District 31 <0.25 mile, west
Smiles Around Us 3854 Hylan Boulevard Staten Island, New York	Pre-Kindergarten 18 Students	Great Kills, District 31, <1 mile west
PS 053 Bay Terrace The Barbara Esselborn School 330 Durant Avenue Staten Island, NY	Pre-Kindergarten through 5 Grade 780 Students	Great Kills, District 31 <0.1 mile west
P.S. 8 Shirlee Solomon 112 Lindenwood Road, Staten Island, NY	Pre-Kindergarten through 5 Grade. 560 Students	Great Kills, District 31, 1.0 mile west
SI YMCA Nursery 3939 Richmond Avenue, Staten Island, NY	Pre-Kindergarten 72 Students	Great Kills, District 31 2 miles west
South Shore Toddler Academy 11 Sampson Avenue Staten Island, NY	Pre-Kindergarten 18 Students	Great Kills, District 31 >1 mile to west
Oakdale Academy 366 Oakdale Street, Staten Island, NY	Pre School	1.5 mile southwest
The Gifford School 232 Barlow Avenue Staten Island, NY 10308	Pre-Kindergarten through 5 Grade 687 students.	Great Kills, District 31 1.25 mile north- northwest
P.S. 37 15 Fairfield Street Staten Island NY	Grades Pre- Kindergarten through 12 Grade, 381 Students	Great Kills, District 31 1.25 mile north-north west
The Richmondtown Children's Preschool 3435 Richmond Road, Staten Island, NY	Pre School	1.5 mile northwest

<sup>21</sup> Numbers of students are approximate.

**Table 3-2. Summary of Schools Located Near GKP**

<b>School Name and Address</b>	<b>Description</b>	<b>Neighborhood, District, Distance, and Direction</b>
Tanglewood Montessori Corporation 15 Tanglewood Drive, Staten Island, NY	Pre-Kindergarten through 8 Grade.	1.5 mile northwest
Community Unity Resources 3651 Richmond Road, Staten Island, NY	Pre School	1.5 mile north
CBI Academy Preschool 45 Twombly Avenue, Staten Island, NY	Pre-Kindergarten 15 Students	Oakwood - Oakwood Beach District 31 <1 mile north
P.S. 050 Frank Hankinson 200 Adelaide Avenue, Staten Island New York	Pre-Kindergarten through 5 Grade 835 Students	Oakwood - Oakwood Beach, District 31 <1 mile north
Saint Charles School 200 Penn Avenue, Staten Island, NY	Pre-Kindergarten 40 Students	Oakwood- Oakwood Beach, District 31 <1 mile north
P.S. 023 Richmondtown 30 Natick Street, Staten Island, NY	Pre-Kindergarten through 5th Grade 518 Students	Oakwood-Oakwood Beach, District 31 1.5 mile north
St. Patricks 3560 Richmond Road, Staten Island, NY	Pre-Kindergarten 40 Students	Oakwood-Oakwood Beach, District 31 1.5 mile north
Monsignor Farrell High School 2900 Amboy Road, Staten Island, NY	Grades 9 through 12 1,200 Students	Oakwood –Oakwood Beach District 31 0.5 mile north
Staten Island Technical High School 486 Clawson Street, Staten Island, NY	Grades 9 through 12 1,190 Students	Oakwood-Oakwood Beach District 31 1.5 mile north

**Table 3-3. Summary of Day Care Facilities Near GKP**

<b>Day Care Facility Name and Address</b>	<b>Distance</b>
Elite Day Care Learning Facility 4239 Richmond Avenue, Staten Island, NY	1.25 mile southwest
Dream A Little Dream Daycare LLC 48 E Figurea Avenue, Staten Island, NY	1 mile west
Kiddie Academy of Staten Island 125 Greaves Lane, Staten Island, NY	0.5 mile west
Lisbeth Brandefine 76 St. Albans Place, Staten Island, NY	1.5 mile west
L&A Centers, Inc 366 Oakdale Street, Staten Island, NY	1.5 mile west
Peas In A Pod Child Care 285 Beach Road, Staten Island, NY	1 mile southwest
Home Sweet Home Child Care Inc 357 Sycamore Street, Staten Island, NY	1.5 mile southwest
Calvary Assembly of God LC 4055 Richmond Avenue, Staten Island, NY	1.5 southwest
Konva Inc. 4239 Richmond Avenue., Staten Island, NY	1.5 mile southwest
Steps to Success 2 2975 Hylan Boulevard, Staten Island, NY	0.5 mile north
Happy Hearts Day Care 3448 Richmond Avenue., Staten Island, NY	1.5 mile west
Kindernook Day Care 3502 Richmond Avenue, Staten Island, NY	1.5 mile west
Oakwood Heights Community Church, Inc., 345 Guyon Avenue, Staten Island, NY	0.5 mile north
Rainbow of Staten Island Day Care Inc., 29 Eva Avenue, Staten Island, NY	0.75 mile north
Congregation Oorah 374 Ridgewood Avenue, Staten Island, NY	1.5 mile west

**Table 3-4. Summary of Regional and Site-Specific Geologic Rock Units<sup>22</sup>**

<b>Age</b>	<b>Regional Geology Unit and Description</b>	<b>Site Geology Unit and Description</b>
Recent	Artificial fill. Up to 30 feet thick or more.	Waste fill, consists of brown to black heterogeneous mixture of highly decomposed waste fill consisting of incinerator residue (cinder-like material), coal ash, and organic material with scattered glass, metal, rubber, and wood debris. Hydraulic fill graded gray to brown sand. Thickness ranges 5 to 25 feet with an average thickness of 15 feet.
Holocene 10,000 years to present	Beach deposits consisting of brown sand and marsh/estuarine deposits consisting of plastic dark gray silty clay to clayey silt with organics. Approximately 10 feet thick.	Marsh/estuarine deposits (plastic dark gray silty clay to clayey silt with organics). Thickness ranges from 2 to 17.5 feet with an average thickness of 7 feet. Deposit ranges in depth from 5 to 25 feet bgs but typically is 15 feet bgs.
Pleistocene 3 Ma to 10,000 years	Outwash consisting of melt water deposited stratified red to brown fine to coarse sand and gravel. Maximum thickness is 95 feet.	Outwash consisting melt water deposited stratified red to brown fine to coarse sand and gravel. Highly permeable. Thickness ranges from 16 to 22.5 feet with an average thickness of 17.6 feet. Deposit ranges in depth from 13 to 28.5 feet bgs but typically is 21.7 feet bgs.

<sup>22</sup> Sources used to compile geologic unit information include: Perlmutter, 1953; Soren, 1988; Rosenberg, 2013; Mueser Rutledge Consulting Engineers, 1991; French & Parrello Associates, PA.1993; and French & Parrello Associates, PA. 1998.

**Table 3-4. Summary of Regional and Site-Specific Geologic Rock Units**

<b>Age</b>	<b>Regional Geology Unit and Description</b>	<b>Site Geology Unit and Description</b>
Pleistocene 3 Ma to 10,000 years	Terminal Moraine consisting of ice deposited and melt-water reworked dark red to brown poorly sorted sand, gravel, cobbles, and boulders in a clay-silt matrix. Ranges in thickness from 75 to approximately 200 feet thick.	Not Present.
	Ground Moraine consisting of ice deposited dark red to brown clayey till. Ranges in thickness to over 150 feet thick.	Not Present.
Upper Cretaceous 85 Ma to 65 Ma	Raritan Formation consisting of stratified white, light to dark gray and red, beds and lenses of clay, silt, and sand with common zones of lignite and pyrite. Ranges from 100 feet thick to over 400 feet thick. When subdivided the Raritan Formation consist of upper Raritan Clay underlain by a Lower Sand.	Raritan Formation Undivided – The “mostly clayey formation” consists of a varicolored interbedded brown to tan to light gray to white medium to fine sand (with trace of silt) with a clayey silt (with mica). The top of the Raritan Formation occurs at 35 to 90 feet bgs and ranges in thickness from 230 to over 300 feet thick beneath GKP.
	Raritan Clay Lower Sand Unit consisting of varicolored gray, white and red fine to coarse sand.	The Raritan Formation at GKP appears undivided and the lower sand does not appear to be present (Soren, 1988).
Upper Triassic to Lower Jurassic 231 Ma to 188 Ma	Palisade Diabase Sill consisting of dark gray sill igneous intrusion.	Not Present.
	Newark Supergroup consisting of reddish brown medium to coarse sandstone and shale.	Not Present.
Upper Proterozoic (PreCambrian to Cambrian) >590 Ma	Staten Island Serpentine - greenish-brown metamorphic ultramafic crystalline rock.	Staten Island Serpentine – greenish brown metamorphic ultramafic crystalline rock. Present in northeast corner of GKP near intersection of Buffalo Street and Hylan Road. Present at a depth of approximately 270 feet below MSL.
	Manhattan Schist consisting of dark-gray micaceous metamorphic rock.	Manhattan Schist consisting of dark-gray micaceous metamorphic rock. Present at a depth of over 300 feet below MSL.

**Table 3-5. Summary of USACE Dredging Information for Great Kills Navigation Channel and Anchorage Area**

<b>Location</b>	<b>Date (Month and Year)</b>	<b>Volume (Cubic Yards)</b>
Channel Entrance	12/1934 – 8/1935	271,408
Channel Entrance	12/1939	50,611
Channel and Anchorage Area	7/1941-2/1942	933,500
Channel and Anchorage Area	1943	27,876
Channel Entrance	1/1945-2/1945	62,516
Anchorage Area	6/1948	76,100
Anchorage Area	7/1948	93,712
<b>Total</b>		<b>1,515,723</b>

(Source: NPS, 2013 and July 27, 2012 Email from Annette Baden, Assistant to the Freedom of Information Act Officer, USACE)(Dallas, 2013)

**Table 3-6. Summary of New York City Department of Sanitation Activities and Waste Fill Volume at Site**

<b>Year and Source</b>	<b>Description of Action</b>	<b>Material</b>	<b>Waste Fill Volume Listed in 1948 Annual Report</b>
1946 NYC Dept. of Sanitation Annual Report	1,842 steel barges were unloaded at GKP. 72 deck scows containing 57,600 tons of sand were unloaded at GKP (96,768 cubic yards of sand).	Waste Fill Sand. (Assume a 1.68 factor to convert 1 wet ton of sand to 1 cubic yard.)	4,913,888 0
	491,117 cubic yards of waste were received by the Oakwood Truck Fill - a portion of the Marine Park set aside to accommodate trucks on Staten Island.	Waste Fill	490,721
1947 NYC Dept. of Sanitation Annual Report	Eight waterfront disposal stations received 4,647,007 cubic yards of ashes and other unburnable waste for...disposition at Great Kills S.I. Landfill	Waste Fill	4,677,293
	Oakwood received 492,050 cubic yards and reclaimed 30 acres.	Waste Fill	492,057
	22,500 tons of sand were unloaded at the Marine Unloading Plant (37,800 cubic yards of sand).	Sand. (Assume a 1.68 factor to convert 1 wet ton of sand to 1 cubic yard.)	0
1948 NYC Dept. of Sanitation Annual Report	Between January 1 and July 8, 1948, over 2 million cubic yards deposited into the landfill and over 467 acres of swamp land were reclaimed.	Waste Fill	2,179,815
	Oakwood received 362,280 cubic yards.	Waste Fill	362,280
		<b>Total</b>	<b>13,116,054</b>
1949 Press Release with Statistical Data Summary	From November 25, 1944 through July 8, 1948, 5,751 barges containing 15,078,725 cubic yards of waste fill and 1,200 scow loads of sand and other material used for dressing up or covering phase. 467 acres reclaimed.		15,078,725 1,962,671 deposited 1944 and 1945. Amount calculated based on total and known amounts for 46, 47, and 48

**Table 3-7. Summary of Fill Material (Percentage per Month) in Five New York City Landfills (August 3, 1939 to October 33, 1940)(NYC, 1941)**

<b>Classification</b>	<b>Range in Volume (Average)</b>	<b>Range in Weight (Average)</b>
Ashes	9.2 to 45.2 (24)	7.8 to 80 (43)
Glass	7.6 to 13.2 (11)	1.9 to 9.1 (6)
Metal	1.8 to 4.8 (3)	3.1 to 11.6 (7)
Wood	0.1 to 8.4 (4)	0.3 to 5.9 (3)
Paper	37.4 to 52.5 (46)	9.0 to 37.6 (22)
Misc	1.1 to 9.3 (4)	0.8 to 7.4 (3)
Food	6 to 14.3 (8)	3.5 to 43.8 (17)

**Table 3-8. Summary of Borings and Wells Near GKP**

<b>Boring/Well Location, Date</b>	<b>Glacial Deposit</b>	<b>Raritan</b>	<b>Bedrock</b>
R56, Test Boring #1 Oakwood Beach, Date drilled 1949, Elevation 2 feet. Total depth 102 feet. Located 500 feet north of GKP near Oakwood Beach WPCP.	Dark red to brown, fine to medium sand grading to fine to coarse sand with gravel. 54 feet thick.	Depth 54 feet. Pink to gray silt and clay grading to yellow and gray fine to medium sand with layers of silt and clay.	Not encountered – borehole completed at shallower depth.
R63 Boulevard Station #1 Well No. 7, Date drilled 1912, Elevation 10 feet. Total depth 319 feet. Casing 6-inch diameter, 6-inch diameter screen set at 45 to 55 feet bgs and 65 to 75 feet bgs. Yield 120 gallons per minute. 45 part per million chloride (composite of 14 wells). Located near intersection of Emmet Avenue and Hylan Boulevard.	Red to brown, coarse to fine sand with gravel. 75 feet thick.	Depth 75 to 270 feet. White to blue to gray to red clay.	Depth to bedrock 270 feet. Serpentine.
R84 564 Lynn Street (near intersection with New Dorp Lane), Date drilled unknown, Elevation 10 feet Total Depth 45. Diameter 1.5-inches. 10 gallons per minute. 131 part per million chloride. 2 miles northeast of GKP (not shown on Figure 3-8)	Sand.	Not described.	Not encountered – borehole completed at shallower depth.

Well 56 and 63 are shown in Figure 3-7. R84-564 is located to the north of mapped area shown in Figure 3-7. (Source Perlmutter, 1953)

**Table 3-9. Summary and Correlation of Fill (Hydraulic and Waste) with Soil Units at Site**

	Map Soil Unit Symbol and Name	Parent Material	Acres	%	Natural drainage class	Capacity
Hydraulic Fill Soil Units	<b>BaA</b> – Barren Sand, 0 to 3% slopes	Sandy <b>dredge spoils</b>	8.2	2	Somewhat poorly drained	Moderately high to very high (1.42 to 20.00 in/hr)
	<b>BiA</b> – Bigapple fine sand, 0 to 3% slopes	Sandy <b>dredge spoils</b>	149.8	32	Well drained	Moderately high to very high (1.42 to 20.00 in/hr)
	<b>BiB</b> – Bigapple fine sand, 3 to 8% slopes	Sandy <b>dredge spoils</b>	2	<1	Well drained	Moderately high to very high (1.42 to 20.00 in/hr)
	<b>JaA</b> – Jamaica sand, 0 to 3% slopes, frequently ponded	Sandy <b>dredge spoils</b>	52	11	Poorly drained	Moderately high to very high (1.42 to 20.00 in/hr)
Waste Fill Soil Units	<b>GOB</b> – Gravesend and Oldmill coarse sands, 0 to 8% slopes	Sandy human-transported material <b>over refuse</b> human-transported material.	180	39	Well drained	High to very high (5.95 to 19.98 in/hr)
	<b>GrA</b> – Greatkills gravelly sandy loam, 0 to 3% slopes	Loamy human transported material <b>over unlined refuse</b> human transported material	29	6	Well drained	Moderately low to moderately high (0.01 to 1.42 in/hr)
Fill Human Transported Material	<b>Gbb</b> – Greenbelt loam, 3 to 8% slopes	Loamy <b>human-transported material</b>	8	2	Well drained	Moderately high (0.43 to 1.42 in/hr)
	<b>UrA</b> – Urban land, reclaimed substratum, 0 to 3% slopes	Asphalt over <b>human-transported material</b>	5.5	1	NA	Very low (0.00 to 0.00 in/hr)
	<b>UtA</b> – Urban land, till substratum, 0 to 3% slopes	Asphalt over <b>human-transported material</b>	9.5	2	NA	Very low (0.00 to 0.00 in/hr)
Native Deposits	<b>BHBu</b> – Booton-Haledon complex, 0 to 8% slopes	Red coarse-loamy till derived from <b>sedimentary rock</b>	12	3	Well drained	Very low to moderately low (0.00 to 0.01 in/hr)
	<b>HDA</b> – Hooksan-Dune land complex, 0 to 3% slopes	<b>Eolian sands</b>	5.3	1	Excessively drained	High to very high (6.00 to 20.00 in/hr)
	<b>IPA</b> – Ipswich –Pawcatuck complex, 0 to 1 percent slopes, very frequently flooded	Herbaceous organic material	*	*	Very poorly drained	Moderately low to very high 0.14 to 99.90 in/hr)
	<b>SaA</b> – Sandyhook mucky fine sand, 0 to 3% slopes, very frequently flooded	<b>Sandy marine deposits</b>	3.7	1	Very poorly drained	Moderately high to high (1.43 to 14.17 in/h_
			465	100		

**Table 3-10 Summary of Hydraulic Conductivities for Staten Island, New York Aquifers**

<b>Aquifer Unit</b>	<b>Horizontal Conductivity</b>	<b>Vertical Conductivity</b>
Upper Glacial Till (Ground Moraine and Terminal Moraine)	0.01 to 0.16 feet per day	0.001 to 0.008 feet per day
Upper Glacial Outwash	270 feet per day	27 feet per day
Raritan Clay	--	0.001 feet per day
Lower Sand (Raritan) (Lloyd Aquifer)	40 feet per day	5 feet per day
Bedrock (Staten Island Serpentine and Manhattan Schist)	Less than 0.1 to 10 feet per day.	Highly variable

**Table 3-11. Summary of Information for Permitted Non-Potable Water Withdrawal Systems  
Located in ZIP Code 10306**

Type	Permit Category	Address	ZIP Code	Inferred Use <sup>23</sup>
Well Water (non-potable)	License	158 Penn Avenue	10306	Residence Use (Unknown)
Well Water (non-potable)	License	217 Midland Avenue	10306	Residence Use (Unknown)
Well Water (non-potable)	License	27 Dustan Street	10306	Residence Use (Unknown)
Well Water (non-potable)	License	23 Wolverine Street	10306	Residence Use (Unknown)
Well Water (non-potable)	License	2519 Hylan Boulevard	10306	Manfred Chevrolet - Carwash
Well Water (non-potable)	License	260 Clawson Street	10306	Residence Use (Pool)
Well Water (non-potable)	License	280 Guyon Avenue	10306	Residence Use (Pool)
Well Water (non-potable)	License	381 Freeborn Street	10306	Residence Use (Pool)
Well Water (non-potable)	License	417 Pendale Street	10306	Residence Use (Unknown)
Well Water (non-potable)	License	529 Oak Avenue	10306	Residence Use (Pool)
Well Water (non-potable)	License	67 Bache Avenue	10306	Residence Use (Unknown)
Well Water (non-potable)	License	255 Greeley Avenue	10306	Residence Use (Unknown)
Well Water (non-potable)	License	22 Zwicky Avenue	10306	Residence Use (Unknown)

<sup>23</sup> Inferred use is based on property location on Google Earth and the presence of pool or business description.

**Table 3-12. Summary of Vegetation Associations and Communities Identified at GKP**

Community	Underlying Soil	Vegetation Community Occurrence and Description
Backdune Association	The North Atlantic Coast Backdune Grassland Community	Vegetation is variable and depends on landscape setting and land-use history. It is dominated by gray clubawn grass ( <i>Corynephorus canescens</i> ) in more disturbed settings and by little bluestem ( <i>Schizachyrium scoparium</i> ).
	Northern Tall Maritime Shrubland Community	Characterized with very dense vegetation and often occurs inland of northern bayberry dune shrubland in sheltered settings.
Maritime Forest Associations	Successional Maritime Forest Community	Occurs on stabilized backdunes, generally leeward of secondary maritime dunes or in protected hollows and is found farther inland in association with Tall Maritime Shrubland Community. This community is characterized as having a somewhat open tree canopy (to 50 feet [15 meters] tall) of successional maritime forest strongly dominated by black cherry with common hackberry. Associated canopy species include red maple, American holly, white poplar, black locust, and lesser amounts of eastern red cedar, Japanese black pine, and eastern cottonwood ( <i>Populus deltoides</i> ).
Human-Modified Vegetation Associations	Early Successional Woodland/Forest Community	Consists of successional shrubland or open woodland or forest with northern hardwoods occurring in various settings following disturbance such as clearing, fragmentation, and deposition of fill material. Often occurs in a mosaic with other disturbed or successional communities, such as successional maritime forest and reed/grass tidal marsh, or even with paved areas. In the forests or woodlands, the open canopy is composed of a mix of early-successional species, including white poplar, quaking aspen ( <i>Populus tremuloides</i> ), gray birch ( <i>Betula populifolia</i> ), and black cherry. The shrubland expression of this community is characterized by a dense layer of tall shrubs that are strongly dominated by white poplar, with northern bayberry and black cherry.

**Table 3-12. Summary of Vegetation Associations and Communities Identified at GKP**

Community	Underlying Soil	Vegetation Community Occurrence and Description	
Human-Modified Vegetation Associations	Little Bluestem Old Field Community	Coarse sand to sandy loam and well-drained to somewhat poorly drained soils formed in sandy dredge fill and loamy fill over sandy sediments.	Occurs in disturbed areas and is generally maintained by mowing. Adjacent communities include northern tall maritime shrubland, northern bayberry dune shrubland, northeastern old field, and North Atlantic Coast backdune grassland, as well as parking lots and airstrips. This successional vegetation is dominated and characterized by little bluestem. Associated species include weeping lovegrass ( <i>Eragrostis curvula</i> ), purple lovegrass ( <i>E. spectabilis</i> ), gray clubawn grass, or a host of other grass or forb species.
	Northeastern Old Field Community	Coarse sand and sandy loam to mucky peat.	Extremely variable assortment of sites, from mowed fields to disturbed maritime dunes often dominated by common wormwood ( <i>Artemisia vulgaris</i> ) with a variety of grasses and forbs.
	Reed/Grass Tidal Marsh Community	Coarse to fine sand or (less often) mucky peat or mucky, fine, sandy loam. Soils can be derived from eolian sands or dredge fill.	Occurs adjacent to and commonly intermingled with mid-Atlantic maritime salt shrub and a range of tidal wetland habitats. Characterized by dense stands of Phragmites, which tends to grow in colonies of tall, stout, leafy plants, often to the exclusion of all other vascular plant species.

**Table 3-13. Summary of Rare Animals and Plants Listed by New York State as Endangered and Threatened**

Common Name	Scientific Name	Subgroup	Distribution Status	Year Last Documented	State Protection Status
Mocha Emerald	<i>Somatochlora linearis</i>	Dragonflies	Historically Confirmed	1926	
Rambur's Forktail	<i>Ischnura ramburii</i>	Damselflies	Recently Confirmed	2007	
Dune Sandspur	<i>Cenchrus tribuloides</i>	Grasses	Recently Confirmed	1998	Threatened
Fairy Wand	<i>Chamaelirium luteum</i>	Other Flowering Plants	Historically Confirmed	1905	Endangered
Fringed Boneset	<i>Eupatorium torreyanum</i>	Asters Goldenrods and Daisies	Recently Confirmed	2008	Threatened
Great Plains Flatsedge	<i>Cyperus lupulinus ssp. lupulinus</i>	Sedges	Recently Confirmed	1997	Threatened
Hyssop-skullcap	<i>Scutellaria integrifolia</i>	Other Flowering Plants	Historically Confirmed	1909	Endangered
Oakes' Evening-primrose	<i>Oenothera oakesiana</i>	Other Flowering Plants	Recently Confirmed	1992	Threatened
Persimmon	<i>Diospyros virginiana</i>	Other Flowering Plants	Recently Confirmed	2006	Threatened
Primrose-leaf Violet	<i>Viola primulifolia</i>	Other Flowering Plants	Recently Confirmed	1997	Threatened
Rose-pink	<i>Sabatia angularis</i>	Other Flowering Plants	Recently Confirmed	2003	Endangered
Southern Wood Violet	<i>Viola hirsutula</i>	Other Flowering Plants	Possible but not Confirmed	1908	Endangered
Trinerved White Boneset	<i>Eupatorium album var. subvenosum</i>	Asters Goldenrods and Daisies	Recently Confirmed	1992	Threatened

Source: NYSDEC Environmental Resources Mapper

**Table 3-14. State or Federally Listed Plant and Animal Species Known to Occur at Gateway National Recreation Area (NPS, 2014)**

Scientific Name	Common Name	Listing
<b>Birds</b>		
<u><i>Accipiter cooperii</i></u>	Cooper's hawk	SL
<u><i>Accipiter gentilis</i></u>	Northerngoshawk	SL
<u><i>Accipiterstriatus</i></u>	Sharp-skinned hawk	SL
<u><i>Ammodramus henslowii</i></u>	Henslow's sparrow	SL
<u><i>Ammodramus maritimus</i></u>	Seaside sparrow	SL
<u><i>Ammodramus savannarum</i></u>	Grasshopper sparrow	SL
<u><i>Asio flammeus</i></u>	Short-eared owl	SL
<u><i>Asio otus</i></u>	Long-earedowl	SL
<u><i>Bartramia longicauda</i></u>	Uplandsandpiper	SL
<u><i>Botaurus lentiginosus</i></u>	American bittern	SL
<u><i>Buteo lineatus</i></u>	Red-shouldered hawk	SL
<u><i>Calidris canutus</i></u>	Red knot	SL
<u><i>Caprimulgus vociferus</i></u>	Whip-poor-will	SL
<u><i>Charadriusmelodus</i></u>	Piping plover	FT,SL
<u><i>Chlidonias niger</i></u>	Black tern	SL
<u><i>Chordeiles minor</i></u>	Commonnighthawk	SL
<u><i>Circus cyaneus</i></u>	Northern harrier	SL
<u><i>Cistothorus platensis</i></u>	Sedge wren	SL
<u><i>Dendroica cerulea</i></u>	Ceruleanwarbler	SL
<u><i>Dolichonyx oryzivorus</i></u>	Bobolink	SL
<u><i>Eremophila alpestris</i></u>	Horned lark	SL
<u><i>Falco peregrinus</i></u>	Peregrinefalcon	SL
<u><i>Gavia immer</i></u>	Common loon	SL
<u><i>Haliaeetus leucocephalus</i></u>	Baldeagle	SL
<u><i>Icteria virens</i></u>	Yellow-breasted chat	SL
<u><i>Ixobrychus exilis</i></u>	Least bittern	SL
<u><i>Lanius ludovicianus</i></u>	Loggerhead shrike	SL
<u><i>Laterallus jamaicensis</i></u>	Blackrail	SL
<u><i>Melanerpes erythrocephalus</i></u>	Red-headed woodpecker	SL
<u><i>Nyctanassa violacea</i></u>	Yellow-crowned night-heron	SL
<u><i>Nycticorax nycticorax</i></u>	Black-crowned night-heron	SL
<u><i>Pandion haliaetus</i></u>	Osprey	SL
<u><i>Passerculus sandwichensis</i></u>	Savannah sparrow	SL
<u><i>Podilymbus podiceps</i></u>	Pied-billedgrebe	SL
<u><i>Pooecetes gramineus</i></u>	Vesper sparrow	SL

**Table 3-14. State or Federally Listed Plant and Animal Species Known to Occur at Gateway National Recreation Area (NPS, 2014)**

<b>Scientific Name</b>	<b>Common Name</b>	<b>Listing</b>
<u><i>Ralluselegans</i></u>	King rail	SL
<u><i>Rynchops niger</i></u>	Black skimmer	SL
<u><i>Sterna antillarum</i></u>	Leasttern	SL
<u><i>Sterna dougallii</i></u>	Roseate tern	FE,SL
<u><i>Sterna hirundo</i></u>	Common tern	SL
<u><i>Strix varia</i></u>	Barred owl	SL
<u><i>Vermivora chrysoptera</i></u>	Golden-winged warbler	SL
<b>Invertebrates</b>		
<u><i>Cicindela dorsalis dorsalis</i></u>	Northeastern beach tiger beetle	FT,SL
<b>Fish</b>		
<u><i>Acipenser brevirostrum</i></u>	Shortnose sturgeon	FE,SL
<u><i>Acipenser oxyrhynchus</i></u>	Atlantic sturgeon	FE
<b>Reptiles</b>		
<u><i>Caretta caretta</i></u>	Loggerhead turtle	FT,SL
<u><i>Chelonia mydas</i></u>	Green turtle	FT,SL
<u><i>Dermochelys coriacea</i></u>	Leatherback turtle	FE,SL
<u><i>Eretmochelys imbricata imbricata</i></u>	Hawksbill turtle	FE,SL
<u><i>Lepidochelys kempii</i></u>	Kemp's Ridley sea turtle	FE,SL
<u><i>Terrapene carolina carolina</i></u>	Eastern box turtle	SL
<b>Mammals</b>		
<u><i>Balaenoptera borealis</i></u>	Sei whale	FE,SL
<u><i>Balaenoptera musculus</i></u>	Blue whale	FE,SL
<u><i>Balaenoptera physalus</i></u>	Fin whale	FE,SL
<u><i>Eubalaena glacialis</i></u>	Northern right whale	FE,SL
<u><i>Megaptera novaeangliae</i></u>	Humpback whale	FE,SL
<u><i>Myotis sodalis</i></u>	Indiana bat	FE,SL
<u><i>Phocoena phocoena</i></u>	Harbor porpoise	SL
<u><i>Physeter macrocephalus</i></u>	Sperm whale	FE,SL
<b>Plants</b>		
<u><i>Amaranthus pumilus</i></u>	Seabeach amaranth	FT, SL
<u><i>Bidens laevis</i></u>	Smooth bur-marigold	SL
<u><i>Cenchrus tribuloides</i></u>	Sanddune sandbur	SL
<u><i>Chenopodium rubrum</i></u>	Red pigweed	SL
<u><i>Cuscuta polygonorum</i></u>	Smartweed dodder	SL

**Table 3-14. State or Federally Listed Plant and Animal Species Known to Occur at Gateway  
(NPS, 2014)**

<b>Scientific Name</b>	<b>Common Name</b>	<b>Listing</b>
<i>Cyperus flavescens</i> var. <i>flavescens</i>	Yellow flatsedge	SL
<i>Cyperus lupulinus</i> ssp. <i>lupulinus</i>	Hop sedge	SL
<i>Cyperus retrorsus</i>	Retrorse flatsedge	SL
<i>Cyperus schweinitzii</i>	Schweinitz's flatsedge	SL
<i>Digitaria filiformis</i>	Slender crabgrass	SL
<i>Eupatorium leucolepis</i> var. <i>leuco-</i>		
<i>Eupatorium torreyanum</i>	Fringed boneset	SL
<i>Galium concinnum</i>	Shining bedstraw	SL
<i>Glaux maritima</i>	Sea milkwort	SL
<i>Juniperus horizontalis</i>	Creeping juniper	SL
<i>Lycopus rubellus</i>	Gypsy wort	SL
<i>Magnolia virginiana</i>	Sweetbay magnolia	SL
<i>Oenothera humifusa</i>	seabeach evening-primrose	SL
<i>Oenothera laciniata</i>	Cut-leaved evening-primrose	SL
<i>Oenothera oakesiana</i>	Oakes' evening-primrose	SL
<i>Polygonum glaucum</i>	Seabeach knotweed	SL
<i>Quercus phellos</i>	Willow oak	SL
<i>Solidago sempervirens</i> var. <i>mexi-</i>		
<i>Suaeda linearis</i>	Narrow leaf sea-blite	SL

SL= State Listed, FT= Federally Threatened, FE=Federally Endangered

**Table 3-15. Summary of Mean Monthly Climatological Data Near GKP**

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
<b>Average Temp. (F)</b>	32.2	34.6	42.7	54.0	63.7	73.0	78.5	76.7	69.1	57.3	47.3	37.9	
<b>Average Precipitation (in)</b>	3.5	2.9	3.9	4.1	3.9	4.7	4.3	4.2	4.1	4.0	3.2	4.1	47
<b>Average Snowfall (in)</b>	9.7	12.2	5.5	0.6	0.0	0.0	0.0	0.0	0.0	0.3	1.0	8.0	37

**Table 4-1. Summary of Operations, Sources, and Hazardous Substances**

<b>Operations</b>	<b>Dates of Operations</b>	<b>Sources/Waste Characteristics (Type and Quantity)</b>	<b>Hazardous Substances<sup>24</sup></b>	
Bay Terrace Incinerator (20 Tons per day of Incinerator Residue) and Garbage	1926-1941	Incinerator Residue (224,615 Cubic Yards/197 Kilotons)	Metals, Radionuclides	
		Gasoline Tank	VOCs	
		Vehicle Maintenance-Repair	VOCs, SVOCs	
GKP Former Landfill/Oakwood Truck Fill GKP Marine Unloading Ops 2 Fuel Oil Tanks Waste Fill Sewage Sludge Soil Amendment	1934-1948	Oakwood Truck Fill and GKP Landfill, 15.1 Million Cubic Yards Waste Fill	Metals, VOCs, SVOCs Radionuclides	
		Incinerator Residue (1,855 Kilotons)	Metals, Radionuclides	
	1944-1948	Radium Contaminated Debris Radioluminescent Markers Brachytherapy Devices Slag and Cinders	Radionuclides	
		Coal Ash (1,198 Kilotons)	Metals, TENORM	
		Marine Unloader Plants. 2 10,000 Gallon Diesel Fuel ASTs	SVOCs	
	1944-1948	Waste Disinfectant Spraying– Dichlorobenzene	VOCs	
	1955-1959	Soil Amendment using Sewage Sludge - 285,000 Cubic Yards of Sludge Mixed with 213,000 Cubic Yards of Clay	Metals, and Organics	
	Oakwood Beach Water Pollution Control Plant Sludge Drying Beds and Associated Buried/Abandoned Piping	1954 to Present	30-Inch Diameter Sanitary Sewer (Approximately 7,900 Feet Long) 7 Feet Below Mean Sea Level	Unknown
		1956 to 1978 (late 70s)	Sludge Drying Beds (Sewage Sludge) Covering 13 Acres and Associated Buried/Abandoned Piping	Metals, SVOCs,
		Late 1970s to Present	8-Foot-Diameter West Branch Interceptor (Approximately 6,300 Feet Long) 23 Feet Below Mean Sea Level	Unknown
Potential Impacts on Site Due to Releases from Tanks are Unknown.	Unknown and Removed 2010	Closed Two 30K-Gallon No. 2 Fuel Oil USTs. Removed 300 Cubic Yards of Impacted Soil. Closed 550 Gallon UST.	VOCs, SVOCs	
Isolated Dump Areas	Unknown	Empty-Rusted Drums Railroad Ties Abandoned Cars Propane Cylinders ~ 20 pounds Tar Stained Surface Areas	SVOCs and Unknown	

<sup>24</sup> Semi Volatile Organic Compounds (SVOCs), Volatile Organic Compounds (VOCs), and Technology Enhanced Naturally Occurring Radioactive Material (TENORM).

**Table 4-2. Summary of Fill Material (Percent per Month) in Five City Landfills and Site**

<b>Classification</b>	<b>Range in Volume (Average)</b>	<b>Site Volume 1944-1948 In 1,000s of Cubic Yards</b>	<b>Range in Weight (Average)</b>	<b>Site Weight 1944-1948 In Kilotons</b>
Ash <sup>25</sup>	9.2 to 45.2 (24)	3,628	7.8 to 80 (43)	3,250
Glass	7.6 to 13.2 (11)	1,663	1.9 to 9.1 (6)	453
Metal	1.8 to 4.8 (3)	453	3.1 to 11.6 (7)	529
Wood	0.1 to 8.4 (4)	605	0.3 to 5.9 (3)	227
Paper	37.4 to 52.5 (46)	6,954	9.0 to 37.6 (22)	1,663
Misc.	1.1 to 9.3 (4)	605	0.8 to 7.4 (3)	227
Food	6 to 14.3 (8)	1,209	3.5 to 43.8 (17)	1,285
<b>TOTAL</b>		<b>15,117</b>		<b>7,634</b>

<sup>25</sup> Assumes ash includes both incinerator residue and coal ash (see terms defined above).

**Table 4-3. Summary of City Incinerator Plants Operating During 1944-1948**

<b>Plant</b>	<b>County</b>	<b>Design Combustion (tons/day)</b>	<b>Year Opened</b>	<b>Year Closed</b>	<b>Incinerator APC Class</b>	<b>Waste Combusted 1944 -1948 (kT)</b>	<b>Incinerator Residue Produced 1944 - 1948 (kT)</b>
56 Street	Manhattan	680	1937	1969	MWC-2	664	179
73 Street	Manhattan	290	1927	1953	MWC-2	283	76
139th Street	Manhattan	290	1925	1958	MWC-2	283	76
W 215th Street	Manhattan	680	1934	1970	MWC-2	664	179
Hamilton Avenue	Kings	454	1929	1962	MWC-2	443	120
Greenpoint	Kings	454	1929	1959	MWC-2	443	120
Flatlands	Kings	454	1929	1958	MWC-2	443	120
Ravenswood	Queens	336	1918	1950	MWC-1	328	89
Flushing	Queens	272	1936	1955	MWC-2	265	72
Zerga Street	Brooklyn	680	1934	1969	MWC-2	664	179
W. New Brighton	Richmond	136	1924	1958	MWC-2	133	36
<b>TOTAL</b>		<b>4,726</b>				<b>4,613</b>	<b>1,246</b>

Information regarding the Bay Terrace Incinerator is included in section 4.1.1. The Bay Terrace Incinerator operated from 1926 to 1941 and the residue from Bay Terrace Incinerator was disposed of on Site in the vicinity of the incinerator. The 11 incinerators identified in Table 4-3 may have contributed incinerator residue to the Site. This incinerator residue was transported to the Site in the scows with the City waste and disposed of on Site as the waste fill.  
(Modified from Walsh, 2001)

**Table 4-4. Summary of Artifacts Identified at the Site**

Artifact	No of Artifacts	Dose at Contact (mR/hr)	Description and Reference	Photograph
Deck Marker	6	1.5 to 19	1.5-inch outer diameter contains approximately 7 $\mu$ Ci. Marked "Poison Inside" Tidewater, 2015, TCRA.	
Personnel Marker	1	3	Marker attached to metal bracket. Tidewater, 2015, TCRA.	
Radium Pellets	20	1.5	Area saturated with pellets. Pellets contain 1 to 2 $\mu$ Ci of radium. Marker for helmet. Tidewater, 2015, TCRA.	
Radium Switch Board Buttons		20	Small buttons impregnated with radium-226 Tidewater, 2015, TCRA.	
Radium Paint Jar	2	20	Jar is approximately 4 oz. based on lid opening diameter and height (less than 2-inches). Tidewater, 2015, TCRA.	
Radium Powder Vial	1	0.05	Vial with white liquid -used to store radium powder/paint for touch-up applications. Tidewater, 2015, TCRA and Oak Ridge Institute for Science and Education, 2008.	
Radium Needle Brachytherapy Device	1	25(*)	Used for cancer treatment, 0.5 inches long. Calculated activity 3 milliCuries (mCi). Needle "degraded" and "not intact.". *calc at one foot. Cabrera Services, 2010, IRA.	
Radium Tube Brachytherapy Device	1	>2R/hr	Used for cancer treatment, less than 1 inch long. Calculated radioactivity was 10 mCi. Tube "degraded" and "not intact." Cabrera Services, 2010, IRA.	
Slag	9	0.06 to 12	Suspected slag, cinder layer, Tidewater, 2015, TCRA.	

**Table 5-1. Summary of Doses for Maintenance Worker, Visitor, Park Ranger, Fire Fighter and Nearby Resident**

<b>Critical Group</b>	<b>External Dose (mrem)</b>	<b>Inhalation Dose (mrem)</b>	<b>Ingestion Dose (mrem)</b>	<b>Fire Inhalation Dose (mrem)</b>	<b>Maximum Annual Total Dose (mrem)</b>
Maintenance Worker	6.63	0.14	0.17	NA	6.93
Recreational Visitor	8.28	0.05	0.02	NA	8.35
Park Ranger	6.63	0.17	0.17	NA	6.96
Fire Fighter	2.03	0.01	0.01	0.19	2.24
Nearby Resident	NA	NA	NA	0.24	0.24

NA = Not Analyzed.

