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Consolidated Edison Company of New York, Inc.

Final Feasibility Study Report

Flushing Industrial Park
Operable Unit 2
Flushing, New York

August 2013

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Feasibility Study Report

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Certification

I, Margaret Carrillo-Sheridan, P.E., certify that I am currently a New York State registered Professional Engineer and that this Feasibility Study Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

22-Aug-2013

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Acronyms and Abbreviations

AKRF	AKRF Engineering, P.C.
AST	aboveground storage tank
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
bgs	below ground surface
BMP	best management practice
bss	below sediment surface
CAMP	Community Air Monitoring Plan
C.E. Flushing	C.E. Flushing, LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Con Edison	Consolidated Edison Company of New York, Inc.
Consent Order	Order on Consent and Administrative Settlement Index Number W2-1114-07-12
CSO	combined sewer overflow
CWA	Clean Water Act
cy	cubic yard
DAR	Division of Air Resources
DDT	dichlorodiphenyltrichloroethane

DER-10	Division of Environmental Remediation-10 Technical Guidance for Site Investigation and Remediation
DER-31	Division of Environmental Remediation-31 Green Remediation
DER-33	Division of Environmental Remediation Institutional Controls: A Guide to Drafting and Recording Institutional Controls
E2EMIP	estuarine and marine wetland
FEMA	Federal Emergency Management Agency
FRTR	Federal Remediation Technologies Roundtable
FS Report	*Feasibility Study Report*
GHG	greenhouse gas
GRA	general response action
HASP	Health and Safety Plan
LDR	Land Disposal Restriction
LNAPL	light non-aqueous phase liquid
mg/kg	milligrams per kilogram
MNR	monitored natural recovery
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NHP	Natural Heritage Program
NWP	Nationwide Permit

NYCDEP	New York City Department of Environmental Protection
NYCDOT	New York City Department of Transportation
NYCRR	New York Codes, Rules, and Regulations
NYC WRP	New York City Wetland Revitalization Program
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
OU1	Operable Unit 1
OU2	Operable Unit 2
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCOI	potential constituent of interest
POTW	publically owned treatment works
PPE	personal protective equipment
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RIR	*Remedial Investigation Report*

SCG	standard, criteria, and guidance
SMP	Site Management Plan
SPDES	State Pollutant Discharge Elimination System
TAGM	Technical and Administrative Guidance Memorandum
TCLP	toxicity characteristic leaching procedure
TOC	total organic carbon
TSCA	Toxic Substances Control Act
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
USCG	United States Coast Guard
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFWS	United States Federal Wildlife Service
UST	underground storage tank
UTS	Universal Treatment Standard
VOC	volatile organic compound
WWTP	wastewater treatment plant

1. Introduction

This *Feasibility Study Report* (FS Report) has been developed on behalf of Consolidated Edison Company of New York, Inc. (Con Edison) in accordance with the Order on Consent and Administrative Settlement Index Number W2-1114-07-12 (Consent Order). The New York State Department of Environmental Conservation (NYSDEC) and Con Edison entered into the Consent Order on April 19, 2008 for development and implementation of a remedial program to investigate and address potential impacts to the Flushing River from historic operations at Flushing Industrial Park located in Flushing, New York. The upland portions of Flushing Industrial Park have been divided into Parcel 1, Parcel 2, and Parcel 3, collectively known as Operable Unit 1 (OU1). Parcel 4 is an approximate 0.3 acre tract in the Flushing River that occupies an intertidal mudflat and underwater portions of the property. Con Edison is responsible for investigation and, if necessary, remediation of Parcel 4 and other potentially impacted portions of the Flushing River, collectively identified as Operable Unit 2 (OU2), which was initially defined without a boundary by the Consent Order as contamination emanating from Parcels 2 and 3. Subsequently, the boundary of OU2 was established as part of the remedial investigation (RI) (see Section 1.5.2).

1.1 Regulatory Framework

This FS Report was developed to evaluate remedial alternatives proposed to address environmental impacts identified during the RI of OU2 in a manner consistent with the Consent Order and with applicable provisions of the following documents:

- NYSDEC Division of Environmental Remediation-10 Technical Guidance for Site Investigation and Remediation (DER-10; NYSDEC, 2010a)
- United States Environmental Protection Agency (USEPA) Guidance for Conducting Remedial Investigations and Feasibility Studies Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Interim Final (USEPA, 1988)
- National Oil and Hazardous Substances Pollution Contingency Plan (NCP) regulations contained in Title 40 of the Code of Federal Regulations (CFR) Part 300

- New York State Environmental Conservation Law and associated regulations, including Title 6 of the New York Codes, Rules, and Regulations (NYCRR) Part 375-6 (6 NYCRR Part 375-6)

1.2 Purpose

The purpose of this FS Report is to identify and evaluate remedial alternatives for OU2 sediments that are:

- appropriate for site-specific conditions
- capable of achieving site-specific remedial action objectives (RAOs)
- consistent with relevant sections of the NYSDEC guidance, NCP, and CERCLA

1.3 Report Organization

The remaining portions of this FS Report are organized into the following sections:

- *Section 2 – Standards, Criteria, and Guidance:* Identifies standards, criteria, and guidance (SCGs) used for the development and selection of remedial alternatives.
- *Section 3 – Remedial Goal and Remedial Action Objectives:* Presents a summary of the RI human health and ecological exposure assessments and develops site-specific RAOs.
- *Section 4 – Development of General Response Actions and Screening of Remedial Technologies:* Presents the results of a screening process to identify potentially applicable remedial technologies and develops remedial alternatives that have the potential to meet the RAOs.
- *Section 5 – Development and Evaluation of Remedial Alternatives:* Presents a detailed description and analysis of each potential remedial alternative using the evaluation criteria presented in the FS guidance documents referenced in Section 1.1 of this FS Report.
- *Section 6 – Comparative Analysis:* Presents a comparative analysis of each remedial alternative using the evaluation criteria.

- *Section 7 – Recommended Remedial Alternative:* Identifies the preferred remedial alternative to meet the RAOs.

- *Section 8 – References*: Provides a list of documents cited in this FS Report.

1.4 Site Description and History

1.4.1 Site Location and Description

Flushing Industrial Park consists of an approximate 13.6-acre tract of improved real property and riverfront located along the northwest corner of College Point Boulevard and 40th Road in Flushing, Queens County, New York (Figure 1-1). The property is bordered by Roosevelt Avenue to the north, College Point Boulevard to the east, 40th Road to the south, and the Flushing River to the west. Flushing Industrial Park is identified by the Borough of Queens as Tax Block 5066, Lots 1, 100, 9001, 9002, and 9100.

Flushing Industrial Park has been the subject of investigation and remediation and has been subdivided into OU1 and OU2. Figure 1-1 depicts the location and extent of OU1 and OU2. OU1 has been defined as the upland portion of Flushing Industrial Park. OU1 has been divided into three parcels under the executed NYSDEC Brownfield Cleanup Agreements (BCAs):

- Parcel 1 (Eastern), designated as NYSDEC Brownfield Cleanup Program (BCP) Site No. C241051, consists of an irregularly shaped approximately 5.4-acre tract located adjacent to College Point Boulevard.

- Parcel 2 (Western), designated as NYSDEC BCP Site No. C241078, consists of an irregularly shaped approximately 7-acre tract located in the central and western portions of the property.

- Parcel 3 (Western Waterfront), designated as NYSDEC BCP Site No. C241079, consists of an irregularly shaped approximately 0.9 acre tract along the Flushing River waterfront.

Parcel boundaries are depicted on Figure 1-2. Parcels 1 and 2 have been redeveloped with mixed use high-rise buildings and parking structures. Redevelopment plans for Parcel 3 consist of a waterfront esplanade and a portion of the Parcel 2 retail structure.

The future use of Parcels 1, 2, and 3 (OU1) is anticipated to remain a mixed commercial/industrial setting. Parcel 4, which is included in OU2, is an approximate 0.3 acre tract in the Flushing River that occupies an intertidal mudflat and underwater portions of the property. Currently, development is not planned in this area and Parcel 4 is anticipated to remain lands underwater. In the longer term, the New York City Wetland Revitalization Program recommends redevelopment of the site and surrounding area for moderate-density residential and commercial uses, with publicly accessible waterfront open space, while still maintaining active industrial use of the Flushing River area north of Northern Boulevard.

As part of the remedial actions implemented under the BCA, an underground barrier wall, constructed of interlocking steel sheeting, was installed at the boundaries of Parcels 3 and 4. Based on groundwater level measurements in monitoring wells installed after the remedial excavation, the sheeting appears to be limiting the tidal influence on OU1 groundwater (AKRF Engineering, P.C. [AKRF], 2007a).

Dredging of the Flushing River through federal navigation improvement projects has been implemented since 1878. However, the river area at and adjacent to Flushing Industrial Park has been closed to navigation for at least 40 years, according to comparisons of National Oceanic and Atmospheric Administration charts from 1967 to 2008 (ARCADIS, 2008).

1.4.2 Site History and Operation

Flushing Industrial Park was owned and used by Con Edison and its predecessor company, Queens Electric Light and Power, from 1923 to the 1980s. Flushing Industrial Park was purchased from Atlas Cereal Company, Inc. (acting for Remington Typewriter) in 1923, and during the 1950s, Con Edison expanded the property through acquisition of several row houses in the southeast portion of the property. On February 24, 1989, Con Edison transferred the title over to C.E. Flushing, LLC (C.E. Flushing) for redevelopment by Muss Development for residential and commercial use.

During the time the property was owned by Con Edison and its predecessor company, it was operated as a service center to support electrical and gas utility operations. The activities conducted on the property during the time of Con Edison’s ownership included:

- servicing and cleaning of trucks
- storage of gasoline and diesel fuel in underground storage tanks (USTs)
- operation of gasoline and diesel fuel dispensing pumps
- storage of electrical cable, pipes, and wooden utility poles
- storage of transformer oil that likely contained polychlorinated biphenyls (PCBs) in aboveground storage tanks (ASTs)
- storage of distribution system equipment, including scrap cable and field-returned transformers that likely used PCB-containing oil

From 1989 until early 2005, C.E. Flushing leased portions of the property to a wide variety of commercial and industrial tenants. Former uses during this time period include a cloth manufacturing workshop, blacksmith shop, incinerator, paint house, gas station, storage warehouse, parking lot for buses and trucks, automobile parts cleaning operation, truck repair shop, the storage of electrical equipment and lighting fixtures, an automobile parts salvage yard, cement mixing facility, and office space.

In 2001, C.E. Flushing entered into a Voluntary Cleanup Agreement with the NYSDEC under which several phases of investigation were completed. In September 2004, Flushing Industrial Park was transferred into the NYSDEC BCP and divided into four parcels (Parcels 1 through 4), each under a separate BCA. In 2005, C.E. Flushing conducted a limited investigation of Parcel 4 and nearby river areas under the BCA. Based on the results of this investigation, Parcel 4 was removed from the BCP and the NYSDEC and Con Edison entered into the Consent Order. The NYSDEC issued certificates of completion for Parcels 1 through 3 (OU1) in 2007.

1.4.3 Physical and Environmental Setting

1.4.3.1 Site Setting

The Flushing River is an approximately 7,000-foot-long narrow tidal water body located in a heavily urbanized area (Figure 1-1). Generally, land use consists of residential and industrial along the eastern shore, parkland along the southern shore, and commercial and transportation along the western shore. Across the river bordering the opposing shoreline from Flushing Industrial Park is Willets Point. The area was historically used as a disposal area for ash in the early 1900s, with an estimated 50 million cubic yards (cy) disposed between 1906 and 1932 (New York City Department of Environmental Protection [NYCDEP], 2007). Current land use in the Willets Point area consists of scrap metal shops, automobile repair shops, and automobile dismantlers. The area is not serviced by public sewer systems, and illegal discharges to groundwater and storm sewers are known to have occurred. In April 2001, 21 automobile dismantlers and 35 individuals were indicted for violating state environmental laws by dumping motor oil, antifreeze, transmission fluid, and other materials onto the ground, into storm drains, and into Flushing Bay (New York State Department of Law, 2001). Wastes were reportedly released as automobiles were dismantled for recycling. According to the New York State Department of Law (2001), the businesses collectively dumped thousands of gallons of waste fluids. This area is currently being considered for redevelopment by New York City.

The Flushing River originates in Flushing Meadows-Corona Park and discharges into the southern end of Flushing Bay just west of its crossing under the Whitestone Expressway. The Flushing River is designated as a Class I water body by the NYSDEC, which indicates that the waters should be suitable for fish propagation and survival and secondary contact recreation and fishing.

Along the length of the Flushing River, various areas have been filled in by dredged material placed directly on adjacent shores to create dry land for development. A large area of filled land exists at the head of the river, at Flushing Meadows-Corona Park. This area, formerly a tidal marsh, was filled in the beginning of 1936 for the New York World's Fair of 1939 to 1940. Soil from subway excavations and garbage and ash from Brooklyn, much of it already disposed in Brooklyn by the Brooklyn Ash Removal Company as early as 1914, was utilized to fill the tidal marsh.

1.4.3.2 Site Geology

At OU1, remedial and geotechnical investigations of Parcel 3 indicated that the top 6 to 17 feet of soil consists of miscellaneous fill, ranging from silty clay to sand with anthropogenic materials, including brick, ash, and cinders (AKRF, 2007a; 2007b; 2007c). The subsequent 30 to 40 feet below this fill layer appeared to be organic clayey silt and peat, underlain by the native clay unit, which is occasionally interspersed with layers of sand, gravel, cobbles, and boulders. Flushing River sediments in Parcel 4 and surrounding areas of the river consist of clayey silt with organics and anthropogenic materials (e.g., paper, slag, plastics, brick, coal, porcelain, Styrofoam, aluminum foil, steel) overlying a dark greenish-gray silty clay (native clay unit) (ARCADIS, 2011). The native clay unit was observed at depths between 2 and 4.6 feet below sediment surface (bss) in Flushing River sediments in Parcel 4, and to a depth of 13.9 feet bss in other portions of the Flushing River. The depth to the native clay unit decreases from the center of the Flushing River channel to the shorelines. Silt, sand, or gravel was observed on top of or interspersed in the native clay unit (ARCADIS, 2011). The location of select soil borings at OU1 and sediment cores on and near Parcel 4 are shown on Figure 1-3. Representative cross-sections within this area are provided as Figures 1-4a, 1-4b, and 1-4c.

1.4.3.3 Site Hydrogeology and Hydrology

Flushing Industrial Park is located adjacent to the Flushing River, an approximately 7,000-foot-long narrow tidal water body located in a heavily urbanized area. The Flushing River originates in Flushing Meadows-Corona Park and discharges into the southern end of Flushing Bay just west of its crossing under the Whitestone Expressway (Figure 1-1). Along the shores, intertidal mudflats are exposed at low tides. Tidal fluctuations within the Flushing River adjacent to Flushing Industrial Park are approximately 7 feet. Tidal exchange is restricted, and the river is a depositional area with low bottom shear stresses. Modeling and dye studies suggest an exchange half-life of 36 hours at the head of the Flushing River (NYCDEP, 2007).

Groundwater elevations are tidally influenced on Parcels 2 and 3 and are generally 3 to 5.5 feet below ground surface (bgs), with a variation of up to 1.5 feet bgs observed in monitoring well MW-6 near the Flushing River. However, the underground barrier wall at the boundaries of Parcels 3 and 4 seems to limit tidal influence based on measurements in monitoring wells installed after the remedial excavation. The general groundwater flow direction is to the west and northwest on Parcel 2, and to the west on Parcel 3 (AKRF, 2006; 2007b; 2007c). Groundwater in the southeastern portion of Parcel 2 appears to be locally influenced by an NYCDEP sewer pump house located in the southwestern area of Parcel 1 (AKRF, 2007b; Figure 1-2).

Due to urbanization of the watershed, the Flushing River receives virtually no freshwater inflow, other than stormwater from three combined sewer overflows (CSOs) and multiple storm sewer outfalls. Base flow is minimal, approximately 5 cubic feet per second. The annual overflow volume to the Flushing River from the three CSOs that discharge to the river is estimated to be 1,942 million gallons under baseline conditions (NYCDEP, 2007). The main source of saline water to the Flushing River is the East River, which is composed of ocean water mixed with freshwater from the Hudson River, as well as smaller freshwater tributaries to the East River and Long Island

Sound. Due to the high oxygen demand resulting from increased organic carbon input from the CSOs and rainfall-induced thermohaline stratification, hypoxia can occur in the Flushing River following large to moderate rainfall events. In the absence of additional rainfall, the stratification typically breaks down within a few tidal cycles due to mixing and the exchange of water with the East River.

1.5 Summary of Remedial Investigations and Actions

1.5.1 Summary of Previous Investigations and Remedial Measures

Between 1989 and 2007, numerous investigations were completed within OU1, and sediment investigations were completed within OU2 between 2005 and 2010 to evaluate the nature and extent of site-related constituents. Remedial actions were implemented within OU1 between 2001 and 2007. A summary of these investigations and remedial actions is presented below.

1.5.1.1 Operable Unit 1

RI activities were conducted within OU1 between 1989 and 2007. Generally, volatile organic compounds (VOCs), semivolatile organic compounds, PCBs, pesticides, and metals were detected in soil at concentrations above the site-specific action levels approved by the NYSDEC and the New York State Department of Health (NYSDOH). These constituents were also detected in groundwater samples collected across OU1. Concentrations of these compounds in both soil and groundwater were mainly distributed heterogeneously across OU1. Two areas, one area on the southern portion of Parcel 2 and one on the northeastern portion of Parcel 3, were found to contain light non-aqueous phase liquid (LNAPL) in monitoring wells. Monitoring wells that contained LNAPL are depicted on Figure 1-2.

Remedial actions implemented across OU1 to mitigate potential exposure to the constituents detected in soil included removal of ASTs and USTs, removal of drainage structures, installation of permanent sheeting along the boundary of Parcels 3 and 4, soil excavation to the water table, soil excavation below the water table in limited areas, and engineering and institutional controls. LNAPL was also removed through activated carbon filtration. No active groundwater remediation was conducted within OU1. The NYSDEC issued certificates of completion for Parcels 1 through 3 (OU1) in 2007.

1.5.1.2 Operable Unit 2

The sediment investigation activities conducted between 2005 and 2010 within OU2 were performed by AKRF (2005) and ARCADIS (2009 to 2010).

In 2005, AKRF conducted a limited investigation of Parcel 4. During the investigation, seven sediment cores were advanced in the mudflat on Parcel 4 (SD-1 through SD-7). In addition, 12 sediment cores (SD-8 through SD-19) were advanced in the Flushing River at locations upstream and downstream from Parcel 4. Sediment cores were completed to depths ranging from 0.5 to 4 feet bss. Sample locations are shown on Figure 1-5. Up to two samples were collected from each core. Sediment samples from cores SD-1 through SD-8 were analyzed for Target Compound List VOCs, polycyclic aromatic hydrocarbons (PAHs), PCBs, pesticides, Target Analyte List metals, and grain size. Sediment samples from cores SD-9 through SD-19 were analyzed for PCBs, lead, total organic carbon (TOC), and grain size. In the samples collected within Parcel 4, PAHs, pesticides, PCBs, and metals were detected at concentrations above the NYSDEC sediment screening levels. PCBs and lead were also detected at concentrations above the NYSDEC sediment screening levels in the samples collected in the Flushing River outside of Parcel 4. Based on the results of the initial Parcel 4 investigation, PAHs, pesticides, PCBs, and select metals were identified as potential constituents of interest (PCOIs) in the sediments of the Flushing River and were identified for further investigation.

RI activities were conducted by ARCADIS in 2009 and 2010 and included the collection of 42 sediment cores at 36 locations (SD-20 through SD-55; at some locations more than one core was collected). Sample locations are shown on Figure 1-5. During the RI, sediment samples were analyzed for PCB Aroclors, PAHs, metals (arsenic, cadmium, copper, lead, mercury, and silver), pesticides, and TOC. A limited number of core locations (nine locations) were also analyzed for VOCs, and select samples (25 samples and two duplicate samples) were analyzed for PCB congeners. Two cores were analyzed for radiochemical parameters.

Field observations and analytical data of sediments within the Flushing River indicated the sediments contain a variety of constituents at varying concentrations depending on location and depth. Based on an evaluation of the frequency of detection, frequency in which concentrations exceeded screening levels, and/or overall concentrations detected of these constituents, representative PCOIs in the Flushing River include total PCBs, total dichlorodiphenyltrichloroethane (DDT), total PAHs, and metals (mercury, copper, lead, and silver). Other constituents evaluated (VOCs, other pesticides, arsenic, and cadmium) were either detected infrequently, generally below screening levels, or generally detected at relatively low concentrations.

Additionally, PCB Aroclor and congener data collected as part of the RI were used to conduct a forensic evaluation to identify potential sources of PCBs in sediments. The distribution of PCB Aroclors in Flushing River sediments (ARCADIS, 2011), in conjunction with PCB Aroclor data collected by AKRF (AKRF, 2007a; 2007b; 2007c) from OU1 catch basins, drainage structures, and monitoring wells (MW-5, MW-6, and MW-12), were evaluated. The PCB Aroclor and congener data from sediment samples were also evaluated using common forensic interpretive tools. The analytical and forensic evaluations were then used as multiple lines of evidence to identify potential PCB sources in the Flushing River. Three potential sources of PCBs to the Flushing River were identified and classified as PCB Source 1, PCB Source 2, and PCB Source 3. These sources are further described below in Section 1.5.2.

The reconnaissance events conducted as part of the RI activities confirmed the presence of two storm sewer culverts and two CSO outfalls, and confirmed the location of four former outfalls from the former OU1 drainage system that discharged to the Flushing River.

1.5.2 Nature and Extent of Impacts

The spatial distribution of representative PCOI concentrations within the sediment are described herein with respect to three geographic areas: Near-Site, North, and South (as shown on Figure 1-5), which are defined below:

- *Near-Site* – Cores located east of the Van Wyck Expressway and south of Roosevelt Avenue
- *North* – Cores located north of Roosevelt Avenue
- *South* – Cores located west of the Van Wyck Expressway and south of Roosevelt Avenue

For the purposes of the RI and FS, three general sediment depth categories have been identified: surface (0 to 0.5 foot bss), near-surface (0.5 to 2 feet bss), and subsurface (greater than 2 feet bss).

Based on the results of the 2009 and 2010 RI, the sediments of the Flushing River were characterized as containing a variety of constituents at varying concentrations depending on locations and depth. The distribution of total PCBs and total DDT varied throughout the investigation area; however, spatial trends were observed in relation to the geographic areas and depth of sediments. Conversely, the evaluation of the representative PCOIs indicated that total PAHs and metals (mercury, copper, lead, and silver) were generally similar across depth intervals and geographic areas (e.g., intertidal mudflats, shoreline, in-channel), suggesting multiple spatial and temporal urban sources are present throughout the Flushing River system. In addition, the distribution of PAHs and metals do not indicate OU1 as a significant source of these constituents (i.e., higher concentrations in similar distributions are not present adjacent to OU1 in the Near-Site area). As such, total PCBs and total DDT were identified as the site-related PCOIs and are further discussed below.

Total PCB distribution patterns varied, as would be expected based on the variety of point and non-point sources of PCBs to this tidal waterway (Figure 1-6). Generally, total PCB concentrations were higher in surface/near-surface sediments (less than 2 feet bss) in the Near-Site area and in subsurface sediments (greater than 2 feet bss) in the North area. Overall, total PCB concentrations are lowest in the South area in comparison to the North and Near-Site areas. In the South area, total PCB concentrations in subsurface sediments are generally less than 5 milligrams per kilogram (mg/kg) and total PCB concentrations in surface and near-surface sediments are generally less than 1 mg/kg. Further, total PCB concentrations decrease at depths above the top of the native clay unit; at some locations just above the native clay unit and at other locations several feet above the native clay unit. Total PCB concentrations are low to non-detect within the underlying native clay unit, which serves as a confining layer.

Similar to total PCBs, total DDT distribution patterns varied, due to the variety of point and non-point sources and the tidal nature of the river. Generally, total DDT concentrations are higher in sediments less than 5 feet bss in the Near-Site area and somewhat higher in sediments below 5 feet in the North area. Overall, total DDT concentrations are lowest in the Near-Site area below 5 feet and in the North and South areas above 2 feet. Total DDT concentrations are low to non-detect within the underlying native clay unit, which serves as a confining layer.

In the North and South areas, total DDT distributions are not similar to total PCB distributions at most locations. Some similarities in the distribution pattern of total DDT to total PCBs were noted in the Near-Site area. For example, the three highest DDT concentrations occurred in the three samples with the highest PCB concentrations. Furthermore, within the Near-Site area, DDT and PCB are significantly correlated (R-0.77, $p<0.01$). The extent of potentially site-related DDT is expected to lie within the extent of site-related PCBs based on the similar distribution patterns primarily observed in the Near-Site area and the similar fate and transport properties of DDT and PCBs. Therefore, the remainder of this FS Report focuses on PCB impacts to OU2 sediment.

As set forth in the forensic evaluation (described above in Section 1.5.1.2), PCB analysis was used as the basis of the source attribution evaluation, and three PCB sources to the Flushing River were identified. Overall, PCB Source 1 samples were located predominately north of Roosevelt Avenue throughout the sediment column and in shallow sediments south of Roosevelt Avenue and west of the Van Wyck Expressway (South area). PCB Source 2 samples were located predominately adjacent to OU1 of Flushing Industrial Park (Near-Site area) throughout the sediment column (above the clay layer) and in sediments greater than 5 feet bss south of Roosevelt Avenue and west of the Van Wyck Expressway (South area). PCB Source 3 samples were only located adjacent to OU1. This spatial distribution (see Figure 1-6) suggests that PCB Source 1 originated from an unknown source north of Roosevelt Avenue, and PCB Sources 2 and 3 may have originated from or near OU1. The likelihood of the PCB source in the North area sediments (PCB Source 1) originating from OU1 was not evident. Further, the predominance of Aroclor 1260 in PCB Source 2 Near-Site samples is consistent with the PCB Aroclor found in OU1 non-aqueous phase liquid, catch basin, and drainage structure samples.

The distribution of these site-related PCBs (i.e., PCB Source 2 and PCB Source 3) is limited to the Near-Site and South areas. As such, the OU2 boundary, defined as Parcel 4 and other potentially impacted portions of the Flushing River, consists of the area south of Roosevelt Avenue (Figure 1-1).

1.6 Exposure Assessment

The exposure assessment identifies potentially complete exposure pathways (both human health and ecological) for OU2. An exposure pathway is complete when all of the following five elements are documented: 1) contaminant source, 2) contaminant release and transport mechanisms, 3) point of exposure, 4) route of exposure, and 5) receptor population (NYSDOH, 2009). If any one of these elements is missing, the exposure pathway is not complete and exposure cannot occur.

This section summarizes the human health exposure assessment and fish and wildlife exposure assessment conducted as part of the RI for OU2 (ARCADIS, 2011).

1.6.1 Human Health Exposure Assessment

Based on current land use and anticipated future use, the most likely receptors at the site include maintenance workers, utility workers, and workers involved in sampling and remedial activities within the Flushing River, although commercial workers, trespassers, and/or recreational users may also access the Flushing River, albeit on an infrequent basis. The portion of the Flushing River adjacent to OU1 most likely is not currently used on a regular basis for recreational purposes, such as fishing and/or boating. However, trespassers and recreational users may be exposed to sediments within the river on an intermittent basis, especially during low tide when sediments may be exposed. If the shoreline of the Flushing River is developed in the future to facilitate public access, recreational use of the area may increase (i.e., increased foot traffic along a shoreline walkway), but recreational use of the river (e.g., boating, fishing) would be expected to remain the same because the river is not conducive to these types of activities. Specifically, the Flushing River is a relatively small tidal water body that lacks boat launches. Additionally, the river may not be capable of supporting a resident fish population due to low dissolved oxygen concentrations. Therefore, fish consumption is not anticipated to be a significant exposure pathway. Although recreational exposure to sediment presents a potentially complete pathway based on current and anticipated future land use, it likely is not a significant exposure pathway.

1.6.2 Fish and Wildlife Exposure Assessment

Wildlife usage of the Flushing River is expected to be limited due to the surrounding residential, commercial, and industrial land uses and the associated urban impacts on the Flushing River. Terrestrial wildlife usage of the upland areas around the river is likely limited to common species typical of urban environments (e.g., small mammals, passerine birds). The Flushing River may, at times, support aquatic organisms, such as fish, invertebrates, and waterfowl, but habitat suitability is limited by urbanization. The NYSDEC considers Flushing Bay and the Flushing River as impaired water bodies based on low dissolved oxygen levels (NYSDEC, 2007). Fish and macroinvertebrate communities in the river are likely impacted by hypoxia and anoxia events, which have been documented in periods following heavy rains. Based on surrounding land use and the degraded condition of the river itself, local fauna are only expected to use river resources on a limited basis and significant environmental exposures are not anticipated.

2. Standards, Criteria, and Guidance

This section identifies the SCGs that have been identified as potentially applicable for OU2.

2.1 Definitions of Standards, Criteria, and Guidance

"Standards and criteria" are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance.

"Guidance" is non-promulgated criteria, advisories, and/or guidance that are not legal requirements and do not have the same status as "standards and criteria;" however, remedial programs should be designed with consideration given to guidance documents that, based on professional judgment, are determined to be applicable to the project [6 NYCRR 375-1.8(f)(2)(ii)].

SCGs will be applied so that the selected remedy will conform to standards and criteria that are generally applicable, consistently applied, and officially promulgated; that are either directly applicable; or that are not directly applicable but relevant and appropriate unless there is good cause [as defined in 6 NYCRR 375-1.8 (f)(2)(i)] for deviation.

2.2 Types of Standards, Criteria, and Guidance

The SCGs considered for the potential remedial alternatives identified in this FS Report were categorized into the following classifications:

- *Chemical-Specific SCGs* – These SCGs are usually health- or risk-based numerical values or methodologies, which, when applied to site-specific conditions, result in the establishment of numerical values for the site-related constituents of interest. These values establish the acceptable amount or concentration of constituents that may be found in, or discharged to, the environment.

- *Action-Specific SCGs* – These SCGs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous substance and waste management and site cleanup.

- *Location-Specific SCGs* – These SCGs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in specific locations.

2.3 Identification of Applicable Standards, Criteria, and Guidance

The SCGs identified for the evaluation of remedial alternatives are presented below.

2.3.1 Chemical-Specific Standards, Criteria, and Guidance

The potential chemical-specific SCGs for OU2 are summarized in Table 2-1. No cleanup standards, criteria, or limitations are currently promulgated under federal or state laws that specifically address concentrations of hazardous substances in sediment. However, technical guidance to be considered for OU2 sediment includes the NYSDEC Technical Guidance for Screening Contaminated Sediments (1999). The 1999 NYSDEC guidance is applicable to OU2 because it provides a methodology for establishing screening criteria to be used to identify sediment that may potentially result in harmful effects to marine and aquatic ecosystems. The document also provides guidance when evaluating risk management options for contaminated sediment and when determining final contaminant concentrations that will be achieved through remedial efforts. According to the 1999 guidance, sediments with concentrations of constituents that exceed the listed screening levels are considered potentially impacted, but the screening levels do not necessarily represent remediation cleanup levels. The NYSDEC has identified site-specific sediment cleanup goals for site-related PCBs, which are described in Section 3 of this FS Report.

The section of the Flushing River within OU2 is classified by the NYSDEC as Class I saline surface water (NYSDEC, 2002) and, as such, the New York State Surface-Water and Groundwater Quality Standards (6 NYCRR Parts 700-705) are potentially applicable to OU2. Specifically, 6 NYCRR Part 703.2 Narrative Water Quality Standards identifies the surface-water quality standards that need to be met during in-water activities, such as standards for turbidity and generation of sheens. In addition, guidance potentially applicable to determining ambient water quality at OU2 includes the NYSDEC's Division of Water, Technical and Operational Guidance Series 1.1.1 Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (NYSDEC, reissued June 1998 and addended April 2000 and June 2004) and Clean Water Act (CWA) – Ambient Water Quality Criteria.

Chemical-specific SCGs that potentially apply to the waste materials generated during remedial activities are the Resource Conservation and Recovery Act (RCRA) and New

York State regulations regarding the identification and listing of hazardous wastes outlined in 40 CFR 261 and 6 NYCRR Part 371. Included in these regulations are the regulated levels for toxicity characteristic leaching procedure (TCLP) constituents. The TCLP constituent levels are a set of numerical criteria at which solid waste is considered a hazardous waste by the characteristic of toxicity. The hazardous characteristics of ignitability, reactivity, and corrosivity may also apply, depending upon the results of waste characterization activities. In addition to New York State regulations, there are also New York City regulations (i.e., Administrative Code) for the treatment and/or disposal of water and the management of solid waste.

Another set of chemical-specific SCGs that may apply to waste materials generated at OU2 (e.g., sediment that is excavated and determined to be a hazardous waste) are the USEPA Universal Treatment Standards/Land Disposal Restrictions (UTS/LDRs), as listed in 40 CFR Part 268. Under 6 NYCRR Part 376, New York defers to the USEPA for UTS/LDR regulations. The USEPA UTS/LDRs identify hazardous wastes for which land disposal is restricted and define acceptable treatment technologies or concentration limits for those hazardous wastes on the basis of their waste code characteristics. The UTS/LDRs also provide a set of numerical criteria at which a hazardous waste is restricted from land disposal based on the concentration of select constituents present. In addition, the UTS/LDRs define hazardous waste sediment and hazardous waste debris and specify alternative treatment standards and treatment methods required to treat or destroy hazardous constituents on or in hazardous waste debris.

The USEPA's "Contained-in Policy" includes guidance potentially applicable to OU2. Pursuant to this "Contained-in Policy," environmental media (including, but not limited to, sediment) and debris impacted by a hazardous waste are subject to RCRA hazardous waste management requirements until they no longer contain the hazardous waste. Specifically, environmental media/debris that has been impacted by a release of characteristic hazardous waste must be managed as hazardous waste until the media/debris no longer exhibits that characteristic (based on laboratory testing). UTS/LDR requirements will continue to apply for the waste in accordance with 40 CFR Part 268.

In addition, environmental media/debris containing a listed hazardous waste must be managed as hazardous waste until the media/debris no longer contains the listed hazardous waste at concentrations exceeding health-based levels. Under certain circumstances, the UTS/LDR requirements might continue to apply. Although the USEPA has not established generic health-based "contained-in" levels for listed hazardous wastes, individual states have been authorized to establish their own levels.

The NYSDEC has established “contained-in” criteria for environmental media and debris, which are presented in the NYSDEC’s Technical and Administrative Guidance Memorandum (TAGM) 3028 entitled Contained-In Criteria for Environmental Media; Soil Action Levels (NYSDEC, 1997a). TAGM 3028 has been rescinded, although the NYSDEC is recommending use of this guidance until a more current version is available (personal communication, Angela Chieco).

2.3.2 Action-Specific Standards, Criteria, and Guidance

The potential action-specific SCGs for OU2 are summarized in Table 2-2. Action-specific SCGs include general health and safety requirements and general requirements regarding handling and disposing waste materials generated during implementation of the selected remedial alternative (including transportation and disposal, permitting, manifesting, and disposal and treatment facilities).

Guidance potentially applicable to OU2 includes the NYSDEC Division of Air Resources (DAR) policy document DAR-1: Guidelines for the Control of Toxic Ambient Air Contaminants (formerly issued as Air Guide 1; NYSDEC, 1997b). DAR-1 incorporates applicable federal and New York State regulations and requirements pertaining to air emissions, which may be applicable for sediment alternatives that result in certain air emissions. Community air monitoring may be required in accordance with the NYSDOH Generic Community Air Monitoring Plan. New York Air Quality Standards provide quality requirements for air emissions (6 NYCRR Part 257). Emissions from remedial activities will meet the air quality standards based on the air quality class set forth in the Air Quality Classification System for New York State, or more specifically, for New York City (6 NYCRR Parts 256 and 269) and the permit requirements set forth in New York Permits and Certificates (6 NYCRR Part 201). The New York City Air Pollution Control Code establishes air quality standards specific to New York City and may require local coordination with the Commissioner of Environmental Protection for remedial alternatives that may result in certain air emissions (i.e., air contaminants that contain cadmium, beryllium, mercury, and/or the emissions of certain odorous air contaminants).

One set of potential action-specific standards for OU2 consists of the LDRs, which regulate land disposal and established UTSs of hazardous wastes. The UTSs/LDRs are applicable to alternatives involving the off-site treatment and disposal of hazardous wastes (if any). The Toxic Substances Control Act (TSCA) regulates the remediation and disposal of PCB-impacted material with concentrations at or above 50 mg/kg. OU2-related PCBs are considered non-TSCA-regulated (i.e., less than 50 mg/kg); therefore, the regulatory and legal requirements under TSCA will not be applicable during the remedial activities. If any materials are determined to be hazardous or TSCA-regulated, these and other federal and state standards and guidance may be applicable as set forth in Table 2-2.

Section 404 of the CWA establishes site-specific pollutant limitations and performance standards that are designed to protect surface-water quality, and Section 401 of the CWA requires a 401 Water Quality Certification permit be obtained for those activities that may result in a discharge to the Flushing River. The NYSDEC State Pollutant Discharge Elimination System (SPDES) administered under the National Pollutant Discharge Elimination System Program establishes permitting requirements for point source discharges that may occur during the treatment and disposal of water generated during remedial activities along the Flushing River. The Rivers and Harbors Act Sections 9 and 10 and the Use and Protection of Waters Program 6 NYCRR Part 608 regulate alterations of navigable waters, including disturbance of the bed or banks and excavation or fill. In addition, New York City regulations (i.e., Administrative Code) for the treatment and/or disposal of water may require local coordination with the Commissioner of Environmental Protection.

Additional standards potentially applicable to OU2 include the United States Department of Transportation and New York State rules for the transport of hazardous materials, which are set forth in 49 CFR Parts 107 and 171.1 through 172.558 and 6 NYCRR 372.3. These rules include procedures for packaging, labeling, manifesting, and transporting hazardous materials, and would be potentially applicable to the transport of hazardous materials under any remedial alternative. New York State requirements for waste transporter permits are included in 6 NYCRR Part 364, as well as standards for the collection, transport, and delivery of regulated wastes within New York. Contractors transporting waste materials off site during implementation of the selected remedial alternative would need to be properly permitted. In addition, New York City regulations (i.e., Administrative Code) for the management (includes transportation and disposal) of solid waste generated within the City may require local coordination with the Commissioner of Sanitation.

A remedial alternative conducted within OU2 would need to comply with applicable requirements outlined under the Occupational Safety and Health Administration (OSHA). General industry standards are outlined under OSHA law (29 CFR 1910) that specify time-weighted average concentrations for worker exposure to various compounds and training requirements for workers involved with hazardous waste operations. The types of safety equipment and procedures to be followed during remediation are specified under 29 CFR 1926, and recordkeeping and reporting-related regulations are outlined under 29 CFR 1904. Hazardous Waste Operations and

Emergency Response regulations (29 CFR 1910.120) will also be followed during remediation. In addition to the requirements outlined under OSHA, the preparedness and prevention procedures, contingency plan, and emergency procedures outlined under RCRA (40 CFR 264) are potentially applicable standards to those remedial alternatives that include the generation, treatment, or storage of hazardous wastes.

Additional NYSDEC guidance (or TAGMs) that may apply during the remedial process. include DER-15: Presumptive/Proven Remedial Technologies, which provides descriptions of generally accepted presumptive/proven (presumptive) remedial technologies, and DER-23: Citizen Participation Handbook (January 2010), which identifies community participation requirements managed by DER.

Additional local requirements included under the New York City Administrative Code may apply during remedial efforts. The New York City Climate Protection Act will require green remediation concepts to be considered during the remedial design process and during construction.

2.3.3 Location-Specific Standards, Criteria, and Guidance

The potential location-specific SCGs for OU2 are summarized in Table 2-3. Examples of potential location-specific SCGs include regulations and federal acts concerning activities conducted in floodplains, wetlands, and historical areas, as well as activities affecting navigable waters and endangered/threatened or rare species. Location-specific SCGs also include local requirements, such as local building permit conditions for permanent or semi-permanent facilities constructed during the remedial activities (if any), and influent requirements of publicly owned treatment works (POTW) if water is treated within OU2 and discharged to these facilities. These potential SCGs are discussed in further detail below.

OU2 is located within the delineated coastal zone boundary included in the New York City's New Waterfront Revitalization Program, and as such, will require a Coastal Consistency Review through the New York City Department of City Planning. The Tidal Wetlands Regulatory Program administered by the NYSDEC establishes certain regulations when conducting remedial activities in areas adjacent to tidal wetlands. According to the NYSDEC, "tidal wetlands regulations apply anywhere tidal inundation occurs on a daily, monthly or intermittent basis" (http://www.dec.ny.gov/permits/6039.html). According to the National Wetlands Inventory, an estuarine and marine wetland (E2EMIP) runs along the western shoreline of the Flushing River, directly across from the OU2 remedial area; however, the distance of E2EMIP in relation to OU2 does not fall within the NYSDEC definition of "adjacent areas," which include areas that are up to 150 feet inland from the wetland boundary, within the limits of New York City.

Because OU2 is located within the 100-year floodplain of the Flushing River, federal floodplain management laws and regulations are potential standards for remedial alternatives that would include staging of materials and dewatering of dredged sediments within the floodplain. Federal requirements for activities conducted within floodplains are provided in 40 CFR, Part 6, Appendix A.

The United States Army Corps of Engineers (USACE) defines navigable waters as "those waters subject to the ebb and flow of the tide shoreward to the mean high water mark and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability, once made, applies laterally over the entire surface of the water body, and is not extinguished by later actions or events which impede or destroy navigable capacity." Based on this definition, the Flushing River is considered a navigable waterway, and as such, Section 10 of the Rivers and Harbors Act and Section 401 of the CWA are potential standards for sediment remediation activities. The following permits from the USACE and NYSDEC may be required:

- Nationwide Permit (NWP) #38 authorization, for "specific activities required to effect the containment, stabilization, or removal of hazardous or toxic waste materials that are performed, ordered, or sponsored by a government agency with established legal or regulatory authority"
- 401 Water Quality Certification

In addition, a Protection of Waters Permit under 6 NYCRR Part 608 would be required for remedial alternatives involving placing a cap in the navigable waters of the Flushing River below the mean high water level.

As part of the *Remedial Investigation Report* (RIR) (ARCADIS, 2011), an information request for threatened/endangered species information was submitted to the NYSDEC Natural Heritage Program (NHP) to inquire about the potential presence of sensitive species or habitats in the vicinity of OU2. Based on the January 26, 2011 response from the NHP, there are no records of rare or state-listed animals or plants, significant natural communities, or other significant habitats within the area of OU2 or in the immediate vicinity of OU2.

However, the piping plover (*Charadrius melodus*, threatened), the roseate tern (*Sterna dougallii dougallii*, endangered), the seabeach amaranth (*Amaranthus pumilus*, threatened), and the shortnose sturgeon (*Acipenser brevirostrum*, endangered) are listed under Queens County in the United States Fish and Wildlife Service (USFWS) list of Federally Listed Endangered and Threatened Species and Candidate Species in New York (by County) (USFWS, 2011). Although the presence of these species will likely not affect the timing and environmental controls associated with potential sediment remedial activities, they will still be listed for consideration under the location-specific SCGs. The short-nose sturgeon is listed on the USFWS list of Federally Listed Endangered and Threatened Species and Candidate Species in New York (by County); however, it primarily inhabits the Hudson River. The piping plover has an early successional habitat that is only found at the shoreline, on barrier islands, sandy beaches, and dredged material disposal islands (http://www.fws.gov/northeast/nyfo/es/PipingPloverFactSheet07.pdf) and has been identified in Queens County. The presence of this species may affect the timing of, and requirements for, environmental controls associated with any potential sediment remedial activities. Specifically, activities that might disturb habitat and are potentially dangerous to the piping plover during the breeding season would include remedial activities that may modify areas of the shoreline or channel of the Flushing River. The timeframe established to protect the piping plover during the breeding season is April 1 through September 1.

In addition, The National Register of Historic Places website was accessed (National Park Service, 2011) and a location search for Flushing, New York was performed. No records were present for historical sites adjacent to OU2; however, the Free Synagogue of Flushing is located approximately 0.5 mile to the east of OU2 and the Main Street Subway Station, near the junction of Roosevelt Avenue and Main Street, is located approximately 0.4 mile to the northeast of OU2. Flushing Armory is located within the National Registry Information System within 1.0 mile to the northeast of OU2.

Location-specific SCGs also potentially include local requirements, such as local building permit conditions for permanent or semi-permanent facilities constructed during the remedial activities (if any) and influent/pre-treatment requirements of the local POTW. If removal activities require a building permit, efforts will be coordinated with the New York City Department of Buildings. If treatment of water occurs and/or remedial alternatives result in certain air emissions at OU2, coordination with New York City's Commissioner of Environmental Protection may be applicable. If there is a need for the management of solid waste, coordination with New York City's Commissioner of Sanitation may be required.

3. Remedial Goal and Remedial Action Objectives

This section presents the primary remedial goal (and sediment cleanup goals) and RAOs for addressing PCB-impacted sediment associated with OU2. The remedial goal is the statutory or regulatory remedial action goal for remedial actions undertaken pursuant to the applicable regulations identified in NYSDEC's DER-10 (NYSDEC, 2010a). RAOs are medium- or operable unit-specific objectives for the protection of public health and the environment and are developed based on contaminant-specific SCGs to address contamination identified at a site.

3.1 Remedial Goal

The primary remedial goal for OU2 is to address site-related PCB-impacted sediments to protect human health and the environment. To achieve this remedial goal, the NYSDEC has requested sediment cleanup goals of:

- 1 mg/kg site-related PCBs in surface and near-surface sediments (collectively 0 to 2 feet bss)

- 10 mg/kg site-related PCBs in subsurface sediments (greater than 2 feet bss)

3.2 Remedial Action Objectives

RAOs are identifiable goals aimed at achieving the primary remedial goal of protecting human health and the environment. Site-specific RAOs were developed pursuant to the NYSDEC's generic sediment RAOs (NYSDEC, 2010a) as follows:

1. To eliminate or reduce, to the extent practicable, the potential for human contact with sediments containing site-related PCBs greater than the sediment cleanup goals.

2. To eliminate or reduce, to the extent practicable, the release(s) of site-related PCBs greater than the sediment cleanup goals from sediments that may partition to the surface-water column.

3. To eliminate or reduce, to the extent practicable, impacts to biota due to ingestion/direct contact with sediments containing site-related PCBs greater than the sediment cleanup goals.

4. Development of General Response Actions and Screening of Remedial Technologies

This section identifies the remediation area and presents the general response actions (GRAs) identified to address site-related PCB-impacted sediment based on the site-specific RAOs (see Section 3). For the purposes of this FS Report and in accordance with the site-specific RAOs outlined in Section 3, the term “PCB-impacted sediment” is defined as sediment containing greater than 1 mg/kg site-related PCBs in the surface or near-surface sediment or greater than 10 mg/kg site-related PCBs in the subsurface sediment within the remediation area. Site-related PCBs were distinguished based on the source evaluation presented in the RIR (ARCADIS, 2011) and summarized in Section 1.5.2.

Given the numerous historical and possibly ongoing sources to the Flushing River, PCBs from other sources are present in the sediments within the North, South, and Near-Site areas. Site-related PCBs were not detected in the North area, but were detected in the Near-Site and South areas. Within the South area, average PCB concentrations in surface and near-surface sediment are less than 1 mg/kg, and total PCB concentrations in subsurface sediment are generally less than 5 mg/kg and do not exceed 10 mg/kg. The Near-Site area was identified as the remediation area based on its proximity to OU1, as well as frequency and concentration of site-related PCBs in sediments relative to the sediment cleanup goals.

GRAs are identified as an initial step to developing potential remedial alternatives to address impacted site media. GRAs are medium-specific and may include various non-technology-specific actions, such as treatment, containment, institutional controls, and excavation, or any combination of such actions. For each GRA identified, a number of technology types and associated process options were identified, described, and screened based on site-specific conditions. According to DER-10, the term “technology type” refers to a general category of technologies appropriate to the site-specific conditions and impacts, such as chemical treatment, immobilization, and capping. The term “process option” refers to a specific process within a technology type.

4.1 Estimate of Areas and Volumes of Polychlorinated Biphenyl-Impacted Sediment

In accordance with the sediment cleanup goals discussed in Section 3.1 and the RAOs developed in Section 3.2, PCB-impacted sediment was identified at six sample locations within the remediation area: SD-20, SD-21, SD-22, SD-23, SD-27, and SD-28 (Figure 4-1). The area of influence around each of the sample points was estimated using the Thiessen polygon method. Thiessen polygons are created by joining the perpendicular bisectors of line segments connecting adjacent sample locations. The resulting polygon boundary is equal distance between two adjacent sample locations, and any point within the polygon is closer to the sample location on which the polygon was based than any other sample location. The Thiessen polygons were further divided into littoral and intertidal portions, where applicable (i.e., SD-27 and SD-28). The area of each of the polygons of interest is summarized below:

Sample ID	Polygon Area square feet (ac)	PCB-Impacted Interval[a] (feet bss)	PCB Conc.[b] (mg/kg)
SD-20	2,600 (0.06)	0 to 1	3.1 J
SD-21	1,900 (0.04)	0 to 1 1 to 2 4 to 4.5	2.21 J 17.8 J [19 J] 32 J
SD-22	3,000 (0.07)	0 to 1 1 to 2	4.52 7.2
SD-23	3,000 (0.07)	0 to 1 1 to 2	11 J [48 J] 28.3 J
SD-27 SD-27 (intertidal portion) SD-27 (littoral portion)	6,300 (0.14) 3,000 (0.07) 3,300 (0.07)	9 to 10	13.4 J
SD-28 SD-28 (intertidal portion) SD-28 (littoral portion)	6,200 (0.14) 2,800 (0.06) 3,400 (0.-8)	0 to 1 1 to 2 3 to 4 4 to 5	2.8 J 4.8 8.7 [12.5 J] 12 J
Total	*23,000 (0.5)*	-	-

Notes:
[a] The intervals shown are the depths where sample results show greater than 1 mg/kg site-related PCBs less than 2 feet bss or greater than 10 mg/kg site-related PCBs greater than 2 feet bss. Units are in feet bss.
[b] PCB concentrations shown are for the interval indicated. A “J” qualifier indicates an estimated concentration. Duplicate values are in brackets. The average concentration between parent and duplicate samples was considered for comparison to the RAOs.

The estimated total area of PCB-impacted sediment is 0.5 acre. The estimated sediment volumes per area are discussed in Section 5, as appropriate. The extent and volume of PCB-impacted sediment will be further defined, as necessary, during the remedial design.

4.2 General Response Actions

Six GRAs have been identified for sediments at the site, as described below:

1. *No Further Action* – Under this GRA, no further action would be taken at OU2 to treat, contain, or remove PCB-impacted sediments within the Flushing River adjacent to Flushing Industrial Park.

2. *Institutional Controls* – This GRA consists of implementing non-intrusive controls to reduce the potential human exposure to PCB-impacted sediments, and to regulate actions that may jeopardize the effectiveness of other remedial alternatives, such as those involving in-place containment. Institutional controls can be in the form of governmental controls, proprietary controls, enforcement and permit controls, and/or informational devices.

3. *In-Situ Treatment* – This GRA involves addressing PCB-impacted sediment by in-place treatment to remove or otherwise alter the constituents of interest.

4. *In-Situ Containment/Controls* – This GRA consists of containing/controlling PCB-impacted sediments without removing or otherwise treating the media.

5. *Removal and Material Management* – This GRA consists of removing PCB-impacted sediment from the river bottom via excavation/dredging and then managing the material through near-site or off-site treatment and off-site disposal once the sediment has been removed from the river.

6. *Residual Management* – This GRA consists of managing residual wastes generated as a result of other remedial technologies, including, but not limited to, managing water, remedial construction debris, and decontamination wastes.

The No Further Action GRA is carried forward through the FS to serve as a baseline against which other alternatives are evaluated. This approach is consistent with applicable state and federal guidance and is required by the NCP [Part 300.430(e)(6)].

4.3 Identification and Screening of Remedial Technologies and Process Options

This section discusses the identification and screening of technologies within each of the GRAs identified above.

4.3.1 Identification of Remedial Technologies and Process Options

Remedial technology types that are potentially applicable for addressing the impacted sediment were identified through a variety of sources, including vendor information, engineering experience, and review of the following documents:

- DER-10 (NYSDEC, 2010a)
- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988)
- Hazardous Waste Clean-Up Information Web Site (USEPA, 2011)
- Remediation Technologies Screening Matrix and Reference Guide (USEPA and United States Air Force, 2002)
- Superfund Innovative Technology Evaluation Program (USEPA, 2010)
- Assessment and Remediation of Contaminated Sediments Program: Remediation Guidance Document (USEPA, 1994)
- Federal Remediation Technologies Roundtable (FRTR) website (FRTR, 2008)
- Contaminant Sediment Remediation Guidance for Hazardous Waste Sites (USEPA, 2005)

According to the USEPA guidance (USEPA, 1988), remedial technology types and process options can be identified by drawing on a variety of sources. For this FS Report, ARCADIS' collective knowledge and experience and regulatory acceptance of previous FSs performed on sites with similar impacts were used to refine the list of potentially applicable process options for the site to those with documented success in achieving similar RAOs. Identified remedial technologies and process options are summarized in Table 4-1.

4.3.2 Screening of Remedial Technologies and Process Options

The remedial technology types and technology process options identified are subjected to preliminary and secondary screening to retain those that could be implemented and would potentially be effective at achieving the RAOs established for the site.

Preliminary screening was performed to reduce the number of potentially applicable technologies on the basis of technical implementability. Technical implementability was determined using existing site characterization information to screen out remedial technology types and technology process options that could not reasonably or practicably be implemented.

Secondary screening was performed on options retained through the preliminary screening. Technology process options were evaluated relative to others of the same remedial technology type using the following criteria:

- *Effectiveness* – This criterion is used to evaluate each technology process option relative to others within the same remedial technology type. This evaluation focused on:

  - The potential effectiveness of process options in handling the estimated areas or volumes of media and meeting the remediation goals identified in the RAOs.

  - The potential impacts to public health and the environment during the construction and implementation phase.

  - How proven and reliable the process is with respect to the contaminants and conditions at the site.

- *Implementability* – Implementability encompasses both the technical and administrative feasibility of implementing a process option. Because technical implementability was considered during the preliminary screening, this subsequent, more detailed evaluation placed more emphasis on the institutional aspects of implementability (e.g., the ability to obtain necessary permits; the availability of treatment, storage, and disposal services). This criterion also evaluates the ability to construct and reliably operate the technology process option, as well as the availability of specific equipment and technical specialists to design, install, operate, and maintain the remedy.

- *Relative Cost* – This criterion evaluates the overall cost required to implement the remedial technology. As a screening tool, relative capital and operation and maintenance (O&M) costs are used rather than detailed cost estimates. For each technology process option, relative costs are presented as low, moderate, or high. Costs are estimated on the basis of engineering judgment and industry experience.

A summary of the preliminary and secondary screening of remedial technologies to address PCB-impacted sediment is presented in the following sections and in Table 4-1.

4.3.2.1 No Further Action

As required by DER-10 (NYSDEC, 2010a), the “No Action” technology has been included and retained through the screening evaluation. No action would be completed to address PCB-impacted sediment under this technology. The “No Action” alternative is readily implementable at no cost and was retained to serve as a baseline against which other alternatives will be compared.

4.3.2.2 Institutional Controls

The remedial technology types identified under this GRA consist of non-intrusive institutional controls focused on mitigating potential human exposure and actions that may disturb the PCB-impacted sediment. Institutional controls may also be used to enhance the effectiveness of other remedial technologies, such as containment via capping, to limit actions that may jeopardize the integrity of the remedy. For example, signs could be posted (e.g., no anchoring) that would limit disturbing the sediment or capped areas.

Institutional controls were retained through the preliminary screening as this GRA is technically implementable. Additionally, use of institutional controls could reduce the potential for human exposure; however, these controls would not achieve RAOs for potential biota exposure to PCB-impacted sediment. Although the implementation of institutional controls would not meet all the RAOs for the site, the use of these controls was retained because they can be readily implemented (at a relatively low cost) in conjunction with other remedial technologies.

4.3.2.3 In-Situ Treatment

Remedial technology types associated with this GRA consist of those that could potentially mitigate potential human and biota exposure for the sediment in-situ (i.e., without removal). The in-situ remedial treatment technologies identified for sediments were natural recovery, immobilization, and sequestration.

The process option identified for natural recovery is monitored natural recovery (MNR). MNR has the potential to reduce concentrations and/or exposure to PCB-impacted sediments via naturally occurring physical, chemical, and/or biological processes, such as burial, advection, dispersion, dissolution, sorption, and biodegradation. Under MNR, periodic sampling and/or observations of the sediment would be required to monitor the progress of the natural recovery processes at the site over time. MNR was determined to be technically implementable and was retained for secondary screening. MNR could be implemented as a stand-alone option or as a component of an active remedial measure. MNR would be expected to meet the RAOs by reducing human and biota exposure to PCB-impacted sediment over time. While long-term monitoring would be required to demonstrate the reduction of impacts, capital and monitoring costs would be low. Therefore, MNR was retained for further evaluation.

The process option identified for the immobilization remedial technology is solidification/stabilization. This process option involves adding and mixing a solidification/stabilization reagent (e.g., Portland cement) into the PCB-impacted sediments. This process would produce a stable material with low leachability that physically and chemically locks the PCBs in the solidified/stabilized sediment matrix. Solidification/stabilization was not retained for secondary screening. Although it has proven to be effective in reducing the potential mobility and toxicity of impacts, there is no precedent for successful full-scale application in sediments and would require bench-scale pilot studies. If in-situ stabilization/solidification were performed, partial removal of sediment prior to treatment would likely be required to accommodate the increase in riverbed elevation resulting from the mixing process and placement of a habitat layer. Given the relatively small area and shallow depth of the majority of PCB-impacted sediments to be addressed at the site and the removal necessary to complete the in-situ solidification/stabilization, this technology is not justifiable.

The process option identified for the sequestration remedial technology is sorbent amendments. This process option involves adding and/or mixing an amendment (e.g., activated carbon) into the PCB-impacted sediments in-situ. The amendment to be added would be evaluated based on the ability of the material to sequester PCBs. This process was not retained for secondary screening because, while there have been successful field-scale pilot studies and application technologies under development, there is no precedent for full-scale application in sediments and would require site-specific bench-scale and field-scale pilot studies. Given the relatively small area and shallow depth of the majority of impacted sediments to be addressed at the site and the pilot studies necessary to evaluate this technology, this technology is not justifiable.

4.3.2.4 In-Situ Containment/Controls

The remedial technology type associated with this GRA could reduce the potential mobility of PCB impacts and could potentially eliminate human and biota exposure to PCB-impacted sediments. The in-situ containment remedial technology identified for sediments was capping.

One process option identified under the capping remedial technology is the construction of a thin layer cap. This process option involves covering sediments with approximately 6 inches of material that may include:

- natural materials (e.g., gravel, sand, clays)
- modified natural materials (e.g., organoclays)
- synthetic materials (e.g., geotextile membranes)

Another process option identified for the capping remedial technology is the construction of an engineered cap. Similar to the thin layer cap, all of the components listed above could be included in the construction of the engineered cap, although, armoring materials may also be included.

The specific details of the cap (e.g., material type, thicknesses) would be determined during the remedial design. Both capping processes would physically isolate PCB-impacted sediments and could be applied with other GRAs (e.g., removal, institutional controls) to reduce the potential mobility of PCB impacts. Periodic monitoring and potential maintenance of the cap would be required to maintain cap effectiveness over time.

Capping was determined to be technically implementable and was retained for secondary screening. Capping would be an effective means of reducing the potential mobility of PCB impacts through isolation and/or sequestration (if reactive material is used) that can be used as a stand-alone option or combined with other GRAs. If properly designed and maintained, capping would eliminate human and biota exposure to PCB-impacted sediments.

Equipment and materials are readily available for implementation of this remedial option. Special consideration would be given in the design phase to address the tidal nature of the area and the potential that portions of the area may be inaccessible by boat during low tide. Implementation of a capping alternative would require coordination with third party landowners/lessees, New York City, New York State, USACE, and any parties with easements (e.g., utility crossings). Coordination would be required to obtain the appropriate access and permits, and to be compatible with local development plans.

Both the thin-layer capping and engineered capping options were retained because they would be effective in meeting the RAOs at a moderate capital and O&M cost. For the purposes of this FS Report, an engineered cap was used as the representative process option for the capping remedial technology; therefore, further references to the cap and/or capping refer to an engineered cap. However, if capping is part of the selected remedy, both thin-layer capping and engineered capping would be further evaluated during the design phase to determine which process option would be the most appropriate to achieve the site-specific RAOs.

4.3.2.5 Removal and Material Management

Remedial technologies screened under this GRA consist of dredging, gravity drainage, immobilization, thermal destruction, extraction, recycle/reuse, and disposal. These remedial technologies consist of those processes that could effectively achieve the following:

- physically remove PCB-impacted sediments
- reduce water content in removed sediments requiring treatment/disposal
- stabilize PCB-impacted sediments in preparation for transport and subsequent treatment/disposal
- treatment of removed sediments
- disposal of removed sediments

Due to the number of remedial technologies investigated under this GRA, screening of the technologies is discussed by remedial technology below.

Dredging

Dredging is the primary remedial technology for the removal of sediments. Dredging would remove and reduce the volume of PCB-impacted sediments and could be implemented with other GRAs (e.g., ex-situ treatment/disposal, in-situ containment). Dredging is technically implementable and is an effective and proven process for reducing the volume of PCB-impacted sediment. The process options evaluated included mechanical in the wet, mechanical in the dry, and hydraulic dredging. Implementation of a dredging alternative would require coordination with third party landowners/lessees, New York City, New York State, USACE, and any parties with easements (e.g., utility crossings). Coordination would be required to obtain the appropriate access and permits, and to be compatible with local development plans.

Mechanical dredging is an effective, readily implementable technology with moderate costs and would achieve the RAOs for sediments. Mechanical dredging in the wet would require the installation of controls to maintain surface-water quality of adjacent areas and prevent potential migration of PCB-impacted sediment. In contrast, mechanical dredging in the dry would require installation of containment (e.g., sheet piles) to separate the removal area from the river to allow the removal area to be dewatered and for work in the dry. Due to the effectiveness of mechanical dredging, it was retained for further evaluation. For the purposes of this FS Report, mechanical dredging in the wet was selected as the representative process option for dredging. However, if mechanical dredging was included in the selected remedy, mechanical dredging in both the dry and the wet would be further evaluated to determine which process option was most appropriate to achieve the site-specific RAOs.

Hydraulic dredging is not appropriate for the low volume of sediment expected and the relatively higher cost compared to mechanical dredging; therefore, it was not retained for further evaluation.

Implementation of dredging would require the use of an upland area to stage and dewater the dredged sediment. Because Con Edison does not own the adjacent upland parcels, third party access agreements would be required. Alternatively, the dredged material could be barged to an alternate location, such as Con Edison's Astoria facility, for dewatering and staging. Accessibility issues (e.g., bridge clearance, low tide access), structural considerations (e.g., bridge foundations, bulkhead walls), and necessary permitting will be evaluated during the design phase.

Gravity Drainage

The process option for gravity drainage is dewatering, which is an effective means for reducing the water content in dredged sediments requiring treatment and/or disposal and is typically used in conjunction with these other technologies. Implementation of this process would require an upland area to dewater dredged sediment, and a means for water collection and treatment would be necessary. Because Con Edison does not own the adjacent upland parcels, third party access agreements would be required or the material would need to be barged to an alternate location for handling. Generally, this process has a relatively low capital cost, although barging requirements could increase the costs. This option was retained for further evaluation.

Immobilization

Immobilization technologies are designed to reduce the mobility of contaminants by changing the physical or leaching characteristics of the PCB-impacted sediments. The process option being considered for immobilization is solidification. Solidification involves adding a material into the sediment as a pre-treatment or pre-disposal process to aid in dewatering and/or stabilizing sediments. Solidification is a common and proven process for solidifying impacted sediments in preparation for transportation over public roads (i.e., pass the paint filter test). An upland area is required to temporarily stage, dewater, and solidify the sediments. Because Con Edison does not own the adjacent upland parcels, third party access agreements would be required or the material would need to be barged to an alternate location for handling. The capital cost to implement this option is low to moderate depending on the blending agent and ratio needed to meet the objectives of this treatment. This option was retained for further evaluation.

Thermal Destruction

The process options being considered for thermal destruction are near-site and off-site incineration. Incineration involves high temperature thermal destruction of the organic compounds present in the sediment; sediment would be excavated and conditioned prior to incineration. Treated sediments are subsequently disposed, unless some beneficial reuse endpoint can be identified (e.g., backfill in the sediment excavation area).

Incineration is a proven process for treating organic constituents, and both near-site and off-site options are technically implementable. Treatment units are available and could be mobilized to the staging area to treat the excavated sediments with near-site incineration. The efficiency of the system would require evaluation during bench-scale and/or pilot-scale testing.

Operation of treatment units may not be acceptable to the local community and would require compliance with permit requirements for emission discharge. However, the cost associated with pilot testing, system mobilization and setup, and O&M, as well as the relatively small quantity of sediment to be treated, makes near-site incineration impractical. Therefore, this process option was not retained.

Off-site treatment facilities are available nearby that offer this process option. Due to the relatively small quantity of sediment, the relatively low concentration of PCBs in the material (i.e., non-TSCA), and less expensive disposal options available, this treatment process was not retained for further evaluation.

Extraction

Another remedial technology for the treatment of PCBs is extraction. The technology process option screened under this remedial technology type includes low temperature thermal desorption, a process by which excavated sediments are heated and the organic compounds are desorbed from the sediments into an induced airflow. The resulting gas is treated either by condensation and filtration or by thermal destruction. Treated sediments are subsequently disposed, unless some beneficial reuse endpoint can be identified (e.g., backfill or landfill daily cover). This process is proven for treating organic constituents, although the efficiency would require bench-scale and/or pilot-scale testing. Treatment facilities are available near the site that would be able to treat the material at a moderate to high capital cost; however, this option was not retained due to the relatively small volume of sediment and availability of less expensive disposal options.

Recycle/Reuse

The remedial technology of recycle/reuse involves transporting PCB-impacted sediment off site for use as raw material at manufacturing facilities, such as asphalt concrete batch plants or brick/concrete manufacturers. Recycle/reuse of the material does not pass the preliminary screening because there are limited permitted facilities and demand for this option. These options were not retained for further evaluation.

Disposal

The process options considered for disposal are a TSCA/RCRA permitted landfill or a solid waste landfill. Both options are technically implementable and proven processes for disposal. Disposal at a permitted solid waste landfill is an effective alternative for the disposal of non-hazardous/non-PCB wastes. The costs associated with disposal are moderate, with disposal at a TSCA/RCRA permitted landfill being more expensive than at a solid waste landfill.

Based on the results of the RI activities, no sediment samples contained greater than or equal to 50 mg/kg of PCBs. Therefore, dredged sediments are not anticipated to be required for disposal in a TSCA/RCRA permitted landfill facility and this option was not retained for further evaluation. Disposal at a solid waste landfill was retained for further evaluation. Further waste characterization may be required by the chosen disposal facility(ies) as a part of the design or implementation phase.

4.3.2.6 Residual Management

Remedial technologies associated with this GRA consist of on-/near-site and off-site water treatment and off-site disposal of construction debris.

The on-/near-site and off-site water treatment would allow for the effective management of residual liquid wastes (for those active alternatives that capture/contain impacted water during implementation of a remedy) and decontamination water generated during the implementation of a remedy. Process options for these remedial technologies include on-/near-site water treatment and/or discharge to a sanitary sewer/wastewater treatment plant (WWTP). On-/near-site water treatment would involve directing impacted water (e.g., water from sediment dewatering or from equipment decontamination) through an on-/near-site treatment process to remove constituents of concern. Treated water is discharged back to the surface water provided that quality and quantity meet the allowable discharge requirements under the NYSDEC SPDES program. Off-site water treatment would include collection, transportation to an off-site treatment facility, or direct discharge to a sanitary sewer to undergo treatment at a local WWTP.

The equipment, materials, and technical personnel required to construct and operate an on-/near-site water treatment system or discharge to a local WWTP facility are available. The on-/near-site water treatment system would be readily implementable, but discharging to a local WWTP may not be as feasible to implement. Because Con Edison does not own the adjacent upland parcels, third party access agreements would be required in order to construct an on-site treatment system, but a near-site water treatment system could be constructed at the staging area (e.g., Con Edison Astoria facility). The relative costs are expected to be relatively low for both residual management processes. On-/near-site and off-site water treatment systems were both retained for further evaluation. For purposes of this FS Report, the on-/near-site water treatment system was selected as the representative process option for residual water management technology. However, if residual water management technology is included in the selected remedy, both on-/near-site and off-site water treatment systems would be further evaluated to determine which process option is most appropriate to achieve site-specific RAOs.

The off-site disposal of construction debris would involve disposal at a licensed solid waste landfill. Disposal at a solid waste landfill was retained for further evaluation. Further waste characterization may be required by the chosen disposal facility(ies) as a part of the design or implementation phase.

4.4 Summary of Retained Technologies

As indicated previously, results of the remedial technology screening process are presented in Table 4-1. Representative remedial technology process options retained for further evaluation are summarized in Table 4-2.

5. Development and Evaluation of Remedial Alternatives

The retained technologies in Section 4 were used to assemble potential remedial alternatives for sediment within the Near-Site area. The assembled sediment remedial alternatives, which were reviewed and approved by the NYSDEC in August 2011, include:

- *Alternative 1* – No action
- *Alternative 2* – MNR of sediments containing site-related PCBs greater than the sediment cleanup goals and institutional controls
- *Alternative 3* – Capping of sediments containing site-related PCBs greater than the sediment cleanup goals within the intertidal zone and institutional controls
- *Alternative 4* – Dredging of sediments (up to 5.0 feet bss) to the extent practicable containing site-related PCBs greater than the sediment cleanup goals, management of dredged material, backfilling within dredged areas, and institutional controls
- *Alternative 5* – Dredging of sediments (up to 5.0 feet bss) containing site-related PCBs greater than the sediment cleanup goals, management of dredged material, backfilling within dredged areas, and institutional controls
- *Alternative 6* – Dredging of sediments (up to 10.0 feet bss) containing site-related PCBs greater than the sediment cleanup goals, management of dredged material, and backfilling within dredged areas

These six remedial alternatives are described below in Section 5.1, while the criteria used to evaluate these alternatives are described in Section 5.2, and the detailed evaluation of the alternatives against the evaluation criteria is presented in Section 5.3. As defined in Section 4, sediments containing greater than 1 mg/kg site-related PCBs less than 2 feet bss or greater than 10 mg/kg site-related PCBs deeper than 2 feet bss are referred to in this FS Report as PCB-impacted sediment.

5.1 Description of Remedial Alternatives

5.1.1 Alternative 1

The no action alternative would not involve implementation of any remedial activities to treat, remove, contain, or monitor PCB-impacted sediment. No effort would be made to change or monitor future sediment conditions. The no action alternative serves as the baseline against which other remedial alternatives may be compared in accordance with the NCP and DER-10 (NYSDEC, 2010a).

5.1.2 Alternative 2

Alternative 2 involves allowing for natural recovery of sediments through naturally occurring physical and biochemical processes (e.g., dispersion, burial, sorption, dechlorination, solubility). Both a short-term (0 to 5 years) and a long-term (greater than 5 years) monitoring program would be designed and implemented to document and measure the progress of these natural processes toward achieving the RAOs.

Sediment/surface-water systems have considerable inherent capacity to recover from either natural or human disturbances. Physical and biochemical processes combine to achieve reductions in constituents' concentrations and the potential for future exposure and transport. The effectiveness of physical processes to address PCBs in sediment has been documented at several sites where PCB-contaminated sediments are being addressed, including Bremerton Naval Complex in Washington, Sangamo Weston/Twelve-Mile Creek/Lake Hartwell in South Carolina, and Manistique Harbor in Michigan (Environmental Security Technology Certification Program, 2009). Although, biochemical processes may occur, those processes occur over longer time periods and, therefore, may not meet the RAOs within a reasonable timeframe at sites with PCB-contaminated sediments (USEPA, 2005). Therefore, the more effective physical natural recovery processes are further described below.

The physical processes effective in PCB-contaminated sediment environments are mechanisms such as burial and dispersion. PCBs sorbed to fine-grain sediments that are suspended within the water column may be removed by dispersion. Burial through natural deposition of sediment is another purely physical process that occurs in areas of sedimentation, where sediments deposit on impacted sediments and mix with or overlie and effectively diminish constituent concentrations at the sediment surface (depending on the origin of the new sediment), specifically within the biological active zone. Based on the information presented in the RIR (ARCADIS, 2011), natural sedimentation processes occur in both the intertidal and littoral zones. Based on the geochronology assessment, sedimentation was measured at SD-21B in the intertidal zone and SD-28B in the subtidal (littoral) zone, and the cesium-137 concentrations indicate long-term deposition, especially in the littoral zone. Using chemical markers, the sedimentation processes result in approximately 0.3 to 0.7 inches per year of sediment deposition in the intertidal zone and approximately 1.1 to 1.7 inches per year of sediment deposition in the littoral zone (see Appendix A).

As discussed in Section 1.5.2, the PCB forensic evaluation provided another line of evidence documenting the sedimentation process through the presence of PCBs from other non-site-related sources in the upper 5 feet of sediment above site-related PCBs (that were less than 10 mg/kg in concentration) in the South area. Similar deposition patterns were observed at sediment core SD-27 within the littoral zone in the Near-Site area. At this core location, non-site-related PCBs were observed in the 2- to 3-foot interval, while site-related PCBs resided deeper within this core. Therefore, over time, additional sediments will continue to accumulate in the Near-Site area (as well as the other areas), and site-related PCBs would be buried beneath newly deposited sediment that may contain PCBs (and other constituents) from other sources within the Flushing River system.

Site-related sources have been mitigated by the OU1 remediation, including the installation of a barrier wall and the removal of the drainage system discharging to the river and are, therefore, not expected to be present in current and future sediment deposition. Further, the barrier wall also affects groundwater flow by reducing the hydraulic gradient in the littoral zone. There is a potential that current near-surface site-related PCBs in the intertidal zone, closer to the shoreline, could be disturbed or migrate upward, resulting in potential transport and redeposition. However, based on the core lithology, radiochemical core results, and the PCB and DDT concentration profiles (chemical markers), the sediment in the intertidal zone and especially the littoral zone in this area of the Flushing River appears to have been stable over decades of deposition. There is no evidence of significant scouring, and mixing is observed only in the upper 10 inches. In the future, barring any specific removal efforts, such as maintenance dredging (which can be addressed through institutional controls), surface and near-surface site-related PCBs will continue to be buried and result in a reduction in potential human and biota exposures.

The existing surface sediments averages nearly 10% TOC content, and presumably, new deposition would be the same. This high TOC content provides an intrinsic sorption capacity for potential upward PCB migration. A preliminary evaluation indicates that site-related PCBs, including those greater than 10 mg/kg below 2 feet in the littoral zone, would not migrate to the surface via porewater advection/diffusion given the combination of minimal porewater advection and high sediment TOC that binds the PCBs (Appendix A). The continued sediment accumulation serves to provide more sorption capacity and greater distance between potential exposures at the surface and the PCB-impacted sediments. Restoration of the area could include provisions to encourage the continued deposition of sediments in this area.

The extent and timeframe for reducing PCB concentrations and removing them from potential exposure under this remedial alternative are governed by several factors. As part of Alternative 2, periodic monitoring (i.e., sediment stability and deposition monitoring, as well as sediment chemical analysis) would be conducted to assess the progress of the natural recovery processes.

The periodic monitoring to be performed as part of this remedial alternative would include measuring the top of sediment elevation and collecting sediment samples for PCB analysis from up to six locations in the intertidal and littoral zones where PCB impacts were greater than 1 mg/kg in the surface/near-surface sediments or greater than 10 mg/kg in the subsurface sediments. The sediment bed surface elevation would be measured to confirm that deposition processes are still occurring as expected in this area. In the littoral zone, monitoring would be focused on confirming the natural cover of non-site-related sediment is maintained at its present elevation or increasing in thickness due to deposition. While in the intertidal zone, in addition to documenting the deposition of sediments, the PCB concentrations and composition of the sediment would be evaluated to document over time that surface and near-surface site-related PCBs greater than 1 mg/kg show decreasing concentration trends and/or change from site-related to non-site-related PCBs. If PCB concentrations greater than 1 mg/kg are detected, forensic analysis would be conducted on the surface and near-surface sediment samples to evaluate PCB origins (i.e., non-site-related PCB sources or site-related sources).

For the purposes of this FS Report, it was assumed that sediment monitoring would be performed every 2 years for the first 5 years (i.e., years 1, 3, and 5), and then every 5 years thereafter until year 30. A baseline monitoring program would provide initial documentation of the top of sediment elevations. This alternative would also include preparation of a Site Management Plan (SMP) that includes the following:

- known locations of PCB-impacted sediment that includes the six Thiessen polygon areas where PCB-impacted sediments were identified (i.e., SD-20, SD-21, SD-22, SD-23, SD-27, and SD-28)

- protocols for sediment MNR monitoring
- conditions for modifying/ceasing the sediment monitoring activities
- protocols (including health and safety requirements) for conducting intrusive (i.e., subsurface) activities within the PCB-impacted areas and managing potentially impacted material encountered during these activities
- restrictions on intrusive activities to mitigate potential exposures to PCB-impacted sediments

Because PCB-impacted sediment would remain in the Flushing River for a period of time, this alternative would also include establishment of institutional controls. Institutional controls would be in the form of governmental enforcement, permit controls, and/or informational devices. The institutional controls would be established in accordance with DER-33 (NYSDEC, 2010c). For example, potential institutional controls could include, but not necessarily be limited to, designating “no anchor” zones in the PCB-impacted area and deed restrictions for Parcel 4.

Reports would be submitted to the NYSDEC to document that natural sedimentation processes are progressing toward achievement of the RAOs, as well as to document that institutional controls are maintained and remain effective.

5.1.3 Alternative 3

The major components of Alternative 3 include the following:

- removing debris or obstructions within the cap area
- installing an engineered cap over PCB-impacted surface and near-surface sediments, as well as sustaining a natural cover in the littoral zone over subsurface sediments containing greater than 10 mg/kg site-related PCBs
- conducting post-construction cap monitoring
- establishing institutional controls

Alternative 3 involves the installation of an engineered cap over PCB-impacted sediments at the surface and near-surface within the intertidal zone (Figure 5-1) in conjunction with the implementation of institutional controls to deter future disturbance of the engineered cap. The estimated capping area measures approximately 11,700 square feet (Figure 5-1). This capping area was estimated using the polygon areas associated with SD-20, SD-21, SD-22, SD-23, and the intertidal portion of polygon SD-28 , where PCB-impacted sediments were generally observed in the surface, near-surface, and subsurface sediments.

Prior to conducting field activities associated with Alternative 3, requirements to obtain necessary permits or permit equivalents would be met. Such permits/permit equivalents may include, but not limited to, NWP #38 and New York State Protection of Waters Permit under New York State Section 608 (permit equivalent). In addition, access agreements to land within Parcel 4 would be necessary to obtain prior to conducting any field work.

Prior to removal of debris and obstructions, turbidity curtains would be installed around the cap placement area to control and contain turbidity that may be generated during water activities conducted to implement Alternative 3. In addition, absorbent booms would be used, as necessary, to address any potential sheens generated during these activities. Water quality monitoring would be performed to assess potential water quality impacts. Daily water column turbidity monitoring outside of the capping area would be conducted during construction activities to monitor the effectiveness of engineering and operation controls established to limit impacts from turbidity. Based on monitoring results, water activities (e.g., capping or debris/obstruction removal) may be modified (e.g., slowed or halted or conducted during low tide when near-shore areas are dry) or additional operational measures implemented (e.g., placement of an additional turbidity curtain) until acceptable turbidity levels are achieved.

Prior to placement of the cap, debris and obstructions would be removed (as necessary for cap placement) via a barge-mounted crane or excavator. For example, the old wooden pilings would be removed or cut off below grade to facilitate cap placement. Cap placement would be conducted using general construction equipment located on a barge. Debris or obstructions removed, if any, would be loaded onto scows that would be transported to an off-site temporary staging area and then transported to a permitted non-hazardous waste landfill. For the purposes of this FS Report, it has been assumed the debris would be first barged to a staging area at the Con Edison Astoria facility for processing (e.g., sorting, crushing) and then loaded for disposal. The Astoria facility is located approximately 5 miles from OU2 on the East River. Off-site facilities for debris disposal would be evaluated and selected during the remedial design and implementation phases. Once the debris and obstructions are removed, the engineered cap would be placed into the river using a crane operating from a floating work platform. Divers would be used, as necessary, during cap installation to assist with cap placement and positioning activities.

The installation of an engineered cap would isolate the PCB-impacted surface sediments and mitigate the potential for future exposure and transport. In addition, the cap would be designed to provide protection against erosional forces (i.e., scour) and provide a surface habitat layer for biota. The cap would be designed to limit the upward migration of PCB impacts and to limit the potential for erosion of cap materials. For the purposes of this FS Report, the cap over PCB-impacted surface and near-surface sediments would consist of (from the bottom up) 0.25 inch of an activated carbon/organoclay mixture in a reactive core mat or equivalent to absorb organics followed by a 12-inch silt/sand/gravel layer, similar to the existing sediment characteristics. The overlying materials would serve to protect the sorption layer and replace the benthic habitat.

The actual cap configuration would be determined during the remedial design. A pre-design investigation may be warranted to support the remedial design for implementing Alternative 3. The potential pre-design activities to support the capping activities may include, but are not limited to, bathymetric survey, debris survey, hydrodynamic modeling, and laboratory evaluation of capping materials.

Based on the physical characteristics and visual observations of the sediments, some compaction is expected to occur after cap placement. Therefore, the final elevation of the cap area after completion of Alternative 3 is expected to be less than 1 foot higher than current elevations. The amount of compaction expected after cap placement would be further evaluated during the remedial design. After cap placement, the areas disturbed as a result of the remedial activities would be restored to tidal wetland habitat (e.g., high marsh and low marsh) depending on the final elevation range. Furthermore, natural deposition would further restore the tidal wetland habitat.

To address the PCB-impacted sediment at SD-27 (9 to 10 feet bss) and potential PCB-impacted subsurface sediment within the littoral portion of polygon SD-28, the natural cover already above these impacted sediments in the littoral zone, as well as the continued future sediment deposits, are sufficient to isolate these sediments from potential exposure. Similar to observations of samples collected within the littoral zone at SD-26 and SD-27, site-related PCBs are not expected to be present in the surface/near-surface sediments within the littoral portion of polygon SD-28. PCBs detected in the surface and near-surface sediments within the littoral zone at SD-26 and SD-27 are not site-related. The natural cover area was estimated using the polygon areas associated with the littoral portion of polygons SD-27 and SD-28. As discussed in Section 5.1.2, non-site-related deposition has already occurred resulting in several feet (3 feet and greater further into the river) of overlying sediment, and future deposition is expected to continue. The TOC content in the existing surface sediments averages nearly 10% within the littoral zone and presumably new deposition would be the same (Appendix A). This high TOC content provides an intrinsic sorption capacity for potential upward PCB migration.

A preliminary evaluation (Appendix A) indicates that site-related PCBs greater than 10 mg/kg below 2 feet in the littoral zone would not migrate to the surface via porewater advection given the high sediment TOC that binds the PCBs. The continued sediment accumulation serves to provide more sorption capacity and greater distance between potential exposures at the surface and the impacted sediments. Restoration of the area could include provisions to encourage the continued deposition of sediments in this area.

Following completion of the engineered cap installation, a monitoring and maintenance program would be implemented to document the long-term effectiveness of the engineered cap, as well as the natural cover. Monitoring activities would consist of visual inspections (watercraft or diver assisted) and bathymetric survey (elevation) of the engineered cap and natural cover to assess the physical condition and elevation of the sediment surface. For the purposes of this FS Report, it has been assumed that this program would involve monitoring the cap and natural cover biennially for the first 5 years (i.e., years 1, 3, and 5) and then once every 5 years until year 30. Inspections of the cap may also be conducted subsequent to episodic events (e.g., extreme high flow events); however, based on the lack of evidence of these types of events effecting the sediment (based on radiochemical data, core logs, and analytical data), it is not anticipated that these types of events would impact the integrity of the cap. This would be further evaluated during preparation of an SMP (see below).

A baseline monitoring program would be required to provide initial documentation of the top of sediment elevations. Any disturbance or damage to the cap or natural cover observed during the periodic inspections would be addressed appropriately to maintain the long-term effectiveness of the cap and natural cover.

Institutional controls would also be implemented to protect the integrity and permanence of the remedy. Potential institutional controls include placement of signs along the banks to deter future disturbance of the cap and natural cover (e.g., no dredging) and a deed restriction to limit invasive activities within Parcel 4. The institutional controls would be established in accordance with DER-33 (NYSDEC, 2010c).

This alternative would include preparation of an SMP to document the following:

- known locations of sediment areas with PCB-impacted sediment
- protocols for sediment elevation and observation monitoring
- protocols for cap and natural cover monitoring and maintenance
- conditions for modifying/ceasing the cap and natural cover monitoring activities
- protocols (including health and safety requirements) for conducting intrusive (i.e., subsurface) activities within the PCB-impacted areas and managing potentially impacted material encountered during these activities
- restrictions on intrusive activities to mitigate potential exposures to PCB-impacted sediment

Reports would be submitted to the NYSDEC to document that the cap and natural sediment cover above the PCB-impacted sediment remains in place, as well as document that institutional controls are maintained and remain effective.

5.1.4 Alternative 4

The major components of Alternative 4 include the following:

- dredging of PCB-impacted surface/near-surface (0 to 2 feet bss) and subsurface sediments (up to 5 feet bss) to the extent practicable
- management of dredge material (off-site treatment and disposal)
- backfilling within dredge areas
- sustaining a natural cover over deeper (>5 feet bss) subsurface sediments containing greater than 10 mg/kg site-related PCBs

· establishing institutional controls

The remediation area to be dredged under Alternative 4 is illustrated on Figure 5-2. Alternative 4 focuses on the removal through dredging of PCB-impacted surface/near-surface (0 to 2 feet bss) and subsurface sediment (up to 5 feet bss)to the extent practicable. The degree of sediment removal in the vicinity of and under the Van Wyck Expressway Bridge will evaluated during design as there are implementability issues with conducting dredging activities in the vicinity of and beneath the Van Wyck Expressway Bridge as there are bridge support structures within and in the vicinity of the SD-28 polygon (Figure 5-2).

The dredging areas and sediment volume were estimated using the polygon areas associated with SD-20, SD-21, SD-22, SD-23, and SD-28 and the depths of the PCB-impacted sediments.

PCB-impacted sediments in the area around SD-20 are estimated to be removed to a depth of 1 foot, PCB-impacted sediments in the area around SD-21 are estimated to be removed to a depth of 4.5 feet, PCB-impacted sediments in the area around SD-22 and SD-23 are estimated to be removed to a depth of 2 feet, and PCB-impacted sediments in the area around SD-28 are estimated to be removed to a depth of 5 feet. For purposes of this FS Report, approximately 2,600 cy of sediment would be removed by the dredging activities. To access the PCB-impacted sediment, sediment that does not exceed the sediment cleanup goals lying over the PCB-impacted sediment would also be removed during dredging (e.g., the depth interval of 2 to 4 feet in the area around SD-21). Additional sediment that does not exceed the sediment cleanup goals would also be removed due to the need to cut back the side slopes to account for sloughing that may occur during dredging. Therefore, the total volume of sediment removed under Alternative 4 is greater than the volume of PCB-impacted sediment. The actual remedial areas and depths would be further evaluated, as necessary, during the remedial design.

A pre-design investigation may be warranted to support the remedial design for implementing Alternative 4. The potential pre-design activities to support the dredging and backfill activities may include, but are not limited to, bathymetric survey, debris survey, sediment characterization (sediment sampling and analysis), and fill material characterization.

Prior to conducting field activities associated with Alternative 4, requirements to obtain necessary permits or permit equivalents would be met. Such permits/permit equivalents may include, but are not limited to, NWP #38, New York State Protection of Waters Permit (permit equivalent), and water discharge permit equivalent. In addition, access agreements would be obtained from the property owners of land within the PCB-impacted area (e.g., Parcel 4), as well as from adjacent property/structure owners (if needed).

A temporary staging area (assumed to be at the Con Edison Astoria facility) would be constructed to support processing dredged sediments for off-site treatment/disposal, water treatment, and storage. The temporary staging area would include a perimeter berm system, liner system, and an asphalt surface. In addition, appropriate erosion control measures (e.g., silt fencing and/or straw/hay bales) would be installed to prevent the potential for rainfall- or flood-induced migration of the sediment into or out of the staging area. The staging area materials and erosion control measures would be removed following completion of remedial activities and either reused or disposed off site.

Prior to the commencement of dredging, turbidity curtains would be deployed to control turbidity and absorbent booms would be used, as necessary, to address any potential sheens generated during these activities. Once the turbidity curtains and absorbent booms are in place, debris and obstructions (e.g., historical wooden pilings) would be removed prior to conducting any dredging. The debris would be barged to the Astoria facility where it would be transferred to trucks that would transport the material to an off-site disposal facility assumed to be a permitted non-hazardous waste landfill.

Dredging would be conducted using mechanical dredging in the wet using, for example, an excavator or crane positioned on a barge. The dredged material would be loaded into scows, which would be transported to an off-site facility for dewatering and disposal. For purposes of this FS Report, it has been assumed that the dredged material would be barged to the temporary staging area at the Con Edison Astoria facility, which is located approximately 5 miles from OU2 on the East River. At the Astoria facility, the material would be off-loaded, staged, dewatered, stabilized, and characterized for disposal at a permitted off-site disposal facility. Based on the waste characterization data from the RI and the remedial actions for OU1, it has been assumed for purposes of this FS Report that the dredged sediment would be characterized as non-hazardous. A temporary water treatment system would be utilized at the staging facility (e.g., Astoria facility) to treat sediment dewatering liquids, and treated water would be disposed via a discharge permit equivalent to the surface water body adjacent to the staging facility (e.g., East River).

For the purposes of developing a cost estimate, it has been assumed that 100% of the dredged material (approximately 4,200 tons, including stabilization admixture) would require disposal as a non-hazardous waste at a solid waste landfill. Alternatively, the dredged material could be taken directly to a facility for processing and disposal. For example, Clean Ventures, Inc. is capable of barging the dredged material to their facility in Port Newark for dewatering and disposal, approximately 32 miles from OU2. Site-specific material management would be further evaluated during the remedial design.

Following the dredging activities, clean granular fill material that meets both the unrestricted use soil cleanup objectives and the NYSDEC sediment quality guidelines would be placed back into the dredged areas to restore the riverbed to its current bed elevation. For purposes of this FS Report, it has been assumed that the granular fill would consist of a silt/sand/gravel mix (in general accordance with the removed sediment composition). However, the specific fill characteristics would be evaluated during the remedial design. Based on the information obtained during the RI activities, it has been assumed that the habitat (i.e., intertidal mudflat) of the dredged area would be further restored by naturally occurring sedimentation processes.

As described in Section 5.1.3, the PCB-impacted sediment at the polygon associated with SD-27 (9 to 10 feet bss) would be addressed by the current (and expected future) natural cover that already overlies (and covers) the deep (>5 feet) impacted sediments. Due to the high binding capacity of the organic carbon content, current thicknesses, and expected continued deposition of organically rich (high TOC) sediments, this natural cover, as discussed, is sufficient to isolate these deeper sediments from potential exposure.

Following completion of the sediment removal and backfill activities, the continued presence of the natural cover would be verified by monitoring as described under Alternative 3.

Institutional controls would also be implemented to protect the long-term integrity of the remedy. Potential institutional controls may include placement of signs along the banks to discourage future disturbance of the natural cover in the littoral zone (e.g., no dredging). The institutional controls would be established in accordance with DER-33 (NYSDEC, 2010c).

This alternative would include preparation of an SMP to document the following:

- known locations of PCB-impacted sediment areas
- protocols for sediment elevation and observation monitoring
- conditions for modifying/ceasing the sediment monitoring activities
- protocols (including health and safety requirements) for conducting intrusive (i.e., subsurface) activities within the PCB-impacted areas and managing potentially impacted material encountered during these activities
- restrictions on intrusive activities to mitigate potential exposures to PCB-impacted sediment

Reports would be submitted to the NYSDEC to document that the natural sediment cover above the PCB-impacted sediment remains in place, as well as that institutional controls are maintained and remain effective.

5.1.5 Alternative 5

The major components of Alternative 5 include the following:

- dredging of surface/near-surface (0 to 2 feet bss) and subsurface (2 to 5 feet bss) sediments containing PCB-impacted sediment
- management of dredged material (off-site treatment and disposal)
- backfilling a natural cover within dredged areas
- sustaining a natural cover over deeper (>5 feet bss) subsurface sediments containing greater than 10 mg/kg site-related PCBs
- establishing institutional controls

The remediation area to be dredged under Alternative 5 is illustrated on Figure 5-3. As previously discussed in Section 5.1.3, the natural cover already serves to mitigate potential exposures to deeper PCB-impacted sediment (i.e., the area around SD-27 at 9 to 10 feet bss). Alternative 5 involves the removal through dredging of PCB-impacted surface/near-surface (0 to 2 feet bss) and subsurface sediment (up to 5 feet bss). The dredging areas were estimated using the polygon areas associated with SD-20, SD-21, SD-22, SD-23, and SD-28 and the depths of the PCB-impacted sediments. PCB-impacted sediments in the area around SD-20 are estimated to be removed to a depth of 1 foot, PCB-impacted sediments in the area around SD-21 are estimated to be removed to a depth of 4.5 feet, the PCB-impacted sediments in the area around SD-22 and SD-23 are estimated to be removed to a depth of 2 feet, and the PCB-impacted sediment in the area around SD-28 are estimated to be removed to a depth of 5 feet. For purposes of this FS Report, approximately 2,550 cy of sediment would be removed by the dredging activities. To access the PCB-impacted sediment, sediment that does not exceed the sediment cleanup goals lying over the PCB-impacted sediment would also be removed during dredging. Additional sediment that does not exceed the sediment cleanup goals would also be removed due to the need to cut back the side slopes to account for sloughing that may occur during dredging. Therefore, the total volume of sediment removed under Alternative 5 is greater than the volume of PCB-impacted sediment. The actual areas and depths would be further assessed, as necessary, during the remedial design.

A pre-design investigation may be warranted to support the remedial design for implementing Alternative 5. The potential pre-design activities to support the dredging and backfill activities for Alternative 5 are similar to those described for Alternative 4 in Section 5.1.4 and, therefore, are not repeated here.

The permitting, access, debris removal, dredging, staging, processing, disposal, backfill, and post-remediation monitoring and reporting for Alternative 5 are very similar to those described for Alternative 4 in Section 5.1.4. Because this alternative is similar to Alternative 4, the detailed descriptions are not repeated here for Alternative 5. Overall for this alternative, all of the dredged material (approximately 4,200 tons, including stabilization admixture) would require disposal as a non-hazardous waste at a solid waste landfill. Similar to Alternative 4, additional access and potentially additional or alternative procedures as a result of working under the Van Wyck Expressway Bridge may be needed. For example, specialized dredging equipment may be required, there may be restrictions against dredging sediment near the bridge foundations or additional controls required.

As described in Section 5.1.3, the PCB-impacted sediment at SD-27 (9 to 10 feet bss) would be addressed by the current (an expected future) natural cover already above the impacted sediments. Due to the high binding capacity of the organic carbon content, current thicknesses, and expected continued deposition of organically rich sediment, this natural cover, as discussed, is sufficient to isolate these deeper sediments from potential exposure.

5.1.6 Alternative 6

The major components of Alternative 6 include the following:

- dredging of PCB-impacted surface and near-surface sediments (0 to 2 feet bss) and subsurface sediments (up to 10 feet bss)
- management of dredged material (off-site treatment and disposal)
- backfilling a natural cover within dredged areas

The remediation area to be dredged under Alternative 6 is illustrated on Figure 5-4. Alternative 6 involves the removal through dredging of PCB-impacted surface/near-surface (0 to 2 feet bss) and subsurface sediment (up to 10 feet bss). The dredging areas were estimated using the polygon areas associated with SD-20, SD-21, SD-22, SD-23, SD-27, and SD-28 and the depths of the PCB-impacted sediments. PCB-impacted sediments in the area around SD-20 are estimated to be removed to a depth of 1 foot, PCB-impacted sediments in the area around SD-21 are estimated to be removed to a depth of 4.5 feet, the PCB-impacted sediments in the area around SD-22 and SD-23 are estimated to be removed to a depth of 2 feet, the PCB-impacted sediment in the area around SD-27 are estimated to be removed to a depth of 10 feet, and the PCB-impacted sediments in the area around SD-28 are estimated to be removed to a depth of 5 feet. For purposes of this FS Report, approximately 6,200 cy of sediment would be generated by the dredging activities.

To access the PCB-impacted sediment, sediment that does not exceed the sediment cleanup goals overlying the PCB-impacted sediment would also be removed during dredging. Additional sediment that does not exceed the sediment cleanup goals would also be removed due to the need to cut back the side slopes to account for sloughing that may occur during dredging. Therefore, the total volume of sediment removed under Alternative 6 is significantly greater than the volume of PCB-impacted sediment. The actual remedial areas and depths would be further assessed, as necessary, during the remedial design. A pre-design investigation may be warranted to support the remedial design for implementing Alternative 6. The potential pre-design activities to support the dredging and backfill activities for Alternative 6 are similar to those described for Alternative 4 in Section 5.1.4 and, therefore, are not repeated here.

The permitting, access, debris removal, dredging, staging, processing, disposal, backfill, and post-remediation monitoring and reporting for Alternative 6 are very similar to those described for Alternative 4 in Section 5.1.4 and Alternative 5 in Section 5.1.5. Because this alternative is so similar to Alternatives 4 and 5, the detailed descriptions are not repeated here for Alternative 6. Overall for this alternative, all of the dredged material (approximately 10,400 tons, including stabilization admixture) would require disposal as a non-hazardous waste at a solid waste landfill. Similar to Alternative 5, there are potentially additional or alternative procedures as a result of working near and under the Van Wyck Expressway Bridge. Because all the PCB-impacted sediments would be permanently removed from OU2, no institutional controls or an SMP would be developed for this alternative as they would be for Alternatives 4 and 5.

5.2 Remedial Alternative Evaluation Criteria

In accordance with Section 4.3 of DER-10 (NYSDEC, 2010a), the alternatives are evaluated using the evaluation criteria set forth in 6 NYCRR 375-1.8(f) in conjunction with the additional guidance provided below for each criterion. These evaluation criteria include the following:

- Threshold Criteria
  - compliance with SCGs
  - protection of public health and the environment
- Primary Balancing Criteria
  - long-term effectiveness and protectiveness
  - reduction of toxicity, mobility, or volume through treatment
  - short-term impacts and effectiveness
  - implementability
  - land use
  - cost effectiveness

The first two evaluation criteria are threshold criteria and must be satisfied in order for an alternative to be considered for selection. The next six evaluation criteria are primary balancing criteria, which are used to compare the positive and negative aspects of each of the remedial alternatives, provided the alternative satisfies the threshold criteria.

Descriptions of the evaluation criteria are presented in the following subsections. Additional criteria, including community acceptance, would be addressed following submittal of this FS Report.

Per DER-10 (NYSDEC, 2010a), sustainability and green remediation should be considered in the remedial evaluation, with the goal of improving the sustainability of the selected remedy. Sustainability and green remediation are discussed under the short-term impacts and effectiveness.

5.2.1 Threshold Criteria

5.2.1.1 Compliance with Standards, Criteria, and Guidance

This criterion is used to evaluate whether the alternative or remedy complies with directly applicable or relevant and appropriate chemical-specific, action-specific, and location-specific SCGs. Conformance with standards and criteria is required, unless:

- The proposed action is only part of a complete program or project that would, as a whole, conform to such standard or criterion upon completion.

- Conformity to such standard or criterion would result in greater risk to the public health and the environment than alternatives.

- Conformity to such standard or criterion is technically impracticable from an engineering or scientific perspective.

- The program or project would attain a level of performance that is equivalent to that required by the standard or criterion through the use of another method or approach.

In addition to standards and criteria, this criterion also provides consideration to guidance, which through the application of scientific and engineering judgment, is determined to be applicable to the alternative evaluation.

5.2.1.2 Overall Protection of Public Health and the Environment

This criterion is used to evaluate how each alternative or remedy achieves and maintains protection of human health and the environment through meeting the RAOs. This criterion relies on other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with SCGs. Because of this reliance in the detailed analysis of alternatives in this FS Report (Section 5.3), this criterion would be addressed after all evaluation criteria, except cost effectiveness.

5.2.2 Primary Balancing Criteria

5.2.2.1 Long-Term Effectiveness and Permanence

This criterion includes an evaluation of the impact on potential human and ecological exposures and receptors and impacts to the environment from untreated contaminated materials or treatment residuals remaining after the remedial action has been concluded (known as residual risk), and the adequacy and reliability of controls to manage that residual risk. It also includes an assessment of the potential need to replace technical components of the alternative, such as a cap or a treatment system, and the potential risk posed by that replacement.

5.2.2.2 Reduction of Toxicity, Mobility, and Volume through Treatment

This criterion includes an evaluation of applicable treatment processes (if any), the amount of material treated, degree of expected reductions through treatment, degree to which the treatment is irreversible, and type and quantity of treatment residuals. Preference is given to remedies that permanently or significantly reduce the toxicity, mobility, or volume of the contamination at the site.

5.2.2.3 Short-Term Impacts and Effectiveness

This criterion includes an evaluation of the effects of the alternative or remedy during the construction and implementation phase until remedial objectives are met. This criterion includes the identification of potential human exposures, adverse environmental impacts and nuisance conditions at the site resulting from implementation of the remedy or alternative. The potential short-term impacts to be evaluated include nuisance conditions or potential exposures resulting from increased traffic, including truck trips, detours, or loss of the use of access to property; potential for releases to downstream/adjacent areas; odors; dust; habitat disturbance; runoff from the site; and noise. This criterion also considers the engineering controls that would be used to mitigate the short-term impacts (i.e., odor control measures) and the length of time needed to implement the remedy or alternative, including time to achieve the RAOs.

Sustainability and green remediation are also evaluated under this criterion, including minimizing energy use; reducing greenhouse gases and other emissions; maximizing reuse/recycling of materials; and preserving, enhancing, or creating natural habitats.

5.2.2.4 Implementability

This criterion is used to evaluate the technical feasibility of implementing an alternative or remedy, including construction and operation, reliability, monitoring, and the ease of undertaking an additional remedial action if the remedy fails. It also considers the administrative feasibility of activities needed to coordinate with other offices and agencies, such as for obtaining permits, rights-of-way, and institutional controls, and the availability of services and materials necessary to the alternative, such as treatment, storage, and disposal facilities. This criterion also evaluates the reliability and viability of implementation of institutional controls necessary for a remedy.

5.2.2.5 Land Use

This criterion is an evaluation of the current, intended, and reasonably anticipated future use of the site and its surroundings as it relates to an alternative or remedy when unrestricted levels would not be achieved. The evaluation considers 16 land use factors specified in DER-10 (NYSDEC, 2010a), including waterfront revitalization plans, adjacent land use and zoning, and natural resources.

5.2.2.6 Cost Effectiveness

This criterion includes an evaluation of overall costs of the remedial alternative. This criterion includes an evaluation of direct and indirect capital costs, including costs of treatment and disposal, costs of monitoring and maintenance of the alternative, and the total present worth of these costs.

5.3 Detailed Evaluation of Remedial Alternatives

5.3.1 Alternative 1 – No Action

Under Alternative 1, no remedial activities would be completed to treat, remove, contain, or monitor PCB-impacted sediment. The site would be allowed to remain in its current condition, and no effort would be made to change or monitor the conditions in the PCB-impacted areas. The natural physical processes that are known to occur in OU2 are anticipated to continue, and over time, such processes would likely reduce the potential for future exposure and transport of PCB-impacted sediments; however, no effort would be taken to confirm or monitor the progress of such processes. Although this alternative does not readily achieve the RAOs established for OU2, it has been retained for use as a baseline against which other remedial alternatives are compared.

5.3.1.1 Compliance with Standards, Criteria, and Guidance

This section summarizes the applicable chemical-, action-, and location-specific SCGs for this alternative.

Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for sediment include screening levels in the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1999). These sediment screening levels were used to evaluate the sediment during the RI. After reviewing the data from the RIR (ARCADIS, 2011), the NYSDEC called for site-specific sediment cleanup goals of 1 mg/kg site-related PCBs in surface/near-surface sediments and 10 mg/kg site-related PCBs in subsurface sediments. Removal or treatment is not included as part of this alternative; therefore, no action is not expected to achieve the chemical-specific SCGs pertaining to sediments in the short-term. Over time, the site-specific sediment cleanup goals would likely be met for surface and near-surface sediments (i.e., the sediment where there is the potential for exposure) through the natural recovery processes; however, no actions would be conducted under Alternative 1 to verify this.

Potentially applicable chemical-specific SCGs for Class 1 saline surface water include NYSDEC surface-water quality standards and guidance values (6 NYCRR Parts 700-705). Overall, surface-water chemical-specific SCGs would likely not be met due to the presence of numerous sources of a variety of constituents present throughout the Flushing River system that continue to discharge into and accumulate within the sediments.

This alternative does not involve implementation of any remedial activities; therefore, the action-specific and location-specific SCGs are not applicable.

5.3.1.2 Long-Term Effectiveness and Permanence

Under the No Action alternative, PCB-impacted sediment would not be actively addressed through removal, treatment, or engineering controls. Therefore, the long-term effectiveness and permanence would be solely based on the extent of any natural recovery processes. No monitoring would be performed to document the effectiveness and progress of such processes in achieving the RAOs. Thus, the long-term effectiveness of the alternative is uncertain.

5.3.1.3 Reduction of Toxicity, Mobility, and Volume through Treatment

Because the sediments would not be actively removed, treated, or isolated, any reduction in the toxicity, mobility, and volume of the PCB-impacted sediments would be based on the extent of natural recovery processes, which would not be monitored or otherwise documented.

5.3.1.4 Short-Term Impacts and Effectiveness

No remedial actions would be implemented for this alternative. Therefore, there would be no short-term environmental impacts or risks associated with remedial activities posed to the community.

5.3.1.5 Implementability

The No Action alternative does not require implementation of any remedial activities and, therefore, is technically and administratively implementable.

5.3.1.6 Land Use

The No Action alternative does not require implementation of any remedial activities that could affect the current or future use of the river.

5.3.1.7 Overall Protection of Public Health and the Environment

The No Action alternative does not actively address the toxicity, mobility, or volume of PCB-impacted sediments and, therefore, the RAOs would not be achieved in the short-term. Exposure to PCB-impacted sediments could be reduced over time through natural recovery processes, such as burial through sediment deposition. However, no monitoring of the PCB-impacted sediments would be conducted to verify that these natural recovery processes are occurring. Therefore, the overall protectiveness of the No Action alternative is considered low in the short-term and uncertain in the long-term.

5.3.1.1 Cost Effectiveness

The No Action alternative does not involve implementation of any active remedial activities or monitoring of conditions; therefore, there are no costs associated with this alternative (Table B-1 of Appendix B).

5.3.2 Alternative 2

As described in Section 5.1.2, Alternative 2 involves allowing for recovery of PCB-impacted sediments primarily through naturally occurring physical processes (i.e., burial through sedimentation). Over time, such processes would likely reduce the potential future exposure to, and transport of, PCB-impacted sediments. A sediment monitoring program would be designed and implemented to assess the progress of these processes.

Because PCB-impacted sediment would remain in the Flushing River for a period of time, this alternative also includes establishment of institutional controls. Institutional controls would be in the form of governmental, enforcement, permit controls, and/or informational devices.

5.3.2.1 Compliance with Standards, Criteria, and Guidance

This section summarizes the applicable chemical-, action-, and location-specific SCGs for this alternative.

Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for sediment include screening levels in the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1999) and the site-specific sediment cleanup goals of 1 mg/kg site-related PCBs in surface/near-surface sediment and 10 mg/kg site-related PCBs in subsurface sediment. Over time, the site-specific sediment cleanup goals would likely be met for surface and near-surface sediments (i.e., the sediment where there is the potential for exposure) through the natural recovery processes. Documentation of meeting the site-specific cleanup goal would be documented through long-term monitoring under this alternative. Potentially applicable chemical-specific SCGs for Class 1 saline surface water include NYSDEC surface-water quality standards and guidance values (6 NYCRR Parts 700-705). Overall, surface-water chemical-specific SCGs would likely not be met due to the presence of numerous sources of a variety of constituents present throughout the Flushing River system that continue to discharge into and accumulate within the sediments.

Because Alternative 2 would not include active remediation, action-specific SCGs, identified in Table 2-2, and location-specific SCGs, identified in Table 2-3, are not applicable.

5.3.2.2 Long-Term Effectiveness and Permanence

Under Alternative 2, the PCB-impacted sediment would not be actively addressed through removal, treatment, or engineering controls. Therefore, the long-term effectiveness and permanence would be based on the degree of natural recovery processes and the effectiveness of the institutional controls.

As discussed in Section 5.1.2, the radiochemical and analytical data, as well as the forensic evaluations, support that natural recovery of sediments has been occurring within OU2, especially in the littoral zone where several feet of non-site-impacted sediment overlays the PCB-impacted sediments and by definition already meet the RAOs. Within the intertidal zone, sedimentation rates are lower, although still significant. Given the uncertainties associated with predictions about natural recovery process rates, further burial of the intertidal sediments is assumed for purposes of this FS Report to require several years to meet the RAOs. Based on the range of sedimentation rates estimated for the intertidal zone (0.3 to 0.7 inches per year), deposition would take approximately 9 to 20 years for 6 inches, 17 to 40 years for 1 foot, and 34 to 80 years for 2 feet. Additional details on these estimations are provided in Appendix A. A sediment monitoring program would be designed and implemented to assess the progress of these processes toward achieving the RAOs.

The implementation of institutional controls would further reduce the potential for exposure of PCB-impacted sediments. The timeframe for implementation of the institutional controls would depend on the specific types of institutional controls selected and the responsiveness and cooperation of the entities that Con Edison would need to coordinate with to establish them. However, once the institutional controls have been implemented, the potential for human exposure to site-related PCBs in sediment, albeit low now due to site-specific conditions, would be reduced. Monitoring reports would be filed with the NYSDEC to demonstrate that the institutional controls are being maintained. The effectiveness and permanence of the institutional controls would be determined by the extent to which governmental or private entities adopt, comply with, and enforce them.

5.3.2.3 Reduction of Toxicity, Mobility, or Volume through Treatment

Because the PCB-impacted sediments would not be actively removed, treated, or isolated, any reduction in the toxicity, mobility, and volume of the sediment containing site-related PCBs would be based on the extent of natural recovery physical processes, such as burial. Natural recovery biochemical processes (e.g., dechlorination) may also reduce toxicity, mobility, or volume, but based on the inherent chemical properties of PCBs and the depositional nature of the Flushing River, it is anticipated that the biochemical processes would not be as prominent as the physical natural recovery processes documented in OU2.

5.3.2.4 Short-Term Impact and Effectiveness

With Alternative 2, there would be no increased short-term environmental impacts or human-health risks posed to site workers or the community because no active remedial actions would be conducted. However, there would be potential for site workers to be exposed to PCB-impacted sediment during the implementation of the sediment monitoring program. A site-specific Health and Safety Plan (HASP) would be developed to prescribe the appropriate personal protective equipment (PPE) for workers to use to protect themselves during the monitoring activities, thereby mitigating the potential for exposure. Although implementation of Alternative 2 would not include active construction within OU2, vessels would be required for monitoring operations, which would result in minor energy use, slight potential for impacts to surface water, and relatively minimal generation of air pollutants and greenhouse gas (GHG) emissions.

5.3.2.5 Implementability

Implementation of Alternative 2 is technically feasible. Based on the successful implementation of previous investigation activities conducted within OU2, sediment monitoring equipment and personnel are available. Further, based on the results of the RI activities, natural recovery of PCB-impacted sediments has been demonstrated to be occurring and recovery is expected to continue in the future.

Implementation of Alternative 2 is also considered to be administratively feasible. Selection of institutional controls would be performed in consultation with the appropriate parties, which could include the property owner of Parcel 4, New York State/New York City (owners of the river bottom), NYSDEC, USACE, and the Borough of Queens.

5.3.2.6 Land Use

The current and anticipated near-future use of OU1 adjacent to the river is a mixed industrial/commercial urban setting. In the longer term, the New York City Wetland Revitalization Program (NYC WRP) recommends redevelopment of this area for moderate-density residential and commercial uses, with publicly accessible waterfront open space, while still maintaining active industrial use of the Flushing River north of Northern Boulevard. To accommodate these future uses, the NYC WRP recommends rezoning this area from M3 (industrial) to M1 (mixed-use). The future use of OU2 is anticipated to remain as land underwater, consistent with its current use. The NYC WRP recommends improving the water quality and wetland restoration of the Flushing River and Flushing Bay.

This alternative would be compatible with current and future land use. Sediment deposition would continue in the OU2 area allowing for the natural restoration of tidal wetlands along the river. There would be limitations on subsurface activities to sustain the natural cover, such as no anchoring and restrictions on the construction of structures (e.g., bulk head, docks) or dredging activities.

5.3.2.7 Overall Protectiveness of Public Health and the Environment

Alternative 2 does not include any removal, treatment, or containment actions to mitigate potential human health and ecological exposures. The potential for human exposure to PCB-impacted sediment would be reduced through the establishment of institutional controls. Under this alternative, natural recovery processes (i.e., deposition of sediments over the impacted sediments) would, in the long-term, isolate and reduce the potential exposure to and transport of PCB-impacted sediment. A monitoring program would be designed and implemented to document the progress of the natural recovery processes and allow for an assessment of progress toward achieving the RAOs.

5.3.2.8 Cost

The estimated costs associated with Alternative 2 are presented in Table B-2 of Appendix B. The estimated 30-year present worth total cost for this alternative is approximately $550,000. The estimated capital cost for establishing institutional controls and preparing an SMP is approximately $150,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting periodic sediment monitoring and verification of the status of institutional controls, is approximately $400,000.

5.3.3 Alternative 3

As detailed in Section 5.1.3, Alternative 3 involves the installation of an engineered cap over PCB-impacted sediments at the surface and near-surface (in the areas established by Thiessen polygons at SD-20, SD-21, SD-22, SD-23, and the intertidal portion of polygon SD-28 (Figure 5-1), thus providing a chemical and physical barrier to mitigate potential exposure to and transport of PCB-impacted sediment. The natural cover currently existing over PCB-impacted sediment in the subsurface (in the areas established by the Thiessen polygons at the littoral portion of polygons SD-27 and SD-28) would be sustained to continue to contain the deeper PCB-impacted sediment. A cap monitoring and maintenance program would be implemented to assess the long-term effectiveness of the cap, a natural cover monitoring program would be implemented to assess that the natural cover remains, and institutional controls would be established to reduce the potential for disturbances of, and damage to, the cap and natural cover as a result of human activities.

5.3.3.1 Compliance with Standards, Criteria, and Guidance

This section summarizes the applicable chemical-, action-, and location-specific SCGs for this alternative.

Chemical-specific SCGs are shown in Table 2-1. Potentially applicable chemical-specific SCGs for sediment include screening levels in the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1999) and the site-specific sediment cleanup goals of 1 mg/kg site-related PCBs in surface/near-surface sediment and 10 mg/kg site-related PCBs in subsurface sediments. Placement of an engineered cap over PCB-impacted surface and near-surface sediments and sustaining the natural cover over PCB-impacted subsurface sediment would isolate and mitigate the potential exposure to and transport of those sediments. The engineered cap would provide a clean sediment surface layer that meets the SCGs.

Potentially applicable chemical-specific SCGs for Class 1 saline surface water include NYSDEC surface-water quality standards and guidance values (6 NYCRR Parts 700-705). Overall, surface-water chemical-specific SCGs would likely not be met due to the presence of numerous sources of a variety of constituents present throughout the Flushing River system that continue to discharge into and accumulate within the sediments.

The chemical-specific surface-water SCGs also identify surface-water quality standards, such as turbidity and generation of sheens, which may be applicable during the placement of the engineered cap. These SCGs would be met through monitoring and engineering controls during cap placement. For purposes of this FS Report, debris removal and capping are assumed to be carried out within turbidity curtains using absorbent booms (as necessary), which would minimize surface-water impacts (turbidity). Debris removed from the remediation area would be characterized in accordance with 40 CFR Part 261 and 6 NYCRR Part 371 to determine appropriate off-site disposal requirements.

Action-specific SCGs are presented in Table 2-2. Permits/approvals with the USACE and NYSDEC would be required for conducting activities included in Alternative 3 within a water body of the United States/New York State. Debris may be subject to United States Department of Transportation (USDOT) and New York State regulation requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following an NYSDEC-approved remedial design and using licensed, Con Edison-approved waste transporters and permitted disposal facilities. For the purposes of this FS Report, all excavated debris is assumed to be disposed at a non-hazardous waste landfill. The CWA Section 404 criteria (33 United States Code [U.S.C.] Chapter 26 Subchapter 4 Section 1341-1346) for discharges of fill into United States waters are applicable for activities placing cap materials in the Flushing River.

Potentially applicable action-specific SCGs are associated with OSHA monitoring and health and safety requirements as identified in 29 CFR Parts 1910, 1926, and 1904. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and recordkeeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP.

Location-specific SCGs are presented in Table 2-3. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit and applicable local permits prior to conducting remedial activities. In addition, remedial activities would be conducted in accordance with local building/construction codes and ordinances.

Permits for remediation in regulated waters are issued by the USACE, usually under NWP #38: Cleanup of Hazardous and Toxic Waste, and jointly with the NYSDEC Water Quality Certification. Although, securing the applicable permits/permit equivalents for this activity could prove difficult and time consuming, the above grade engineered cap is anticipated to meet the substantive requirements of the NWP #38 and the Protection of Water Permit under NYSDEC Part 608.

5.3.3.2 Long-Term Effectiveness and Permanence

The potential for future long-term impacts resulting from human and biota exposures to PCB-impacted sediment would be reduced through implementation of Alternative 3. PCB-impacted surface and near-surface sediment would be isolated via an engineered cap and the existing natural cover would reduce potential exposure to and transport of deeper impacted sediments. The engineered cap and natural cover would require monitoring. The engineered cap would also require maintenance, as well as potential activity restrictions within the capped and natural cover areas, for this alternative to remain effective and reliable over the long-term. Periodic cap inspections would occur.

Maintenance activities would be performed, as necessary, and could include replacing and repairing disturbed or damaged sections of the cap. Monitoring reports would also be submitted to the NYSDEC to describe any cap monitoring and maintenance activities. Institutional controls would be established to mitigate the potential for disturbance of or damage to the cap, thereby enhancing its long-term effectiveness and permanence. The effectiveness and permanence of the institutional controls would largely be determined by the extent to which governmental or private entities adopt, comply with, and enforce them. Reports would be submitted to the NYSDEC to document that the institutional controls are being maintained.

5.3.3.3 Reduction of Toxicity, Mobility, and Volume through Treatment

Installation of an engineered cap over PCB-impacted surface and near-surface sediments and a natural cover over deeper PCB-impacted subsurface sediments would reduce the exposure to and mobility of the PCB-impacted sediments by isolating the sediments. However, sediments would remain in-place so the volume of PCB-impacted sediments would remain the same.

5.3.3.4 Short-Term Impacts and Effectiveness

The short-term impacts resulting from the implementation of Alternative 3 could include potential minor impacts to the water column due to resuspension of sediments and minor impacts to biota due to temporary alteration/destruction of existing habitat in the area subject to capping. However, restoration of previous benthic communities is expected to occur in relatively short timeframes as a result of continued sediment deposition and benthic recolonization.

Additionally, the small portion of the Flushing River where the engineered cap would be constructed would initially be above the current sediment surface elevation, but it is anticipated that due to the physical characteristics and visual observations of the sediment, there would be some compaction that would occur. The final elevation of the cap would likely be less than 1 foot above the current top of sediment elevation and have minimal affect on the Flushing River. In the Flushing River, capping can be viewed as an engineering process that acts as an accelerated sedimentation process that is already occurring and would, over time, have the same net effect of natural sedimentation processes that create successional habitat types or ecosystems. For example, the intertidal zone could be restored as a tidal wetland, consisting of a variety of habitat types: mudflat, low marsh, and high marsh.

Additionally, implementation of Alternative 3 may result in short-term worker safety concerns, including working with and around large construction equipment, working on and around water, noise generated from operating construction equipment, and increased vessel and truck traffic associated with transportation of materials to/from the staging area and the site. These concerns would be mitigated by using engineering and operational controls, as well as appropriate health and safety practices. Transportation of cap materials would result in approximately 33 tractor trailer trips to the staging area (assuming 14 cy per tractor trailer). The increased potential for total emissions and motor vehicle accidents on local roadways would be mitigated through the use of appropriate best management practices (BMPs) for clean fuel and emission (e.g., engine idle reduction practices, diesel particulate filters on trucks, utilizing alternative fuels), careful planning of truck routes to mitigate impacts on local community, the use of appropriate health and safety practices (29 CFR 1910), and compliance with the site-specific HASP.

Temporary fencing would be used to restrict access to work areas. Access to the river work areas would also be restricted through buoys, signs, lighting, and other controls. Although there is minimal river activity in this section of the Flushing River, the schedule of debris removal and capping activities would be coordinated with the United States Coast Guard (USCG) to minimize access disruptions to river users. A site-specific Community Air Monitoring Plan (CAMP) would be prepared and community air monitoring would be performed during debris removal and capping activities to evaluate the need for additional engineering controls (e.g., use of odor controls).

Under this alternative, energy would be used for construction and transportation, primarily through fuel consumption. Placement of cap materials and transportation of materials would result in the emission of GHGs from remediation equipment and transportation vehicles. Site management practices that would be put in place to minimize impacts and improve sustainability include modifying field operations to reduce idling equipment, using biofuels (if available), mitigating impacts to stormwater and the river, and minimizing transportation miles consistent with the core elements of the USEPA's Green Cleanup Standard Initiative (USEPA, 2009) and DER-31 (NYSDEC, 2010d).

Based on the area of the engineered cap to be installed as part of Alternative 3, it is anticipated that construction activities would take approximately 1 month to complete.

5.3.3.5 Implementability

Alternative 3 would be both technically and administratively implementable. Equipment, materials, and remedial contractors necessary to construct, install, and monitor and maintain the engineered cap are readily available. Potential technical implementability issues for this alternative would be associated with severe weather, tidal fluctuations, access due to low bridge clearance, potential protection of ecological habitats, potential presence of debris or other obstructions, and mobilizing equipment and materials to the remedial area. These implementation challenges may be mitigated with proper advanced planning and coordination of remedial activities.

Conducting sediment remedial activities in an urban public setting presents numerous logistical challenges. There is limited upland space at OU1 for materials handling and staging. Transportation planning would be required to conduct the capping activities. Additionally, remedial activities would have to be conducted in a manner as to not jeopardize health and safety of, or cause a nuisance to, nearby businesses.

The administrative issues that could limit the implementability of Alternative 3 are obtaining access agreements with property owners (if needed) and obtaining permits (or permit equivalents)/license from the USACE, NYSDEC, New York State Coastal Management Program, and local agencies for the construction of a cap within the Flushing River.

For remedial actions being conducted as part of an NYSDEC-ordered action (i.e., Consent Order), certain NYSDEC-regulated activities are required to meet the substantive requirements applicable to the NYSDEC-issued permits, but may be exempted by the NYSDEC from obtaining individual permits. Pursuant to NYSDEC regulations, 6 NYCRR Part 375-1.12 – Permits, the NYSDEC may exempt a remedial party from the requirement to obtain any NYSDEC-issued permits for sites that meet prescribed regulatory conditions. Because this remedial alternative would be implemented under a Consent Order, the substantive requirements of a Protection of Waters Permit under 6 NYCRR Part 608 would be required for placing a cap in the Flushing River.

It is anticipated that Alternative 3 would meet the substantive requirements of the Protection of Water Permit, which include that the alternative be reasonable and necessary; would not endanger the health, safety, or welfare of the people of the State of New York; and would not cause unreasonable, uncontrolled, or unnecessary damage to the natural resources of the state. Based on previous experience evaluating alternatives that include an above grade cap component, securing the applicable permits/permit equivalents for this activity could prove difficult and time consuming. An above grade cap can reduce water depth, flood storage, and benthic habitat quality, which are some of the issues considered under the Protection of Water Permit. The actual cap configuration would be determined during the remedial design, but for purposes of this FS Report, the cap thickness has been assumed to be approximately 1 foot. The increase in elevation over the relatively small capped area would not likely affect the hydraulics of the Flushing River as a whole. However, based on the physical characteristics and visual observations of the sediments, some compaction is expected to occur after cap placement. Therefore, the final elevation of the cap area after completion of Alternative 3 is expected to be less than 1 foot higher than current elevations. The amount of compaction expected after cap placement would be further evaluated during the remedial design.

As previously discussed above in Section 5.3.3.4, capping under Alternative 3 can be viewed as an engineering process that acts as an accelerated sedimentation process that is already occurring and would, over time, have the same net effect of natural sedimentation processes that create successional habitat types or ecosystems. However, to facilitate the rate of establishment of the habitat over the cap, the areas disturbed as a result of the remedial activities would be restored after cap placement to tidal wetland habitat (e.g., high marsh, low marsh) depending on the final elevation range. Furthermore, natural deposition would further restore the tidal wetland habitat.

Permits/approvals that also would be required to be obtained from the USACE for NWP #38, Cleanup of Hazardous and Toxic Waste, Section 401 Water Quality Certification from NYSDEC (Water Quality Certification is a federal requirement implemented by the state, so it is not considered a "state permit," per se), consistency assessment relative to the New York State Coastal Management Program (including the NYC WRP), and local permits for placement of fill in the 100-year Federal Emergency Management Agency (FEMA) flood zone.

Administratively, institutional controls would be established for the PCB-impacted sediment areas. Implementation of institutional controls would require coordination with state and/or local agencies (i.e., NYSDEC, NYSDOH, New York State Department of Transportation [NYSDOT]/New York City Department of Transportation [NYCDOT]) and property owners (owner of Parcel 4 and New York State/New York City).

5.3.3.6 Land Use

The current and anticipated near-future and longer-term use of OU1 adjacent to the river and the NYC WRP are discussed in Section 1.4.1.

This alternative would be compatible with current and future land use. Sediment deposition would continue in the OU2 area allowing for the natural restoration of tidal wetlands along the river. There would be limitations on subsurface activities to maintain the integrity of the engineered cap in the intertidal zone and the natural cover in the littoral zone, such as no anchoring and restrictions on the construction of structures and dredging activities.

5.3.3.7 Overall Protection of Public Health and the Environment

Alternative 3 would reduce the potential exposure to and transport of PCB-impacted sediments and thereby meet the RAOs established for OU2. Appropriate institutional controls would be established to limit the potential for disturbance of or damage to the cap and natural cover.

Potential short-term impacts to the community from remedial construction activities are expected to be minimal and would be managed by following site plans, establishing appropriate engineering controls, and proper sequencing of work. Potential short-term exposure to site workers to PCB-impacted sediments during implementation of this alternative could be mitigated by following appropriate health and safety practices. A long-term cap monitoring and maintenance program would be implemented to enhance the long-term effectiveness of the cap, and a long-term natural cover monitoring program would be implemented to confirm that the natural cover is sustained. Potential short-term impacts to the environment from implementing Alternative 3 would be managed by the use of environmental controls, work seasons compatible with biota habitat, and restoration of the habitats (e.g., mudflat, high marsh, low marsh).

5.3.3.8 Cost Effectiveness

The estimated costs associated with Alternative 3 are presented in Table B-3 of Appendix B. The total 30-year present worth cost for this alternative is approximately $3,200,000. The estimated capital cost for this alternative is approximately $2,600,000. The estimated 30-year present worth costs for O&M activities associated with this alternative, including conducting sediment monitoring and verifying the status of institutional controls is approximately $600,000.

5.3.4 Alternative 4

As described in Section 5.1.4, Alternative 4 involves the removal of PCB-impacted sediment in the areas established by Thiessen polygons at SD-20, SD-21, SD-22, SD-23; and to the extent practicable in the area established by Thiessen polygon at SD-28 (Figure 5-2). The degree of sediment removal in the vicinity of and under the Van Wyck Expressway Bridge will evaluated during design as there are implementability issues with conducting dredging activities in the vicinity of and beneath the Van Wyck Expressway Bridge as there are bridge support structures within the vicinity of and in the SD-28 polygon (Figure 5-2). Dredging would be conducted as practical to remove sediments up to the bridge and foundations such that structural supports or modifications to the Van Wyck Expressway Bridge would not be required. Approximately 2,600 cy of sediment would be removed by the dredging activities, and the dredged areas would be backfilled with clean fill. As discussed in Section 5.1.4, the removal volume includes PCB-impacted sediments, as well as sediments with PCB concentrations less than the sediment cleanup goals because the PCB-impacted sediments are deeper than these sediments and/or the need to slope the sides of the dredging area to account for sloughing. As part of Alternative 4, the natural cover currently existing over PCB-impacted sediment in the subsurface (in the areas established by Thiessen polygon SD-27) would be sustained to continue to contain these deeper PCB impacts. A natural cover monitoring program would be implemented to assess that the natural cover remains, and institutional controls would be established to reduce the potential for disturbances of, and damage to, the natural cover as a result of human activities.

5.3.4.1 Compliance with Standards, Criteria, and Guidance

This section summarizes the applicable chemical-, action-, and location-specific SCGs for this alternative.

Chemical-specific SCGs are shown in Table 2-1. Potentially applicable chemical-specific SCGs for sediment include screening levels in the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1999) and the site-specific sediment cleanup goals of 1 mg/kg site-related PCBs in surface and near-surface sediment and 10 mg/kg site-related PCBs in subsurface sediment. Removal and off-site disposal of the sediment removed and backfilling the dredge area would remove and, therefore, eliminate the potential for migration of those sediments, resulting in the achievement of the site-specific sediment cleanup goals and RAOs following remedy implementation. Dredging PCB-impacted sediments and backfilling with clean granular fill would meet the SCGs. Sustaining the natural cover over deeper PCB-impacted subsurface sediment would isolate and mitigate the potential exposure to, and transport of, those sediments. The alternative would meet the applicable chemical-specific SCGs by isolating the PCB-impacted sediment from surface water, and the implementation of institutional controls should reduce the potential for disturbance of the natural cover.

Potentially applicable chemical-specific SCGs for Class 1 saline surface water include NYSDEC surface-water quality standards and guidance values (6 NYCRR Parts 700-705). Overall, surface-water chemical-specific SCGs would likely not be met due to the presence of numerous sources of a variety of constituents present throughout the Flushing River system that continue to discharge into and accumulate within the sediments.

The chemical-specific surface-water SCGs also identify surface-water quality standards, such as turbidity and generation of sheens, which may be applicable during the dredging and backfilling. These SCGs would be met through monitoring and engineering controls during the dredging and backfilling. For purposes of this FS

Report, debris removal, dredging, and backfilling are assumed to be carried out within turbidity curtains using absorbent booms (as necessary), which would minimize surface-water impacts (turbidity). Removed debris and dredged sediment would be characterized in accordance with 40 CFR Part 261 and 6 NYCRR Part 371, as well as local solid waste management regulations to determine appropriate off-site disposal requirements.

Action-specific SCGs are presented in Table 2-2. Permits/approvals with the USACE and NYSDEC would be required for conducting activities included in Alternative 4 within a water body of United States/New York State. Debris and sediment may be subject to USDOT and New York State regulation requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following an NYSDEC-approved remedial design and using licensed, Con Edison-approved waste transporters and permitted disposal facilities. For the purposes of this FS Report, all excavated debris is assumed to be disposed at a non-hazardous waste landfill. Additionally, an SPDES permit equivalent would be required to discharge treated water to surface water (e.g., East River). The permit equivalent would establish maximum discharge limits and pre-treatment requirements that would need to be achieved prior to discharge. The CWA Section 404 criteria (33 U.S.C. Chapter 26 Subchapter 4 Section 1341-1346) for discharges of fill into United States waters are applicable for activities placing backfill within the dredged areas in the Flushing River.

Potentially applicable action-specific SCGs are associated with OSHA monitoring and health and safety requirements as identified in 29 CFR Parts 1910, 1926, and 1904. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and recordkeeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP.

Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations on conducting backfilling and construction activities within United States/New York State waters. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit and applicable local permits prior to conducting remedial activities. In addition, remedial activities would be conducted in accordance with local building/construction codes and ordinances.

Permits for remediation in regulated waters are issued by the USACE, usually under NWP #38: Cleanup of Hazardous and Toxic Waste, and jointly with the NYSDEC Water Quality Certification. Alternative 4 is anticipated to meet the substantive requirements of the NWP #38.

5.3.4.2 Long-Term Effectiveness and Permanence

The potential exposures to and transport of PCB-impacted sediments would be reduced through the implementation of this alternative. This alternative would include permanent removal of PCB-impacted sediment in the vicinity of SD-20, SD-21, SD-22, SD-23, and SD-28 and by sustaining the natural cover over the PCB-impacted sediments at depth in the vicinity of polygon SD-27). For purposes of this FS Report, it is assumed that inspection of the natural cover would be conducted biennially for the first 5 years and then every 5 years thereafter until year 30. Monitoring reports that describe the methods and results of monitoring activities would be prepared and submitted to the NYSDEC. Reports would also be submitted to the NYSDEC to document that the institutional controls are being maintained. The effectiveness of the institutional controls would be determined by the extent to which governmental or private entities adopt, comply with, and enforce them.

5.3.4.3 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative would include the removal and off-site disposal of up to approximately 1,200 cy of PCB-impacted sediment, which would reduce the potential exposure to and transport of PCB-impacted sediment by permanently containing the removed sediments within an off-site landfill. The natural cover of the PCB-impacted areas at depth also reduces the potential exposure to and transport of PCB-impacted sediments by isolating the sediments and providing a physical barrier.

Stabilization would be included as part of Alternative 4 for the purpose of meeting waste transportation SCGs. Stabilization would potentially reduce leachability of PCBs from sediment (i.e., mobility), but stabilization would not reduce the potential toxicity or volume of the removed sediment disposed in the licensed landfill facility.

5.3.4.4 Short-Term Impacts and Effectiveness

Implementation of this alternative may result in short-term exposure of the surrounding community and site workers to PCB-impacted sediment as a result of dredging, materials handling, and off-site transportation activities. Additionally, field personal may be exposed to impacted surface water and sediments during dredging. Potential exposure of remedial workers would be minimized through the use of appropriately trained field personnel and the appropriate level of PPE, as specified in a site-specific HASP that would be developed as part of the remedial design.

Temporary fencing would be used to restrict access to work areas from the landside (Parcel 3). Access to the river work areas would also be restricted through buoys, signs, lighting, and other controls. Although there is minimal boating activity in this section of the Flushing River, the schedule of dredging activities would be coordinated with the USCG to minimize access disruptions to river users. A site-specific CAMP would be prepared, and community air monitoring would be performed during dredging and backfilling activities to evaluate the need for additional engineering controls (e.g., use of odor controls, modify rate of dredging or backfilling). As discussed in the RIR (ARCADIS, 2011), odor has been an issue for the Flushing River due to the CSO discharges and the decomposed state of the sediments. Although this odor issue is not related to the PCB-impacted sediments, odor control measures would potentially be required while implementing the dredging portion of Alternative 4.

Additional worker safety concerns include working with and around large construction equipment, working on and around water, noise generated from operating construction equipment, and increased vehicle traffic associated with transportation of excavated materials from the staging area and delivery of fill materials to the staging area.

These concerns would be minimized by using engineering controls, BMPs, and appropriate health and safety practices. Off-site transportation of excavated material and importation of clean fill materials would result in up to approximately 190 tractor trailer round trips (assuming 14 cy per tractor trailer). The increased potential for total emissions and motor vehicle accidents on local roadways would be mitigated through the use of appropriate BMPs for clean fuel and emission (e.g., engine idle reduction practices, diesel particulate filters on trucks, utilizing alternative fuels), careful planning of truck routes to mitigate impacts on local community, the use of appropriate health and safety practices (29 CFR Part 1910), and compliance with the site-specific HASP. The dredged material would be barged to the staging area to reduce the handling of the material.

Under this alternative, energy would be used for construction, transportation, and treatment operations primarily through fuel consumption. Dredging of sediments, transportation of dredged sediments, and dewatering of sediments would result in the emission of GHGs from remediation equipment, transportation vehicles, and the sediment dewatering process. Site management practices that could be put in place to minimize impacts and improve sustainability include modifying field operations to reduce idling equipment, using biodiesel fuels (if available), mitigating impacts to stormwater and the river, and minimizing transportation miles consistent with the core elements of USEPA's Green Cleanup Standard Initiative (USEPA, 2009) and DER-31 (NYSDEC, 2010d).

Dredged sediments would be transported from the site to the staging area and from the staging area to the disposal facility as few miles as possible to mitigate total energy use and GHG emissions.

The short-term effects on the environment resulting from implementation of Alternative 4 would include potential impacts to the water column, air and biota in the Flushing River area during dredging and backfilling activities, and alteration/destruction of habitat in the areas subject to those activities. These effects would be mitigated by the use of environmental controls, work seasons compatible with biota habitat, and habitat restoration.

Based on the volume of sediment to be dredged under Alternative 4, it is anticipated that sediment remediation would require approximately 3 months to complete.

5.3.4.5 Implementability

This remedial alternative would be both technically and administratively implementable. Equipment and materials necessary to dredge sediment are readily available, although specialized. Remedial contractors are also available to perform these activities.

Implementability issues for this alternative would be associated with severe weather conditions, tidal fluctuations, protection of potential ecological habitat, potential presence of debris or other obstructions, and mobilizing equipment and materials to the remedial area. These implementation challenges may be minimized with proper advanced planning and coordination of the remedial activities. In addition, there are implementability issues with conducting dredging activities in the vicinity of and beneath the Van Wyck Expressway Bridge. There are bridge support structures within the vicinity of and in the SD-28 polygon (Figure 5-2) that would need to be evaluated to address potential structural considerations and measures to mitigate potential structural issues. These potential considerations and measures have not been evaluated in this FS Report, but have the potential to be significant and may result in substantial changes and material increases to the dredging methods, duration, and cost. Due to the location of the bridge support structures, permission from the bridge owner/operator to perform any construction activities in the vicinity of these structures would likely be required, and additional and significant provisions (if work around these structures is allowed) may be necessary. Therefore, as shown on Figure 5-2, dredging underneath the Van Wyck Expressway Bridge would be completed to the extent practicable after evaluation of these factors. Dredging would be conducted as practical to remove sediments up to the bridge and foundations such that structural supports or modifications to the Van Wyck Expressway Bridge would not be required.

Managing, treating, and discharging water generated from dewatering processes may present implementation challenges. A temporary treatment system would be constructed at the staging area (e.g., Astoria facility). As part of the remedial design, a SPDES permit equivalent would be obtained to discharge the treated water to the adjacent surface-water body. Alternatively, the dredged material may be barged to a disposal facility (e.g., Clean Ventures) that could manage the dewatering, treatment, and disposal of the material. Options for sediment management would be evaluated during the remedial design. For the purpose of this FS Report, it has been assumed that the material would be managed and dewatered at a staging area at the Astoria facility and then transported to an off-site non-hazardous disposal facility.

Conducting sediment removal activities in an urban public setting presents numerous logistical challenges. There is limited space upland in OU1 for materials handling and staging due to recent commercial development. Transportation planning would be required to conduct the removal and backfill activities. Additionally, sediment removal activities would have to be conducted in a manner as to not jeopardize health and safety of or cause a nuisance to the nearby businesses.

The administrative issues that could limit the implementability of Alternative 4 are obtaining access agreements with property owners (if needed) and obtaining permits (or permit equivalents)/license from the USACE, NYSDEC, New York State Coastal Management Program, and local agencies for implementing the remedial action within Flushing River. These potentially applicable permits/permit equivalents/approval would include the USACE for NWP #38, Cleanup of Hazardous and Toxic Waste, Protection of Waters Permit from the NYSDEC (Part 608), Section 401 Water Quality Certification from the NYSDEC, consistency assessment relative to the New York State Coastal Management Program (including the NYC WRP), and local permits for placement of fill in the 100-year FEMA flood zone.

Administratively, institutional controls would be established for the deeper PCB-impacted sediment areas. Implementation of institutional controls would require coordination with state and/or local agencies (i.e., the NYSDEC, NYSDOH, and NYSDOT/NYCDOT) and property owners (owner of Parcel 4 and New York State/New York City).

5.3.4.6 Land Use

The current and anticipated near-future and longer-term use of OU1 adjacent to the river and the NYC WRP are discussed in Section 1.4.1.

This alternative would be compatible with current and future land use. Sediment deposition would continue in the OU2 area allowing for the natural restoration of tidal wetlands along the river. There would be limitations on subsurface activities to maintain the integrity of the natural cover, such as no anchoring and restrictions on the construction of structures and dredging activities.

5.3.4.7 Overall Protection of Public Health and the Environment

Alternative 4 would address potential long-term exposure to PCB-impacted sediments by dredging the PCB impacts (in the areas established by Thiessen polygons at SD-20, SD-21, SD-22, SD-23, and SD-28). Dredged material would be permanently transported off site for disposal. In addition, the existing natural cover (overlying material) would continue to prevent the potential exposure to and transport of PCB-impacted sediments at depth. Appropriate institutional controls would be established to limit the potential for disturbance of the natural cover.

Potential short-term impacts to site workers and the community from remedial construction and off-site transportation of dredged material would be managed by following site plans and establishing appropriate engineering controls (e.g., site fencing, signage, barricades). Potential short-term exposures to PCB-impacted sediment during implementation of this alternative would be mitigated by appropriate health and safety planning and practices. Through dredging and institutional controls, Alternative 4 would achieve the RAOs. Potential short-term impacts to the environment from implementing Alternative 4 would be managed by the use of environmental controls, work seasons compatible with biota habitat, and restoration of the habitats (e.g., mudflat, high marsh, low marsh).

5.3.4.8 Cost Effectiveness

The estimated costs associated with Alternative 4 are presented in Table B-4 of Appendix B. The total estimated 30-year present worth cost for this alternative is approximately $4,700,000. The estimated capital cost, including costs of sediment removal and establishing institutional controls, is approximately $4,400,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting sediment monitoring and verifying the status of institutional controls, is approximately $300,000.

5.3.5 Alternative 5

As described in Section 5.1.5, Alternative 5 is similar to Alternative 4, except that the top 4.5 feet of sediment would be removed from the area established by the entire Thiessen polygon at SD-28 regardless of implementability issues associated with sediment removal in the vicinity of and under the Van Wyck Expressway Bridge.t SD-27, an area of deep (greater than 9 feet bss) PCB-impacted sediments would remain in place beneath a natural cover. Because of the similarities between Alternatives 4 and 5, the detailed analysis of Alternative 5 is not repeated herein. Rather, the significant changes from Alternative 4 to Alternative 5 with respect to the evaluation criteria are highlighted in the subsections below.

5.3.5.1 Compliance with Standards, Criteria, and Guidance

The SCGs that apply to Alternative 4 would also apply to Alternative 5.

5.3.5.2 Long-Term Effectiveness and Permanence

Alternative 5 is expected to have the same long-term effectiveness as Alternative 4. The permanence of Alternative 5 would be slightly increased if a greater quantity of PCB-impacted sediment was removed and disposed off-site. The PCB-impacted sediment at depth (i.e., within the Thiessen polygons established around SD-27) are already naturally covered and expected to remain covered (stable) into the future.

5.3.5.3 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative would include the removal and off-site disposal of approximately 2,600 cy of sediment, which would reduce the potential exposure to transport of PCB-impacted sediment by permanently containing the removed sediments within the off-site landfill as described under Alternative 4 (Section 5.3.4.3).

5.3.5.4 Short-Term Impacts and Effectiveness

The short-term impacts and effectiveness for Alternative 5 are similar to the short-term impacts for Alternative 4. However, if ultimately more sediment was removed in this alternative due to issues with dredging near and under the bridge in Alternative 4, there would be differences in the number of truck trips, the duration to conduct remediation activities, and the potential for worker and public exposure. The number of truck trips estimated for the implementation of Alternative 5 is approximately 190, each carry a total of 14 cy of material. Based on the volume of sediment to be dredged, it is anticipated that the remediation activities associated with Alternative 5 would require approximately 4 months to complete. The longer duration of dredging activities (as a result of a decrease in the dredging rate due to the difficulties of dredging under the Van Wyck expressway) associated with Alternative 5 could result in greater potential for short-term exposures to site workers and the community and an increased potential for sediment releases (e.g., turbidity). In addition, if the dredging has the potential to impact the foundation supports of the Van Wyck Expressway Bridge then traffic may need to be rerouted while portions of the dredging is completed. This would result in a significant impact to the community.

5.3.5.5 Implementability

The same technical and administrative implementability issues that apply for Alternative 4 would also apply to Alternative 5. The Van Wyck Expressway Bridge poses potentially significant technical and administrative implementability issues for Alternatives 4 and 5. The Van Wyck Expressway Bridge currently has limited clearance beneath the bridge that may not be adequate to accommodate conventional dredging equipment. In addition, there are bridge support structures within the vicinity of SD-28 (Figure 5-3), which would need to be evaluated to address potential structural considerations and measures to mitigate potential structural issues. These potential considerations and measures have not been evaluated in this FS Report but have the potential to be significant and may result in substantial changes and material increases to the dredging methods, duration, and cost. Due to the location of the bridge support structures, permission from the bridge owner/operator to do any construction activities in the vicinity of these structures would likely be required and additional and significant provisions (if work around these structures is allowed) may be necessary.

5.3.5.6 Land Use

Alternative 5 would be compatible with the current and future land uses. Limitation on subsurface activities to sustain the natural cover would only be needed in the area around SD-27.

5.3.5.7 Overall Protection of Public Health and the Environment

Alternative 5 would address potential long-term exposure to PCB impacts by dredging the PCB-impacted sediments (up to 5 feet bss) in the vicinity of SD-20, SD-21, SD-22, SD-23, and SD-28. Dredged material would be permanently transported off site for disposal. In addition, the natural cover would continue to prevent the potential exposure to and transport of PCB-impacted sediments at depth (in the area of SD-27). Appropriate institutional controls would be established to limit the potential for disturbance of the natural cover.

Potential short-term impacts to site workers and the community from remedial construction and off-site transportation of dredged material would be managed by following site plans and establishing appropriate engineering controls (e.g., site fencing, signage, barricades). Potential short-term exposures to PCB-impacted sediment during implementation of this alternative would be mitigated by appropriate health and safety planning and practices. Potential short-term impacts to the environment from implementing Alternative 5 would be managed by the use of environmental controls, work seasons compatible with biota habitat, and restoration of the aquatic habitat.

Through dredging, sustaining a natural cover, and institutional controls, Alternative 5 would achieve the RAOs.

5.3.5.8 Cost Effectiveness

The estimated costs associated with Alternative 5 are presented in Table B-5 of Appendix B. The total estimated 30-year present worth cost for this alternative is approximately $5,100,000. The estimated capital cost, including costs for sediment removal and establishing institutional controls, is approximately $4,800,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting annual sediment monitoring and verifying the status of institutional controls, is approximately $300,000.

5.3.6 Alternative 6

As described in Section 5.1.6, Alternative 6 is very similar to Alternatives 4 and 5, with the addition of up to 10 feet of PCB-impacted sediment removal (in the vicinity of SD-27) (Figure 5-4). Because of the similarities between Alternatives 4, 5, and 6, the entire detailed analysis of Alternative 6 is not repeated herein. Rather, the significant changes from Alternative 4 and Alternative 5, with respect to the evaluation criteria, are highlighted in the subsections that follow.

5.3.6.1 Compliance with Standards, Criteria, and Guidance

The SCGs that apply to Alternatives 4 and 5 would also apply to Alternative 6.

5.3.6.2 Long-Term Effectiveness and Permanence

Alternative 6 has the same long-term effectiveness as Alternatives 4 and 5; however, the permanence would slightly increase as a result of removing more of the PCB-impacted sediment (i.e., larger quantity of sediment removed) (refer to Section 5.3.6.3 below). However, the PCB-impacted sediment at depth (i.e., within the Thiessen polygons established around polygon SD-27) are already naturally covered and expected to remain covered (stable) into the future.

5.3.6.3 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative would include the removal, handling, and off-site disposal of approximately 6,200 cy of sediment, which would reduce the potential exposure to and transport of PCB-impacted sediment by permanently containing the removed sediments within an off-site landfill as described under Alternative 4 (Section 5.3.4.3).

5.3.6.4 Short-Term Impacts and Effectiveness

The short-term impacts and effectiveness for Alternative 6 are similar to the short-term impacts for Alternatives 4 and 5. However, due to the additional volume of sediment removed, there would be differences in the number of truck trips, the duration to conduct remediation activities, and the potential for exposure. The number of truck trips estimated for the implementation of Alternative 6 is approximately 450, each carry a total of 14 cy of material. Based on the volume of sediment to be dredged, it is anticipated that the remediation activities associated with Alternative 6 would require approximately 7 months to complete. The longer duration of dredging activities (as a result of the increase in dredge depth and associated dredge volume) associated with Alternative 6 would result in greater potential for short-term exposures to site workers and the community and an increased potential for sediment releases.

5.3.6.5 Implementability

The same technical and administrative implementability issues that apply to Alternatives 4 and 5 would also apply to Alternative 6, with the additional technical implementability issue of installing support structures during dredging activities at deeper depths. It has been assumed for purposes of this FS Report that dredging at depths greater than 5 feet would require sloping; however, the need for support structures (e.g., steel sheeting) would be evaluated during the remedial design phase. Remedial contractors, equipment, and materials are also available to perform these activities. Technical implementability issues are associated with dredging and backfilling near and under the existing man-made structures (e.g., Van Wyck Expressway Bridge) within the vicinity of SD-28 and SD-27 (Figure 5-4), which would need to be evaluated to address potential structural considerations and measures to mitigate potential structural issues. As discussed for Alternatives 4 and 5, structural issues may be significant and may result in significant changes and material increases to the dredging methods, duration, and cost.

5.3.6.6 Land Use

Alternative 6 would be compatible with the current and future land uses.

5.3.6.7 Overall Protection of Public Health and the Environment

Alternative 6 would address potential long-term exposure to PCB impacts by dredging the PCB-impacted sediments in the upper 2 to 10 feet of sediment in in the areas established by Thiessen polygons around SD-20, SD-21, SD-22, SD-23, SD-27, and SD-28). Dredged material would be permanently transported off site for disposal.

Potential short-term impacts to site workers and the community from remedial construction and off-site transportation of dredged material would be managed by following site plans, employing BMPs, and establishing appropriate engineering controls (e.g., site fencing, signage, barricades). Potential short-term exposures to site-related PCBs during implementation of this alternative would be mitigated by appropriate health and safety planning and practices. Potential short-term impacts to the environment from implementing Alternative 6 would be managed by the use of environmental controls, work seasons compatible with biota habitat, and restoration of the aquatic habitat. Through dredging, Alternative 6 would achieve the RAOs.

5.3.6.8 Cost Effectiveness

The estimated costs associated with Alternative 6 are presented in Table B-6 of Appendix B. The total estimated 30-year present worth cost for this alternative is approximately $9,200,000. The estimated capital cost, including costs for sediment removal, is approximately $9,200,000. There are no long-term or short-term monitoring costs associated with Alternative 6.

6. Comparative Analysis

After the remedial alternatives were evaluated individually against the evaluation criteria, all six alternatives were compared against each other using those same criteria. This section presents the results of that comparative analysis and identifies the advantages and disadvantages of each alternative relative to each other and with respect to the evaluation criteria.

6.1 Compliance with Standards, Criteria, and Guidance

The compliance with SCGs comparison includes an evaluation of the alternative's ability to comply with applicable federal, state, and local criteria; advisories; and guidance.

6.1.1 Chemical-Specific Standards, Criteria, and Guidance

Potentially applicable chemical-specific SCGs for sediment include screening levels in the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1999) and the site-specific sediment cleanup goals of 1 mg/kg site-related PCBs in surface and near-surface sediments and 10 mg/kg site-related PCBs in subsurface sediments. Removal or treatment is not included as part of Alternatives 1 and 2; therefore, they are not expected to achieve the chemical-specific sediment SCGs in the short-term. Over time, the chemical-specific sediment SCGs may be achieved through the natural recovery processes, which would be monitored under Alternative 2, but no actions would be conducted under Alternative 1 to verify this. Alternative 3 would achieve the chemical-specific sediment SCGs by capping and sustaining the natural cover over the PCB-impacted sediment and implementing institutional controls. Alternatives 4 and 5 would achieve the chemical-specific sediment SCGs through sediment removal and backfill/natural cover overlaying remaining PCB-impacted sediment. Alternative 6 would achieve the chemical-specific sediment SCGs through removal of the deeper PCB-impacted sediment, in addition to the PCB-impacted sediment above 5 feet bss and backfilling.

Potentially applicable chemical-specific SCGs for Class 1 saline surface water include NYSDEC surface-water quality standards and guidance values (6 NYCRR Parts 700-705). Overall, surface-water chemical-specific SCGs would likely not be met due to the presence of numerous sources of a variety of constituents present throughout the Flushing River system that continue to discharge into and accumulate within the sediments. Because of the upland remedial action, PCB sources and pathways that originated from OU1 have been eliminated.

The chemical-specific surface-water SCGs also identify surface-water quality standards, such as turbidity and generation of sheens that may be applicable during the debris removal, capping, dredging, and backfilling associated with Alternatives 3 through 6. These SCGs would be met through monitoring and engineering controls, such as turbidity curtains and absorbent booms (as necessary), which would minimize surface-water impacts (turbidity). The placement of the cap in Alternative 3 may result in a small amount of sediment resuspension, which could potentially result in short-term exceedances of surface-water quality standards. For the alternatives that involve dredging, the potential for sediment resuspension and exceedances of the surface-water quality standards would increase with increases in sediment removal areas and volumes (i.e., risk increases progressively for Alternatives 4 through 6). Alternative 6 presents more significant risk than Alternatives 4 and 5 due to the much larger volume of sediment to be removed and managed..

In summary, Alternatives 1 through 6 all could achieve the chemical-specific sediment SCGs, but Alternatives 4 through 6 would have greater potential for sediment resuspension and associated surface-water quality standard exceedances (the potential progressively increases from Alternatives 4 through 6 due to the dredge volume/depth, duration, and size).

6.1.2 Action-Specific Standards, Criteria, and Guidance

Alternatives 1 and 2 do not include any active remediation to remove, treat, or contain PCB-impacted sediment; therefore, the action-specific SCGs are not considered applicable.

For Alternatives 3 through 6, a site-specific HASP would be developed to address the health and safety SCGs. The required permits/approvals from the USACE and NYSDEC would be secured to conduct construction activities within a water body of New York State under Alternatives 3 through 6. Permits/permit equivalents for remediation in regulated waters are issued/approved by the USACE, usually under NWP #38: Cleanup of Hazardous and Toxic Waste jointly with the NYSDEC Water Quality Certification. For Alternative 3, construction of an above grade cap would require meeting the substantive requirements of the Protection of Water Permit under NYSDEC Part 608. For Alternatives 4 through 6, appropriate federal and state regulations and guidance would be followed to address sediment disposal SCGs, and staging area water treatment with discharge to the surface-water body adjacent to the staging area would be performed in accordance with a SPDES permit equivalent to address water treatment SCGs.

Overall, Alternatives 3 through 6 would be equally effective at achieving the applicable action-specific SCGs, assuming proper project planning, design, and implementation of appropriate controls. Although the construction of the cap under Alternative 3 is anticipated to meet the substantive technical requirements associated with USACE and NYSDEC permits, securing the applicable permits for this activity could prove difficult and time consuming.

6.1.3 Location-Specific Standards, Criteria, and Guidance

Alternatives 1 and 2 would not include any active remedial actions; therefore, location-specific SCGs are not applicable.

Alternatives 3 through 6 would achieve the regulatory requirements for conducting dredging, capping, backfilling, and/or construction activities in navigable waterways by obtaining a joint USACE and NYSDEC permit and coordinating with the USCG. In addition, remedial activities conducted under Alternatives 3 through 6 would be completed in accordance with applicable local building/construction codes and ordinances.

Overall, Alternatives 3 through 6 would be equally effective at achieving the location-specific SCGs.

6.2 Implementability

Alternatives 1 and 2 would not involve any active remedial activities and, therefore, pose no technical implementability issues. The monitoring plan that would be developed to assess and document the progress of natural recovery for Alternative 2 can be readily designed and implemented.

The equipment, materials, and contractors required for implementing Alternatives 3 through 6 are expected to be readily available. The post-remedial action monitoring plan for the engineered cap and/or natural cover components of Alternatives 3 through 5 can be readily designed and implemented to monitor the effectiveness and integrity of the engineered cap and/or natural cover associated with these alternatives. Off-site landfill disposal facilities are readily available to accept the PCB-impacted sediment that would be removed under Alternatives 4 through 6.

Implementability of the remedial alternatives involving construction activities in the river (i.e., Alternatives 3 through 6) could be affected by weather conditions. Severe weather conditions (winds, thunderstorms, hurricanes, high flows, and reduced visibility) could impact safety and limit work activities, thus resulting in potential schedule delays. The implementability issues and associated risks would progressively increase for Alternatives 3 through 6 as a result of the increasing complexity, size, and duration of the remedial alternatives. Alternatives 4, 5 and 6 would have the most implementation challenges as a result of performing construction activities under the bridge structures (Van Wyck Expressway Bridge). Alternative 4 would have less implementation challenges as a result of performing construction activities underneath the bridge structures (Van Wyck Expressway Bridge) only to the extent practicable as structural supports or modifications to the Van Wyck Expressway Bridge would not be required. The Van Wyck Expressway Bridge poses technical implementability issues related to the limited clearance under the bridge, as well as the presence of numerous bridge support structures (i.e., foundation) within the PCB-impacted sediment dredging areas near SD-27 and SD-28. The bridge support structures would also pose administrative implementability issues as the owner/operator of the bridge may have limitations on disturbing the riverbed around the support structures. The deeper dredging to be conducted as part of Alternative 6 may require sheeting installation, which would also pose additional technical implementability issues.

An administrative implementability issue associated with the active remedial alternatives include the need to obtain access agreements with the property owner of Parcel 4, which includes a portion of the capping and dredging areas (Alternatives 3 through 6) and sediment staging/processing areas and water treatment areas (Alternatives 4 through 6 only), the potential presence of underwater structures and obstructions, and working in a waterway with an approximate tidal fluctuation of 7 feet. Alternatives 4, 5 and 6 would pose the most implementability issues due to the location of the bridge support structures, which would likely require permission from the bridge owner/operator to do any construction activities in the vicinity of these structures and additional and significant provisions may be necessary. Alternative 4 may pose less implementability issues as the result of only performing construction activities underneath the bridge structure to the extent practicable.

Another administrative implementability issue potentially applicable to Alternatives 3 through 6 is that permits would be required because these alternatives would involve placing fill within the Flushing River and/or dredging materials from the river. For Alternatives 3 through 6, permits/permit equivalents would be required from USACE NWP #38, Section 401 Water Quality Certification from the NYSDEC, consistency assessment relative to the New York State Coastal Management Program (including the NYC WRP), and local permits for placement of fill in the 100-year FEMA flood zone. It is anticipated that the substantive requirements for NWP #38 would be achieved by Alternatives 3 through 6, but the permitting process could be more extensive for the above grade cap under Alternative 3, due to potential changes to water depth, flood storage, and habitat quality, although any change associated with Alternative 3 is anticipated to be minimal. A permit equivalent under New York State Section 608 (the Protection of Waters Permit) for the cap under Alternative 3 may be difficult and time consuming because an above grade cap can reduce water depth, flood storage, and benthic habitat quality, which are some of the issues considered by the NYSDEC under the Protection of Waters Permit. However, it is anticipated that under Alternative 3, the cap thickness, physical characteristics of the sediment in the cap area, the natural deposition occurring, and the restoration of the disturbed area to tidal wetland habitat after capping would meet the substantive requirements of the Protection of Waters Permit.

Administratively, institutional controls would be implemented and maintained as the final component of Alternatives 2 through 5. The institutional controls would limit the potential for exposure to and transport of PCB-impacted sediments. Implementing and maintaining institutional controls are both technically and administratively implementable for all of these alternatives.

Alternatives 1 through 6 are all technically and administratively implementable. Overall, although all of the active remedial alternatives are both technically and administratively implementable, as described above, the technical implementability issues progressively increase from Alternatives 3 to 6. Alternative 3 would pose the least technical implementability issues, as it would not require dredging, handling, and processing of PCB-impacted sediments. Alternatives 4 through 6 involve varying degrees of total sediment removal (ranging from approximately 2,600 cy under Alternatives 4 and 5 to 6,200 cy under Alternative 6). As noted above, the technical implementability issues increase progressively with these alternatives as a result of the increasing volumes of sediment required to be dredged and handled, as well as the proximity to the bridges under Alternatives 4, 5, and 6 and deeper dredging depths.

6.3 Reduction of Toxicity, Mobility, or Volume through Treatment

Although Alternatives 1 and 2 do not include any actions to actively remediate the PCB-impacted sediments, natural recovery processes are occurring in the Flushing River that serve to eliminate pathways, and thus, the potential for exposure and transport. Under Alternative 2, the progress of such natural recovery processes would be assessed and documented through the design and implementation of a monitoring program. However, no such monitoring would be performed under Alternative 1.

Alternative 3 would not reduce the volume of the PCB-impacted sediment within OU2; however, if properly designed, maintained, and monitored, the engineered cap and the natural cover would physically isolate and reduce the potential mobility of PCB-impacted sediments. The engineered cap and natural cover would also mitigate the potential for human and biota exposure to the PCB-impacted sediments.

Alternatives 4 and 5 would involve the removal and off-site disposal of PCB-impacted sediment above 5 feet bss.. These alternatives would reduce the volume, as well as the potential exposure to and transport of PCB-impacted sediments in the river. Deeper PCB-impacted sediment would remain at depth and isolated through the existence of a natural cover over these sediments.

Alternative 6 would involve the removal and off-site disposal of PCB-impacted sediment in deeper (above 10 feet bss) sediments. Therefore, this alternative would reduce the volume, as well as the potential exposure to and transport of PCB-impacted sediments in the river. While the sediment removal volume increases (approximately 2,600 cy Alternative 4), the reduction in potential exposures remains similar to Alternatives 4 and 5 because the potential exposure is associated with the upper sediments (surface and near-surface) and not the subsurface sediments, which are covered by several feet of stable, high organic content non-site-related sediments. In Alternative 6, PCB-impacted subsurface sediment greater than 10 mg/kg would not remain at depth after implementation.

6.4 Short-Term Impact and Effectiveness

Alternative 1 would not include any active remedial measures or monitoring; therefore, this alternative does not present any short-term impacts to site workers, the community, or the environment. No time is required to implement Alternative 1.

Alternative 2 also would not include any active remedial measures; however, the implementation of institutional controls are expected to make it more effective than Alternative 1 in the short-term with respect to reduction in potential for human exposure to PCB-impacted sediments. Because Alternative 2 would also involve the implementation of a program to monitor the progress of natural recovery processes, it could result in potential exposures of site workers during sampling. These short-term risks would be mitigated by using properly trained personnel and following appropriate health and safety practices, including the use of PPE. There are no significant impacts to the community associated with Alternative 2. Alternatives 3 through 6 would include active remedial measures and would, therefore, result in a number of short-term impacts to site workers, the community, and the environment as further described below. Alternative 3 would not result in significant exposure of workers to PCB-impacted sediments because this alternative does not include handling PCB-impacted sediment associated with dredging and management of dredged material.

Alternatives 4 through 6 may result in exposure of workers to PCB-impacted sediments. These potential exposures would be mitigated through proper training; the use of PPE; and implementation of air, surface-water, and work space monitoring programs, as well as other engineering controls. The potential for worker exposure increases progressively for Alternatives 4 through 6 as a result of the larger quantities of sediment required to be dredged and processed, the larger quantities of water to be treated, and/or the increasing implementation timeframes associated with those alternatives.

Short-term impacts of Alternatives 3 through 6 also include the generation of noise and odors associated with the operation of large construction equipment and potential excess vehicle traffic in the vicinity of the staging area (e.g., Astoria facility) and neighboring community. Alternative 3 would require the least number of truck trips and energy consumption, and would, therefore, result in the least amount of GHG emissions. Truck trips, energy consumption, and GHG emissions would progressively increase with increasing volumes of impacted sediment to be removed and transported off site for disposal, and increasing volumes of clean fill materials to be backfilled into the river. As discussed in the RIR (ARCADIS, 2011), general odors associated with the Flushing River sediments would also likely cause short-term impacts to the community. Although this odor issue is not related to the PCB-impacted sediments, odor control measures would potentially be required while implementing the dredging portion of Alternatives 4 through 6.

Short-term impacts associated with Alternatives 4 through 6 are expected to be greater than Alternative 3 due to the potential for sediment resuspension that could occur as a result of the dredging component of Alternatives 4 through 6. Based on experience installing similar caps at other sites, placement of an engineered cap associated with Alternative 3 is not anticipated to result in as significant sediment disturbance. Alternatives 4 through 6 have the potential for greater short-term impacts to the community and environment than Alternative 3.

Implementation of Alternatives 3 through 6 would also have short-term impacts on land use during the remedy implementation period (Alternative 3 would have the least impact and Alternative 6 the most). When remedial activities are being conducted, buoys, signs, lights, or other means of demarcation (in accordance with USCG requirements) would be used to keep recreational and commercial boaters out of the work area.

Alternatives 1 and 2 have no or low short-term impacts. Of the alternatives involving sediment removal, Alternative 4 would have the least short-term impacts and Alternative 6 would have the most. Alternative 3 would be more sustainable than the removal and disposal alternatives (Alternatives 4 through 6) because it would involve fewer truck trips, much less heavy equipment use, and less potential for impacts on the environment (water) during implementation. Of the four active remedial alternatives, Alternative 3 would have the shortest duration (approximately 1 month), followed by Alternative 4 (3 months), Alternative 5 (4 months), and Alternative 6 (7 months).

6.5 Long-Term Effectiveness and Permanence

Alternatives 1 and 2 would not involve any active remedial activities to address PCB-impacted sediment. While achieving the RAOs is expected to occur in the long-term due to natural recovery processes, only Alternative 2 would include monitoring to document the progress of such processes. The implementation of institutional controls under Alternative 2 would further reduce the potential for human exposure to PCB-impacted sediments compared to Alternative 1. For Alternative 2, the long-term effectiveness and permanence would be a function of the progress of the natural recovery processes and compliance with the selected institutional controls.

Alternative 3 would involve the installation of an engineered cap and sustaining the natural cover over the PCB-impacted sediment. Alternatives 4 and 5 would involve the removal and off-site disposal of the PCB-impacted sediment, followed by backfilling, as well as sustaining the natural cover over the remaining PCB-impacted sediment at depth. Institutional controls would be established for Alternatives 3 through 5 to reduce the potential for future disturbance of the cap and/or natural cover. A monitoring and maintenance program would also be implemented, as necessary, to enhance the short- and long-term effectiveness of Alternatives 3 through 5.

Alternative 6 would involve the removal and off-site disposal of more PCB-impacted sediment than Alternatives 4 and 5. Alternative 4 and 5 would remove PCB-impacted sediment up to 5 feet bss (approximately 1,200 cy of the 2,600 cy of overall sediment removal), and Alternative 6 would remove the PCB-impacted sediment up to 10 feet bss (approximately 1,500 cy of the 6,200 cy of overall sediment removal). Even though the total overall volume of sediment removal is substantially more under Alternative 6, the volume of PCB-impacted sediment (i.e., sediments with greater than 1 mg/kg site-related PCBs in surface and near-surface sediments and greater than 10 mg/kg site-related PCBs in subsurface sediments) does not significantly increase from Alternatives 4 and 5 to 6 (1,200 cy to 1,500 cy). These alternatives would permanently eliminate the potential human health and ecological exposures to those sediments.

Overall, Alternative 6 offers the greatest degree of permanence, albeit a small increase over Alternatives 3 through 5. However, Alternatives 3 through 6 would be equally effective at achieving the RAOs, assuming the engineered cap and/or natural cover component of Alternatives 3 through 5 are properly designed, maintained, and monitored. Both Alternatives 1 and 2 could achieve the RAOs, although the timeframe is longer and there is more uncertainty associated with these alternatives in comparison to the more active alternatives. Alternative 6 would remove a much larger total volume of sediment than Alternatives 4 and 5 (thousands of cy more), but only a small relative volume increase of PCB-impacted sediment would be removed (about 300 cy). The potential for releases, such as sediment resuspension as a result of dredging would be progressively higher for Alternative 6 compared to Alternatives 4 and 5 as a result of the larger quantity of sediment removed with each alternative and corresponding increase in dredging durations.

6.6 Land Use

All of the alternatives are expected to be compatible with the current or future use of the adjacent upland properties. The institutional controls that would be implemented under Alternative 2 would likely place limitations on activities that could be performed within the PCB-impacted areas; for example, anchoring may be prohibited to reduce the potential for disturbance of the surface and near-surface PCB-impacted sediment. Likewise, the institutional controls that would be implemented under Alternatives 3 through 5 would likely place limitations on activities that could disturb or damage the engineered cap and/or natural cover component of those alternatives and potentially jeopardize their effectiveness. Such activity limitations could include no anchoring and construction within the PCB-impacted sediment areas associated with each alternative. An SMP would be prepared under Alternatives 2 through 5 to document protocols to be followed in the event that intrusive activities (e.g., navigational dredging, construction of piers or docks) are required in the future that could disturb the PCB-impacted sediments (Alternative 2) or the engineered cap and/or natural cover (Alternatives 3 through 5). Alternative 6 would not require the placement of any limitations on the use of the river following implementation.

Overall, Alternatives 1 and 6 would result in the least amount of restrictions on use of the river, although the restrictions associated with Alternatives 2 through 5 would be minimal and would be compatible with the land uses and the future waterfront plans in the NYC WRP. In all alternatives, sediment deposition would continue in the OU2 area allowing for the natural restoration of tidal wetlands along the river.

6.7 Overall Protectiveness of Public Health and the Environment

Alternatives 1 and 2 would not involve any remedial activities to actively address in the PCB-impacted sediments. Under Alternative 2, the potential for human exposure to PCB-impacted sediments would be reduced through the implementation of institutional controls to reducing the potential for disturbance of the sediments. The RAOs could be met in the long-term under both Alternatives 1 and 2 as a result of natural recovery processes. However, only Alternative 2 would include monitoring to document that these natural processes are occurring.

Alternative 3 would achieve the RAOs by reducing the potential for human and biota exposure to PCB-impacted sediment through the installation, monitoring, and maintenance of an engineered cap and natural cover. Alternatives 4 and 5 would achieve the RAOs through removal of the PCB-impacted sediment followed by backfill and sustaining a natural cover on the deeper PCB-impacted sediment. Institutional controls would be implemented as part of Alternatives 3 through 5 to reduce the potential for disturbance of, or damage to, the engineered cap, backfill, and/or natural cover.

Alternatives 4 through 6 would achieve the RAOs through the removal of the PCB-impacted sediments. For Alternatives 4 through 6, the degree of potential short-term risk increases with the volume of removal (i.e., potential for short-term exposures and impacts on the surrounding community increases from Alternatives 4 to 6). Alternatives

4 and 5 would result in the overall sediment removal of approximately 2,600 cy. Alternative 6 would result in; however, the total PCB-impacted sediments removed would be approximately 1,200 cy. Alternative 6 would result in the overall sediment removal volumes of approximately 6,200 cy; however the total PCB-impacted sediments removed would be approximately 1,500 cy. Therefore, an additional 3,600 cy of sediment would be dredged to remove only an additional 300 cy of PCB-impacted sediment in Alternative 6. The sediment removal volumes and associated costs for Alternatives 4, 5, and 6 are summarized in the table below and in Table B-7. Further discussion of the costs to implement these alternatives is provided below in Section 6.8.

Table 6-1. Summary of Remedial Alternative Costs

	Alternative 4	Alternative 5	Alternative 6
PCB-Impacted Sediment Removed (cy)	1,200	1,200	1,500
Total Sediment Removed (cy)	2,600	2,600	6,200
Total Estimated Cost ($)	$4.7 million	$5.1 million	$9.2 million

In summary, Alternatives 1 through 6 are all effective at achieving the RAOs that have been established for the OU2 sediments. Of the active remediation alternatives, Alternative 3 would result in the least amount of short-term exposures to site workers and impacts on the surrounding community during implementation, and Alternative 6 the most. Alternatives 4 through 6 each provide a greater degree of permanence than Alternative 3 because Alternatives 4 through 6 each involves removal of varying volumes of the sediments identified as containing PCB concentrations above the cleanup goals. Although there is a slight increase in the degree of permanence (i.e., based on the removal volume of PCB-impacted sediment of 1,500 cy) associated with 6 over the 1,200 cy of PCB-impacted sediment associated with Alternatives 4 and 5. Alternative6 has higher short-term impacts than Alternatives 4 and 5.

6.8 Cost Effectiveness

The following table summarizes the estimated costs associated with each of the remedial alternatives. The detailed cost estimates for each remedial alternative are presented in Appendix B.

Alternative	Estimated Capital Cost	Estimated Present Worth of O&M Cost	Total Estimated Cost
1 - No Action	$0	$0	$0
2 - MNR of Sediments Containing Site-Related PCBs Greater than the Sediment Cleanup Goals and Institutional Controls	$150,000	$400,000	$550,000
3 - Capping of Sediments Containing Site-Related PCBs Greater than the Sediment Cleanup Goals and Institutional Controls	$2,600,000	$600,000	$3,200,000
4 - Dredging of Sediments (up to 5.0 feet bss) Containing Site-Related PCBs Greater than the Sediment Cleanup Goals to the Extent Practicable, Management of Dredged Material, Backfilling within Dredged Areas, and Institutional Controls	$4,400,000	$300,000	$4,700,000
5 - Dredging of Sediments (up to 5.0 feet bss) Containing Site-Related PCBs Greater than the Sediment Cleanup Goals, Management of Dredged Material, Backfilling within Dredged Areas, and Institutional Controls	$4,800,000	$300,000	$5,100,000
6 - Dredging of Sediments (up to 10.0 feet bss) Containing Site-Related PCBs Greater than the Sediment Cleanup Goals, Management of Dredged Material, and Backfilling within Dredged Areas	$9,200,000	$0	$9,200,000

Alternative 1 has the lowest cost and may achieve the RAOs in the long-term depending upon the progress of natural recovery processes, but no action would be taken to verify this. Alternative 2 has the next lowest cost to implement and is anticipated to achieve the RAOs over time based on the natural recovery of the PCB-impacted sediments. Alternatives 3 through 6 all would achieve the RAOs, but at a wide array of costs, as presented in Table 6-1 above.

7. Recommended Remedial Alternative

Based on a review of the array of potential remedial alternatives presented in this FS Report, Con Edison has selected Alternative 4 to address the OU2 sediments. As described in Section 5, the primary components of Alternative 4 consist of the following:

- dredging of surface/near-surface and subsurface (up to 5 feet bss) sediments to the extent practicable
- management of dredged material (off-site treatment and disposal)
- backfilling within dredged areas
- sustaining a natural cover in the littoral zone over subsurface sediments containing greater than 10 mg/kg of site-related PCBs
- establishing institutional controls

This alternative would achieve the RAOs that have been established for OU2. The PCB-impacted sediment identified during the RI activities would be permanently removed from the river and disposed off site (approximately 1,200 cy total), thus resulting in a reduction in both volume and toxicity of PCB-impacted sediments in the river. The dredged area would be backfilled with suitable fill material to restore the habitat. In addition, the existing natural cover would mitigate the potential of future exposure to and transport of PCB-impacted sediments that would remain at depth beneath the cover.

Alternative 4 would remove similar volumes of PCB-impacted sediments as the other removal alternatives with significantly lower potential short-term impacts of worker and community exposure and sediment resuspension compared to Alternative 6.. As summarized in Section 6, Alternative 4 is similar to Alternative 6 with respect to the other screening criteria, except cost effectiveness. The results of implementing Alternative 4 would be similar to the results of implementing Alternative 6, but with less potential short-term impacts and at a lower cost. In addition, Alternative 4 is similar to Alternative 5, except for implementability. The results of implementing Alternative 4 would be similar to or the same as Alternative 5 but would have less implementation challenges as a result of performing construction activities underneath the bridge structures (Van Wyck Expressway Bridge) only to the extent practicable.

8. References

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Tables

Table 2-1
Summary of Federal, State, and Local Chemical-Specific SCGs

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal				
CWA - Ambient Water Quality Criteria	40 CFR Part 131; USEPA 440/5-86/001 "Quality Criteria for Water – 1986," superseded by "National Recommended Water Quality Criteria: 2009"	**S**	Criteria for protection of aquatic life and/or human health depending on designated water use.	Applicable to the evaluation of potential impacts to the Flushing River from site-related constituents.
CWA Section 136	40 CFR 136	**G**	Identifies guidelines for test procedures for the analysis of pollutants.	Applicable to the evaluation of potential impacts to the Flushing River from site-related constituents.
CWA Section 404	33 U.S.C. Chapter 26 Subchapter 4 Section 1341-1346	**S**	Regulates discharges to surface waters, indirect discharges of water to POTWs, and discharge of dredged or fill material into waters of the United States (including wetlands).	Applicable for remedial activities that include dredging or capping and/or the treatment of water generated during excavation and dewatering activities.
RCRA-Regulated Levels for TCLP Constituents	40 CFR Part 261.24	**S**	These regulations specify the TCLP constituent levels for identification of hazardous wastes that exhibit the characteristic of toxicity.	Dredged materials may be sampled and analyzed for TCLP constituents prior to disposal to determine if the materials are hazardous based on the characteristic of toxicity.
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	**S**	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371, 373, and 376.	Applicable for determining if materials generated during implementation of remedial activities are hazardous wastes.
UTS/LDRs	40 CFR Part 268.48	**S**	Identifies hazardous wastes for which land disposal is restricted and provides a set of numerical constituent concentration criteria at which hazardous waste is restricted from land disposal (without treatment).	Applicable if waste is determined to be hazardous and off-site land disposal is contemplated.

Table 2-1
Summary of Federal, State, and Local Chemical-Specific SCGs

Feasibility Study Report
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Consolidated Edison Company of New York, Inc.

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
New York State				
LDRs	6 NYCRR Part 376	**S**	Restricts land disposal of hazardous wastes that exceed specific criteria.	New York defers to USEPA for UTS/LDR regulations.
“Contained-In Criteria” for Environmental Media; Soil Action Levels	TAGM 3028 (1997)	**G**	Establishes health-based "contained-in" levels for environmental media and debris.	This guidance will be used as appropriate in the management of waste generated during the remedial activities.
Technical Guidance for Screening Contaminated Sediments	Division of Fish, Wildlife, and Marine Resources (January 1999).	**G**	Describes the methodology for establishing numeric sediment cleanup standards. It also provides guidance when evaluating risk management options for contaminated sediment and when determining final contaminant concentrations that will be achieved through remedial efforts.	Used in the RIR as screening levels. Following comprehensive investigations, a sediment cleanup goal of 10 mg/kg site-related PCBs was identified by the NYSDEC, thereby identifying those areas to be included within the sediment remediation area.
NYSDEC Ambient Water Quality Standards and Guidance Values	Division of Water TOGS 1.1.1 (6/98, addended 4/00 and 6/04)	**G**	Provides a compilation of ambient water quality standards and guidance values for toxic and non-conventional pollutants for use in the NYSDEC programs.	To be considered in evaluating surface-water quality.
New York State Surface Water and Groundwater Quality Standards	6 NYCRR Part 703	**S**	Establishes quality standards for surface water and groundwater.	Potentially applicable for assessing water quality at the site during remedial activities.
Local				
New York City Administrative Code	Title 24, Chapter 5: Drainage and Sewer Control: 24-501; 24-514; and 24-523 through 24-525	**S**	Local coordination with the Commissioner of Environmental Protection would be required to coordinate water release from the site into the POTW, if applicable.	Removal activities may involve treatment/disposal of water. If so, coordination with the City of New York may be required.

Table 2-1
Summary of Federal, State, and Local Chemical-Specific SCGs

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Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
New York City Administrative Code	Title 16: Sanitation Chapter 2: Solid Waste Management	**S**	The Commissioner of Sanitation is authorized to regulate the management of all solid waste generated or disposed within the City and to regulate the transportation and disposition of all solid waste generated or disposed within the City pursuant to the standards established in Title 16.	Removal activities may generate solid waste that will need to be managed. If so, coordination with the City of New York may be required.

Notes:
CWA = Clean Water Act
CFR = Code of Federal Regulation
LDR = Land Disposal Restriction
mg/kg = milligrams per kilogram
NYCRR = New York Codes, Rules, and Regulations
NYSDEC = New York State Department of Environmental Conservation
PCB = polychlorinated biphenyl
POTW = publically owned treatment works
RCRA = Resource Conservation and Recovery Act
RIR = Remedial Investigation Report
TAGM = Technical and Administrative Guidance Memorandum
TCLP = toxicity characteristic leaching procedure
TOGS = Technical and Operational Guidance Series
U.S.C. = United States Code
USEPA = United States Environmental Protection Agency
UTS = Universal Treatment Standard

Table 2-2
Summary of Federal, State, and Local Action-Specific SCGs

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal				
OSHA - General Industry Standards	29 CFR Part 1910	**S**	These regulations consist of occupational safety and health standards that have been found to be national consensus standards or established federal standards, including worker exposure limits (e.g., 8-hour time-weighted average and ceiling concentrations) for various compounds, and associated training requirements for workers at hazardous waste operations.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below required concentrations. Appropriate training requirements will be met for remedial workers.
OSHA - Safety and Health Standards	29 CFR Part 1926	**S**	These regulations provide general construction safety and health standards. These regulations specify the type of safety equipment to be utilized and procedures to be followed during site remediation.	Appropriate safety equipment will be on site, and appropriate procedures will be followed during remedial activities.
OSHA - Recordkeeping, Reporting and Related Regulations	29 CFR Part 1904	**S**	These regulations outline recordkeeping and reporting requirements for an employer under OSHA.	These regulations apply to the company(s) contracted to install, operate, and maintain remedial actions at hazardous waste sites.
RCRA - Preparedness and Prevention	40 CFR Part 264.30 - 264.37	**S**	These regulations outline requirements for safety equipment and spill control when treating, handling, and/or storing hazardous wastes.	Safety and communication equipment will be installed at the site as necessary. Local authorities will be familiarized with the site.
RCRA - Contingency Plan and Emergency Procedures	40 CFR Part 264.50 - 264.56	**S**	Provides requirements for outlining emergency procedures to be used following explosions, fires, etc. when storing hazardous wastes.	Emergency and contingency plans will be developed during remedial design. Copies of the plan will be kept on site.

Table 2-2
Summary of Federal, State, and Local Action-Specific SCGs

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
CWA - Discharge to Waters of the United States, General Pretreatment Regulations for Existing and New Sources of Pollution and Guidelines for Specification of Disposal Sites for Dredged or Fill Material	40 CFR Parts 403, and 230 Section 404 (b) (1); 33 U.S.C. 1341-1346	**S**	Establishes site-specific pollutant limitations and performance standards that are designed to protect surface-water quality. Types of discharges regulated under CWA include indirect discharge to a POTW and discharge of dredged or fill material into United States waters.	Applicable to remedial activities within and/or adjacent to the Flushing River.
CWA Section 401	33 U.S.C. 1341	**S**	Requires that 401 Water Quality Certification permit be provided to federal permitting agency (USACE) for any activity, including, but not limited to, the construction or operation of facilities that may result in any discharge into jurisdictional waters of the United States.	Applicable to remedial activities within and/or adjacent to the Flushing River.
90-Day Accumulation Rule for Hazardous Waste	40 CFR Part 262.34	**S**	Allows generators of hazardous waste to store hazardous waste at the generation site for up to 90 days in tanks, containers, and containment buildings without having to obtain a RCRA hazardous waste permit.	Potentially applicable to remedial alternatives that involve storing hazardous materials on site.
Rivers and Harbors Act, Sections 9 and 10	33 U.S.C. 1341 and 1343; 33 CFR Parts 320- 330	**S**	Prohibits unauthorized obstruction or alteration of navigable waters of the United States (e.g., dredging, fill, cofferdams, piers). Requirements for permits affecting navigable waters of the United States.	Potentially applicable to remedial activities within and/or adjacent to the Flushing River.

Table 2-2
Summary of Federal, State, and Local Action-Specific SCGs

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
RCRA - Closure Performance Standard	40 CFR Part 264.111	**S**	This regulation establishes performance standards required for closing hazardous waste facilities, including minimizing the need for further maintenance; controlling, minimizing, or eliminating post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products; and decontaminating or disposing contaminated equipment, structures, and soils.	Decontamination actions and facilities will be constructed for remedial activities and disassembled after completion.
Standards Applicable to Transporters of Hazardous Waste - RCRA Sections 3002 and 3003	40 CFR Parts 262 and 263	**S**	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation, and management of the waste. Requires manifesting, recordkeeping, and immediate action in the event of a discharge.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.
USDOT Rules for Transportation of Hazardous Materials	49 CFR Parts 107 and 171.1 - 172.558	**S**	Outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous materials.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.
Clean Air Act - National Ambient Air Quality Standards	40 CFR Part 60	**S**	Establishes ambient air quality standards for protection of public health.	Remedial operations will be performed in a manner that minimizes the production of certain air emissions.
USEPA-Administered Permit Program: The Hazardous Waste Permit Program	RCRA Section 3005; 40 CFR Part 270 and 124	**S**	Covers the basic permitting, application, monitoring, and reporting requirements for off-site hazardous waste management facilities.	Any off-site facility accepting hazardous waste from the site must be properly permitted. Implementation of the site remedy will include consideration of these requirements.

Table 2-2
Summary of Federal, State, and Local Action-Specific SCGs

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
TSCA	15 U.S.C. 2605	**S**	Authorizes the USEPA to regulate any of the substances that were determined to cause unreasonable risk to public health or the environment.	Applicable for the remediation of TSCA-regulated material. PCB concentrations are anticipated to be non-TSCA-regulated (i.e., less than 50 mg/kg).
PCBs Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions	40 CFR Part 761	**G**	Establishes specific regulatory and legal requirements under TSCA that pertain to the remediation of PCB-impacted material.	These regulations may be used as appropriate in the management of PCB-impacted material generated during the remedial activities. Site PCBs are anticipated to be non-TSCA regulated.
PCB Site Revitalization Guidance Under TSCA	15 U.S.C. 2605	**G**	Developed as a guide for complying with the TSCA regulations for the cleanup and disposal of PCB contamination.	This guidance may be used as appropriate in the management of PCB-impacted material generated during the remedial activities. Site PCBs are anticipated to be non-TSCA regulated.
LDRs	40 CFR Part 268	**S**	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes UTSs to which hazardous waste must be treated prior to land disposal.	Excavated materials that display the characteristic of hazardous waste or that are decharacterized after generation must be treated to 90% constituent concentration reduction capped at 10 times the UTS.
CERCLA - NCP	42 U.S.C. Section 9605; 33 U.S.C. 1321 (d); 40 CFR Part 300	**S**	Provides the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants.	Potentially applicable to remedial activities that include, but are not limited to, the dredging and disposal or capping of waste material from the site.

Table 2-2
Summary of Federal, State, and Local Action-Specific SCGs

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
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Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
RCRA Subtitle C	42 U.S.C. Section 6901 et seq.; 40 CFR Part 268	**S**	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes UTSs to which hazardous wastes must be treated prior to land disposal.	Potentially applicable to remedial activities that include the disposal of waste material from the site.
New York State				
Use and Protection of Waters Program	6 NYCRR Part 608	**S**	Protection of waters permit program regulates: 1) any disturbance of the bed or banks of a protected stream or water course, 2) construction and maintenance of dams, and 3) excavation or fill in navigable waters of the state.	A permit will be required for the excavation and/or placement of fill associated with the remediation of impacted sediment in the Flushing River.
Guidelines for the Control of Toxic Ambient Air Contaminants	DAR-1 (Air Guide 1)	**G**	Provides guidance for the control of toxic ambient air contaminants in New York State and outlines the procedures for evaluating sources of air pollution.	This guidance may be applicable for remedial alternatives that result in certain air emissions.
Air Resources - Prevention and Control of Air Contamination and Air Pollution, Air Quality Classifications and Standards	6 NYCRR Parts 200, 201, 256, 257, and 269	**S**	Provides methods to prevent and control air contamination and establishes air quality standards, general classifications, and air quality classifications specific to New York City.	These regulations may be applicable for remedial alternatives that result in certain air emissions.
New York Hazardous Waste Management System - General	6 NYCRR Part 370	**S**	Provides definitions of terms and general instructions for the Part 370 series of hazardous waste management.	Hazardous waste is to be managed according to this regulation.
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	**S**	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 370-373 and 376.	Applicable for determining if solid waste generated during implementation of remedial activities are hazardous wastes. These regulations do not set cleanup standards, but are considered when developing remedial alternatives.

Table 2-2
Summary of Federal, State, and Local Action-Specific SCGs

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	6 NYCRR Part 372	**S**	Provides guidelines relating to the use of the manifest system and its recordkeeping requirements. It applies to generators; transporters; and treatment, storage, or disposal facilities in New York State.	This regulation will be applicable to any company(s) contracted to transport or manage hazardous material generated at the site.
New York Regulations for Transportation of Hazardous Waste	6 NYCRR Part 372.3 a-d	**S**	Outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous waste.	These requirements will be applicable to any company(s) contracted to transport hazardous waste from the site.
Waste Transporter Permits	6 NYCRR Part 364	**S**	Governs the collection, transport, and delivery of regulated waste within New York State.	Properly permitted haulers will be used for any waste materials transported off-site.
NYSDEC TAGMs	NYSDEC TAGMs	**G**	TAGMs are NYSDEC guidance that are to be considered during the remedial process.	Appropriate TAGMs will be considered during the remedial process.
NYSDEC Technical Guidance for Site Investigation and Remediation	DER-10 (2010)	**G**	Outlines the minimum technical activities the NYSDEC accepts for remedial projects administered under DER.	This guidance is applicable for various stages of the remediation process (e.g., remedy selection, remedial design, remedial action).
New York Regulations for Hazardous Waste Management Facilities	6 NYCRR Part 373.1.1 - 373.1.8	**S**	Provides requirements and procedures for obtaining a permit to operate a hazardous waste treatment, storage, and disposal facility. Also lists contents and conditions of permits.	Any off-site facility accepting waste from the site must be properly permitted.
NPDES Program Requirements, administered under New York SPDES	40 CFR Parts 122 Subpart B and 125; CWA Sections 301, 303, and 307 (Administered under 6 NYCRR 750-758)	**S**	Establishes permitting requirements for point source discharges; regulates discharge of water into navigable waters, including the quantity and quality of discharge.	Removal activities may involve treatment/disposal of water. If so, water generated at the site will be managed in accordance with the NYSDEC SPDES permit requirements.
Remedial Program	6 NYCRR 375.1.8	**S**	Provides general actions to be considered during the remedial process.	This guidance is applicable for various stages of the remediation process (e.g., remedy selection, remedial design, remedial action).

Table 2-2
Summary of Federal, State, and Local Action-Specific SCGs

Feasibility Study Report
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Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Presumptive/Proven Remedial Technologies	DER-15 (2007)	**G**	Provides brief descriptions of generally accepted presumptive/proven (presumptive) remedial technologies suitable for implementing and complying with 6 NYCRR Section 375.1.8.	This guidance is applicable for the remedy selection process and remedial design process.
Citizen Participation Handbook for Remedial Programs	DER-23 Citizen Participation Handbook (January 2010) - supersedes June 1998 Guidebook	**G**	Identifies community participation requirements managed by DER and according to 6 NYCRR Part 375.	This guidance may be applicable for various stages of the remediation process (e.g., remedy selection, remedial design, remedial action).
Local				
New York City Administrative Code	Title 24, Chapter 5: Drainage and Sewer Control: 24-501; 24-514; and 24-523 through 24-525	**S**	Local coordination with the Commissioner of Environmental Protection would be required to coordinate water release from the site into the POTW, if applicable.	Removal activities may involve treatment/disposal of water. If so, coordination with New York City may be required.
New York City Administrative Code	Title 16: Sanitation Chapter 2: Solid Waste Management	**S**	The Commissioner of Sanitation is authorized to regulate the management of all solid waste generated or disposed within the City and to regulate the transportation and disposition of all solid waste generated or disposed within the City pursuant to the standards established in Title 16.	Removal activities may generate solid waste that will need to be managed. If so, coordination with New York City may be required.
New York City Air Pollution Control Code	Title 24: Environmental Protection and Utilities, Chapter 1: Air Pollution Control	**S**	Local coordination with the Commissioner of Environmental Protection would be required if emissions of air contaminants that contain cadmium, beryllium, mercury, and/or the emissions of certain odorous air contaminants. Provides air quality standards specific to New York City.	These regulations may be applicable for remedial alternatives that result in certain air emissions.
New York City Climate Protection Act	Title 24, Chapter 8: New York City Climate Protection Act, Sections 24-801 and 24-803.	**S**	Includes policies, programs, and actions included in the sustainability plan issued by New York City on April 22, 2007 (i.e., PlaNYC) for the reduction of greenhouse gas emissions within the City that contribute to global warming.	Green remediation concepts will be considered during the design process of the selected remedy and during the construction.

Table 2-2
Summary of Federal, State, and Local Action-Specific SCGs

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
CWA = Clean Water Act
DAR = Division of Air Resources
DER = Division of Environmental Remediation
LDR = Land Disposal Restriction
mg/kg = milligram per kilogram
NCP = National Oil and Hazardous Substances Pollution Contingency Plan
NPDES = National Pollutant Discharges Elimination System
NYCRR = New York Codes, Rules, and Regulations
NYSDEC = New York State Department of Environmental Conservation
OSHA = Occupational Safety and Health Administration
PCB = polycyclic aromatic hydrocarbon
POTW = publically owned treatment works
RCRA = Resource Conservation and Recovery Act
SPDES = State Pollutant Discharge Elimination System
TAGM = Technical and Administrative Guidance Memorandum
TSCA = Toxic Substances Control Act
USACE = United States Army Corps of Engineers
USDOT = United States Department of Transportation
USEPA = United States Environmental Protection Agency
U.S.C. = United States Code
UTS = Universal Treatment Standard

Table 2-3
Summary of Federal, State, and Local Location-Specific SCGs

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal				
National Environmental Policy Act Executive Orders 11988 and 11990	40 CFR 6.302; 40 CFR Part 6, Appendix A	**S**	Requires federal agencies, where possible, to avoid or minimize adverse impact of federal actions upon wetlands/floodplains and enhance natural values of such. Establishes the "no-net-loss" of waters/wetland area and/or function policy.	To be considered if remedial activities are conducted within the floodplain. The site falls within the 100-year flood zone (i.e., base flood) as identified by FEMA Map No. 3604970114F.
CWA Section 470	33 U.S.C. 1344, Section 404; 33 CFR Parts 320-330; 40 CFR Part 230	**S**	Discharge of dredge or fill materials into waters of the United States, including wetlands are regulated by the USACE. May require a USACE permit or Joint Application, if both federal and state permits are required.	Potentially applicable to remedial activities within and/or adjacent to the Flushing River.
Fish and Wildlife Coordination Act	16 U.S.C. 661; 40 CFR 6.302	**S**	Actions must be taken to protect fish or wildlife when diverting, channeling, or otherwise modifying a stream or river.	Potentially applicable to remedial activities within and/or adjacent to the Flushing River. The USFWS standard recommendation for the protection of the piping plover is to conduct activities outside the breeding season or April 1 to September 1.
Historical and Archaeological Data Preservation Act	16 U.S.C. 469a-1	**S**	Provides for the preservation of historical and archaeological data that might otherwise be lost as a result of alteration of the terrain.	The National Register of Historic Places website indicated no records present for historical sites in the immediate vicinity of the site.
National Historic Preservation Act	16 U.S.C. 470; 36 CFR Part 65; 36 CFR Part 800	**S**	Requirements for the preservation of historic properties.	The National Register of Historic Places website indicated three historic sites are present within 1 mile of the site.

Table 2-3
Summary of Federal, State, and Local Location-Specific SCGs

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
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Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
CWA Section 401	33 U.S.C. 1341	**S**	Requires that 401 Water Quality Certification permit be provided to federal permitting agency (USACE) for any activity, including, but not limited to, the construction or operation of facilities that may result in any discharge into jurisdictional waters of the United States.	Applicable to remedial activities within and/or adjacent to the Flushing River.
Rivers and Harbors Act, Sections 9 and 10	33 U.S.C. 1341 and 1343; 33 CFR Parts 320- 330	**S**	Prohibits unauthorized obstruction or alteration of navigable waters of the United States, including wetlands (e.g., dredging, fill, cofferdams, piers). Requirement for permits affecting navigable waters of the United States.	Potentially applicable to remedial activities within and/or adjacent to the Flushing River.
Hazardous Waste Facility Located on a Floodplain	40 CFR Part 264.18(b)	**S**	Requirements for a TSD facility built within a 100-year floodplain.	Hazardous waste TSD activities (if any) will be designed to comply with applicable requirements cited in this regulation. The site falls within the 100-year flood zone (i.e., base flood) as identified by FEMA Map No. 3604970114F.
Endangered Species Act	16 U.S.C. 1531 et seq.; 50 CFR Part 200; 50 CFR Part 402	**S**	Requires federal agencies to confirm that the continued existence of any endangered or threatened species and their habitat will not be jeopardized by a site action.	The Short-nose Sturgeon (endangered), the Piping plover (threatened), the Roseate tern (endangered), and the Seabeach amaranth (threatened) are on the USFWS list of Threatened, Endangered, Sensitive Species for Queens County.

Table 2-3
Summary of Federal, State, and Local Location-Specific SCGs

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Floodplains Management and Wetlands Protection	40 CFR 6 Appendix A	**S**	Activities taking place within floodplains and/or wetlands must be conducted to avoid adverse impacts and preserve beneficial value. Procedures for floodplain management and wetlands protection provided.	To be considered because the site falls within the 100-year flood zone (i.e., base flood) as identified by FEMA Map No. 3604970114F.
Coastal Management Act of 1972	16 U.S.C. 1451 - 1465	**S**	Encourages and assists states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone. May include USACE permits.	Applicable to remedial activities, because the site falls within the delineated coastal zone boundary.
New York State				
New York State Floodplain Management Development Permits	6 NYCRR Part 500	**S**	Provides conditions necessitating NYSDEC permits and provides definitions and procedures for activities conducted within floodplains.	Applicable to remedial activities within and/or adjacent to the Flushing River. The site falls within the 100-year flood zone (i.e., base flood) as identified by FEMA Map No. 3604970114F.
Tidal Wetlands Act	Article 25, ECL	**S**	Allows the NYSDEC to administer the Tidal Wetlands Regulatory Program. May require a NYSDEC permit or a Joint Permit, if both state and federal requirements apply.	Potentially applicable if remedial activities are conducted within or adjacent to tidal wetlands.
Tidal Wetlands Regulatory Program	6 NYCRR Part 661	**S**	Establish regulations that allow only those uses of tidal wetlands and areas adjacent (up to 150 feet inland within New York City) thereto that are compatible with the preservation, protection, and enhancement of the present and potential values of tidal wetlands.	Potentially applicable if remedial activities are conducted within or adjacent to tidal wetlands.

Table 2-3
Summary of Federal, State, and Local Location-Specific SCGs

Feasibility Study Report
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Consolidated Edison Company of New York, Inc.

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
New York State Parks, Recreation, and Historic Preservation Law	New York Executive Law Article 14	**S**	Requirements for the preservation of historic properties.	The National Register of Historic Places website indicated no records present for historical sites in the immediate vicinity of the site.
Use and Protection of Waters Program	6 NYCRR Part 608	**S**	Protection of waters permit program regulates: 1) any disturbance of the bed or banks of a protected stream or water course; 2) construction and maintenance of dams; and 3) excavation or fill in navigable waters of the state.	Potentially applicable to remedial activities within and/or adjacent to the Flushing River. Applicable to remedial activities that would increase the riverbed elevation.
Endangered and Threatened Species of Fish and Wildlife	6 NYCRR Part 182	**S**	Identifies endangered and threatened species of fish and wildlife in New York.	NYSDEC Natural Heritage Program confirmed that there are no records of rare or state-listed animals or plants in the immediate vicinity of the site.
New York State Waterfront Revitalization and Coastal Resource Act of 1981	New York Law Executive Article 42 (910-922)	**S**	The state program contains 44 coastal policies and provides for local implementation when a municipality adopts an LWRP.	OU2 is located within the coastal zone; therefore, state and local policies will be considered during remedial activities.
Waterfront Revitalization and Coastal Resources	19 NYCRR Part 600	**S**	Implements the provisions of the Waterfront Revitalization and Coastal Resources Act.	OU2 is located within the coastal zone; therefore, state and local policies will be considered during remedial activities.
New York State Coastal Management Program	Significant Fish and Wildlife Habitat Policies 7 and 8	**S**	Requires that a Consistency Determination be obtained for activities proposed within Significant Fish and Wildlife Habitats.	The Flushing River is not designated as a Significant Fish and Wildlife Habitat.

Table 2-3
Summary of Federal, State, and Local Location-Specific SCGs

Feasibility Study Report
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Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Local				
Local Building Permits	NA	**S**	Local authorities may require a building permit for any permanent or semi-permanent structure, such as an on-site water treatment system building or a retaining wall.	Substantive provisions are potentially applicable to remedial activities that require construction of permanent or semi-permanent structures.
New York City Administrative Code	Title 24, Chapter 5: Drainage and Sewer Control: 24-501; 24-514; and 24-523 through 24-525	**S**	Local coordination with the Commissioner of Environmental Protection would be required to coordinate water release from the site into the POTW, if applicable.	Removal activities may involve treatment/disposal of water. If so, coordination with New York City may be required.
New York City Administrative Code	Title 16: Sanitation Chapter 2: Solid Waste Management	**S**	The Commissioner of Sanitation is authorized to regulate the management of all solid waste generated or disposed within the City and to regulate the transportation and disposition of all solid waste generated or disposed within the City pursuant to the standards established in Title 16.	Removal activities may generate solid waste that will need to be managed. If so, coordination with New York City may be required.
The New WRP	Department of City Planning # 02-14 September 2002	**S**	Establishes New York City's policies for development and use of the waterfront and provides the framework for evaluating the consistency of all discretionary actions in the coastal zone with those policies. Incorporates the 44 state policies, includes 12 local policies, and delineates a coastal zone to which the policies would apply. May require submission of a New York City WRP Consistency Assessment Form.	Applicable to remedial activities, because the site falls within the delineated coastal zone boundary.

Table 2-3
Summary of Federal, State, and Local Location-Specific SCGs

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
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Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
New York City Comprehensive Wetlands Study and Protection Strategy	Title 24, Chapter 5: Drainage and Sewer Control: 24-528	**S**	Commissioner of Environmental Protection can determine if a wetland has unusual local importance in providing one or more of the functions described in Article 24 of ECL. A preliminary Wetlands Plan will be developed no later than December 2011, and a finalized report will be developed no later than March 1, 2012.	Remedial activities will be conducted adjacent to an estuarine and marine wetland; therefore, coordination with New York City may be required.

Notes:
CFR = Code of Federal Regulations
CWA = Clean Water Act
FEMA = Federal Emergency Management Agency
LWRP = local Waterfront Revitalization Program
NA = not applicable
NYSDEC = New York State Department of Environmental Conservation
OU2 = Operable Unit 2
POTW = publically owned treatment works
TSD = treatment, storage, and disposal
USACE = United States Army Corps of Engineers
USFWS = United States Federal Wildlife Service
U.S.C. = United States Code
WRP = Waterfront Revitalization Program

Table 4-1
Remedial Technology and Process Option Screening

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening	Secondary Screening			
				Technical Implementability	Effectiveness	Implementability	Relative Cost	Retained (Yes or No)? /Comments
No Action	No Action	No Action	Alternative would not include any active remedial action to address PCB-impacted sediment.	A “No Action” alternative serves as a baseline for comparison of the overall effectiveness of other remedial alternatives. Consideration of a “No Action” alternative is required by the NCP, DER-10, and USEPA.	Would not achieve RAOs in the short-term. However, some reduction in exposure to PCB-impacted sediments is expected to occur over the long-term as a result of natural recovery processes (e.g., sedimentation).	Implementable	None	Yes
Institutional Controls	Institutional Controls	Non-physical means to mitigate potential exposure, provide notice to public, and/or enhance the effectiveness of other remedies (e.g., engineered sediment cap)	Examples of institutional controls include posting of signs to mitigate potential exposure and actions that may disturb sediments and/or jeopardize the integrity of the remedy.	Technically implementable.	This option could reduce the potential for human exposure, and may be effective when combined with other process options. Would not achieve RAOs for potential biota exposure to PCB-impacted sediments.	Implementable. Would require coordination with third party landowners/lessees, New York State, United States Army Corps of Engineers, and any parties with easements (e.g., utility crossings), as well as cooperation of the users of the Flushing River.	Low capital and O&M costs	Yes
In-Situ Treatment	Natural Recovery	Monitored Natural Recovery	Reducing concentrations and/or exposure to impacted sediments via naturally occurring physical, chemical, and/or biological processes, such as burial, advection, dispersion, dissolution, sorption, and biodegradation. Periodic monitoring of the sediment would be required over time to monitor the progress of the natural recovery processes.	Technically implementable.	May achieve the RAOs over time. Requires monitoring to document changes in the sediment conditions and progress toward achieving the RAOs.	Implementable. Equipment and contractors are readily available to conduct periodic monitoring of PCB-impacted sediment.	Low capital costs Moderate O&M costs	Yes
	Immobilization	Solidification/ Stabilization	Addition and mixing of materials (e.g., Portland cement) into PCB-impacted sediments to limit the mobility of PCBs. Involves treating sediment to produce a stable material with low leachability that physically and chemically locks PCBs in the solidified/stabilized matrix.	This technology has not been successfully implemented on a full-scale for treatment of impacted sediments. Not retained for secondary screening.	May achieve the RAOs over time. Requires monitoring to document changes in the sediment conditions and progress toward achieving the RAOs.	Not implementable full-scale; bench-scale pilot studies would be required. Partial removal may be required to accommodate increased riverbed elevation from mixing process and placement of a habitat layer.	Moderate capital and O&M costs	No
	Sequestration	Sorbent Amendments	Addition and/or mixing of materials (e.g., activated carbon) into PCB-impacted sediments containing to limit the bioavailability of PCBs.	This technology has not been successfully implemented on a full-scale for treatment of impacted sediments. Not retained for secondary screening as part of this Feasibility Study Report, although may be considered in the future depending on advancements with this technology.	May achieve the RAOs over time. Requires monitoring to document changes in the sediment conditions and progress toward achieving the RAOs.	Implementable. Equipment and materials necessary to perform in-situ addition/mixing of material to sediment are readily available.	Moderate capital and O&M costs	No

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Feasibility Study Report
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General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening: Technical Implementability	Secondary Screening: Effectiveness	Secondary Screening: Implementability	Secondary Screening: Relative Cost	Secondary Screening: Retained (Yes or No)? /Comments
In-Situ Containment/ Controls	Capping	Thin Layer Cap	Covering or encapsulating sediments with a thin layer (approximately 6 inches) of natural material (e.g., gravel, sand, clays), modified natural materials (e.g., organoclays), and/or synthetic materials (e.g., geotextile membranes) to physically isolate PCB-impacted sediments. The specific details of the cap (i.e., material types and thicknesses) would be determined during the remedial design. This option could be applied as a stand-alone alternative or combined with other GRAs (e.g., removal, institutional controls).	Technically implementable. The Flushing River is tidal in nature and portions of the project area may be inaccessible by boat during low tide.	Would achieve RAOs and reduce the mobility of site-related PCBs through isolation, and if properly designed and maintained, would eliminate human and biota exposure to PCB-impacted sediments. Would require periodic monitoring and potential maintenance to verify and maintain the cap effectiveness over the long-term.	Implementable. Equipment and materials necessary to construct an engineered cap are readily available. The Flushing River, including the bed of the Flushing River, is owned by the State of New York. An application for use of land underwater must be submitted to the New York Office of General Services. Access agreement with the property owner of Parcel 4 would be required. Additionally, the Flushing River waterfront has been identified by the City of New York as a Special Natural Waterfront Area. Activities will require review for consistency with the New York City WRP.	Moderate capital and O&M costs	Yes; selected other representative process option
	Capping	Engineered Cap	Covering or encapsulating sediments with natural material (e.g., sand, clays), modified natural materials (e.g., organoclays), synthetic materials (e.g. geotextile membranes), and/or armoring to physically isolate PCB-impacted sediments. The specific details of the cap (i.e., material types and thicknesses) would be determined during the remedial design. This option could be applied as a stand-alone alternative or combined with other GRAs (e.g., removal, institutional controls).	Technically implementable. The Flushing River is tidal in nature and portions of the project area may be inaccessible by boat during low tide.	Would achieve RAOs and reduce the mobility of PCBs through isolation, and if properly designed and maintained, would eliminate human and biota exposure to PCB-impacted sediments. Would require periodic monitoring and potential maintenance to verify and maintain the cap effectiveness over the long-term.	Implementable. Equipment and materials necessary to construct an engineered cap are readily available. The Flushing River, including the bed of the Flushing River, is owned by the State of New York. An application for use of land underwater must be submitted to the New York Office of General Services. Access agreement with the property owner of Parcel 4 would be required. Additionally, the Flushing River waterfront has been identified by the City of New York as a Special Natural Waterfront Area. Activities will require review for consistency with the New York City WRP.	Moderate capital and O&M costs	Yes
Removal and Material Management	Dredging	Mechanical (in the wet)	Removing impacted sediment using barge-mounted dredges (e.g., clamshell) and/ or conventional construction equipment on barges within the river. Can also be implemented with other GRAs (ex-situ treatment/disposal, in-situ containment).	Technically implementable. The Flushing River is tidal in nature and portions of the project area may be inaccessible by boat during low tide.	Would achieve the RAOs. Proven process for removing and reducing volume of PCB-impacted sediments. Would require installation of controls to maintain surface-water quality of adjacent areas and prevent migration of PCB-impacted sediment to non-impacted areas.	Implementable. Equipment and materials necessary to dredge sediment are readily available. An upland area to stage and dewater excavated sediment would be necessary. Because Con Edison does not own the adjacent upland parcels, third party access agreements would be required. Alternatively, the material would need to be barged to an alternate location for dewatering and staging. The Flushing River, including the bed of the Flushing River, is owned by the State of New York. An application for use of land underwater must be submitted to the New York Office of General Services. Access agreement with the property owner of Parcel 4 would be required. Additionally, the Flushing River waterfront has been identified by the City of New York as a Special Natural Waterfront Area. Activities will require review for consistency with the New York City WRP. Appropriate permits would be required to be obtained in order to perform dredging within the river.	Moderate to high capital costs No O&M costs	Yes

Table 4-1
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Feasibility Study Report
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General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening	Secondary Screening			
				Technical Implementability	Effectiveness	Implementability	Relative Cost	Retained (Yes or No)? /Comments
Removal and Material Management (continued)	Dredging	Mechanical (in the dry)	Removing impacted sediment using barge-mounted dredges (e.g., clamshell) and/ or conventional construction equipment on barges within the river. The removal area would be isolated from the rest of the river and dewatered to allow for material to be removed in the dry. Can also be implemented with other GRAs (ex-situ treatment/disposal, in-situ containment).	Technically implementable. The Flushing River is tidal in nature and portions of the project area may be inaccessible by boat during low tide. Would require installation of containment (i.e., sheet pile) around the removal area to allow control of water to maintain dry conditions. Installation of controls would be required to maintain surface-water quality of adjacent areas and prevent migration of sediment impacted with site-related PCBs to non-impacted areas.	Would achieve the RAOs and is a proven process for removing and reducing volume of PCB-impacted sediments.	Implementable. Equipment and materials necessary to dredge sediment are readily available. An upland area to stage and dewater excavated sediment would be necessary. Because Con Edison does not own the adjacent upland parcels, third party access agreements would be required. Alternatively, the material would need to be barged to an alternate location for dewatering and staging. The Flushing River, including the bed of the Flushing River, is owned by the State of New York. An application for use of land underwater must be submitted to the New York Office of General Services. Access agreement with the property owner of Parcel 4 would be required. Additionally, the Flushing River waterfront has been identified by the City of New York as a Special Natural Waterfront Area. Activities will require review for consistency with the New York City WRP. Appropriate permits would be required to be obtained in order to perform dredging within the river.	High capital costs No O&M costs	Yes; selected other representative process option
	Dredging	Hydraulic	Sediments are removed in liquid slurry form using pumps, suction hose, horizontal auger and/or cutter-head dredge. Simultaneously removes large quantities of water, which requires handling/treatment. Can be implemented alone or with other GRAs (ex-situ treatment/disposal, in-situ containment).	Technically implementable but would require installation of controls to maintain surface-water quality of adjacent areas and prevent migration of PCB-impacted sediment to non-impacted areas.	Would achieve the RAOs and is a proven process for effectively removing sediment of the type encountered on site.	Implementable; however, significant quantity of upland space needed for sediment dewatering and water treatment facilities. Because Con Edison does not own the adjacent upland parcels, third party access agreements would be required. The Flushing River, including the bed of the Flushing River, is owned by the State of New York. An application for use of land underwater must be submitted to the New York Office of General Services. Access agreement with the property owner of Parcel 4 would be required. Additionally, the Flushing River waterfront has been identified by the City of New York as a Special Natural Waterfront Area. Activities will require review for consistency with the New York City WRP. Appropriate permits would be required to be obtained in order to perform dredging within the river.	Very high capital cost No O&M costs	Due to very high capital costs compared to mechanical dredging and small volume of sediment, this process option has not been retained
	Gravity Drainage	Dewatering	Sediment is stockpiled and allowed to gravity dewater as a pre-treatment or pre-disposal step. Water is collected and treated on site or off-site.	Technically implementable. Typically used in conjunction with other technologies (e.g., sediment treatment/disposal, water treatment).	Effective means of reducing water content in sediments requiring treatment/disposal.	An upland area to dewater excavated sediment and a means for water collection and treatment would be necessary. Because Con Edison does not own the adjacent upland parcels, third party access agreements would be required.	Low capital costs No O&M costs	Yes

Table 4-1
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General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening: Technical Implementability	Secondary Screening: Effectiveness	Secondary Screening: Implementability	Secondary Screening: Relative Cost	Secondary Screening: Retained (Yes or No)? /Comments
Removal and Material Management (continued)	Immobilization	Solidification	Addition of material to the removed sediment as a pre-treatment process to aid in the dewatering and stabilization for transport/disposal	Technically Implementable.	Common and proven process for solidifying impacted sediments in preparation for subsequent transportation over public roads (i.e., pass the paint filter test) and treatment/disposal.	Implementable. An upland area to temporarily stage, dewater, and solidify sediment would be required. Because Con Edison does not own the adjacent upland parcels, third party access agreements would be required.	Low to Moderate capital costs No O&M costs	Yes
	Thermal Destruction	Incineration (on site)	Use of a mobile incineration unit installed on site for high temperature thermal destruction of the organic compounds present in the media. Sediments are conditioned prior to incineration. Treated sediments are subsequently disposed, unless some beneficial reuse endpoint can be identified, such as backfill in the sediment excavation area.	Technically implementable.	Proven process for treating organic constituents. The efficiency of the system and rate of destruction of organic constituents would require evaluation during bench-scale and/or pilot-scale testing.	Implementable. Treatment units are available and could be mobilized to processing facilities near the site to treat excavated sediments. No precedence exists for the placement of treated material back in the riverbed after thermal treatment; treatment would likely be done in combination with a disposal option. An upland area to treat the sediment would be required. Because Con Edison does not own the adjacent upland parcels, third party access agreements would be required. Compliance with permit requirements for emission discharge would be required. May not be acceptable to the local community.	Very high capital cost for system mobilization and setup; O&M costs for an on-site incineration unit would be dependent upon the physical and chemical characteristics of the sediment, and the volume of sediment to be treated	Not retained due to the low concentration of PCBs in the sediment, small quantity of sediment that would be removed; limited land available for installation, the very high costs involved to pilot test, design, mobilize, and construct a treatment system on site; and the local availability of off-site treatment facilities
	Thermal Destruction	Incineration (off site)	Sediments are incinerated off site for high temperature thermal destruction of the organic compounds present in the media. Sediments are excavated and conditioned prior to incineration.	Technically implementable.	Proven process for treating organic constituents. The efficiency of the system and rate of destruction of organic constituents would require evaluation during bench-scale and/or pilot-scale testing.	Implementable. Treatment facilities are available in relatively close proximity to the site (i.e., Stoughton, Massachusetts).	High to very high capital costs No O&M cost	Not retained due the low concentration of PCBs in the sediment, high costs, and availability of alternate disposal options
	Extraction	Low Temperature Thermal Desorption	Process by which excavated sediments are heated and the organic compounds are desorbed from the sediments into an induced airflow. The resulting gas is treated either by condensation and filtration or by thermal destruction. Treated sediments are subsequently disposed, unless some beneficial reuse endpoint can be identified, such as backfill or landfill daily cover.	Technically implementable.	Proven process for treating organic constituents. The efficiency of the system and rate of destruction of organic constituents would require evaluation during bench-scale and/or pilot-scale testing.	Implementable. Treatment facilities are available in relatively close proximity to the site (i.e., Pittsfield, Massachusetts).	Moderate to high capital costs No O&M cost	Not retained due to the low concentration of PCBs in the sediment, high costs, and availability of alternate disposal options

Table 4-1
Remedial Technology and Process Option Screening

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General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening: Technical Implementability	Secondary Screening: Effectiveness	Secondary Screening: Implementability	Secondary Screening: Relative Cost	Secondary Screening: Retained (Yes or No)? /Comments
Removal and Material Management (continued)	Recycle/Reuse	Asphalt Concrete Batch Plant	Sediment is used as a raw material in asphalt concrete paving mixtures. The impacted sediment is transported to an off-site asphalt concrete facility and can replace part of the aggregate and asphalt concrete fraction. The hot-mix process melts asphalt concrete prior to mixing with aggregate. During the cold-mix process, aggregate is mixed at an ambient temperature with an asphalt concrete/water emulsion. Organics are bound in the asphalt concrete. Some organics may volatilize in the hot-mix.	Not implementable. Permitted facilities and demand are limited. Not retained for secondary screening.				
		Brick/Concrete Manufacture	Impacted sediment is transported off site and used as a raw material in the manufacture of bricks or concrete. Heating in ovens during the manufacturing process volatilizes organics.	Not implementable. Permitted facilities and demand are limited. Not retained for secondary screening.				
	Off-Site Disposal	TSCA/RCRA Landfill	Disposal of impacted material in an existing TSCA/RCRA permitted landfill facility.	Technically implementable.	Proven process for disposal of environmental remediation wastes.	Implementable. Based on the results of the RI activities, excavated materials are not anticipated to be required to be disposed in a TSCA/RCRA permitted landfill facility. The closest RCRA landfill to the site is the Chemical Waste Management facility located in Model City, New York.	Moderate to high capital costs No O&M cost	Not retained based on the results of the RI activities, no sediment samples contained greater than or equal to 50 mg/kg of PCBs
		Solid Waste Landfill	Disposal of non-TSCA material and non-impacted soil/debris in an existing permitted non-hazardous landfill.	Technically implementable.	Effective alternative for bulk PCB remediation waste containing less than 50 ppm PCBs and other non-impacted wastes generated during remedial activities.	Implementable. Non-hazardous solid waste landfills are in close proximity to the site (e.g., Albany Landfill).	Moderate capital costs No O&M cost	Yes
Residual Management	On-Site Water Treatment	On-Site Treatment System/ Discharge to Surface Water	Impacted surface water is passed through an on-site treatment process to remove constituents of concern utilizing chemical treatment or physical separation processes, in addition to suspended solids removal. Treated water is discharged back to the surface water provided that quality and quantity meet the allowable discharge requirements for surface waters (NYSDEC SPDES compliance).	Technically Implementable.	Effective process to manage residual liquid wastes.	Implementable. Would require permits from the City of New York for construction of treatment system on site and from the NYSDEC to discharge residual liquid wastes. Permit conditions would be required to be met in order to discharge liquids to the Flushing River. An upland area to treat the water would be required. Because Con Edison does not own the adjacent upland parcels, third party access agreements would be required.	Low to moderate capital costs No O&M cost	Yes
	Off-Site Water Treatment	Discharge to Sanitary Sewer/WWTP	Pre-treated or untreated water is collected/transported or discharged directly to a sanitary sewer and treated at a local WWTP facility.	Technically implementable.	Effective process to manage residual liquid wastes.	Implementable. Would require permits from the City of New York and/or the NYSDEC to discharge residual liquid wastes. Permit conditions would be required to be met in order to discharge liquids to the sanitary sewer.	Low to moderate capital costs No O&M cost	Yes, selected other representative process option

Notes:

1. For the purposes of this *Feasibility Study Report*, the term 'PCB-impacted sediment' is defined as sediment containing greater than 10 milligrams per kilogram of site-related PCBs. Site-related PCBs were distinguished based on the source evaluation presented in the *Remedial Investigation Report* and summarized in Section 1.5.2 of the *Feasibility Study Report*.

Con Edison = Consolidated Edison Company of New York, Inc.
DER-10 = Division of Environmental Remediation-10 Technical Guidance for Site Investigation and Remediation
GRA = general response action
NCP = National Oil and Hazardous Substances Protection Contingency Plan
NYSDEC = New York State Department of Environmental Conservation
O&M = operation and maintenance
PCB = polychlorinated biphenyl
ppm = parts per million
RAO = remedial action objective
RCRA = Resource Conservation and Recovery Act
RI = remedial investigation
SPDES = State Pollutant Discharge Elimination System
TSCA = Toxic Substances Control Act
USEPA = United States Environmental Protection Agency
WRP = Waterfront Revitalization Program
WWTP = wastewater treatment plant

Table 4-2
Representative Remedial Technology Process Options

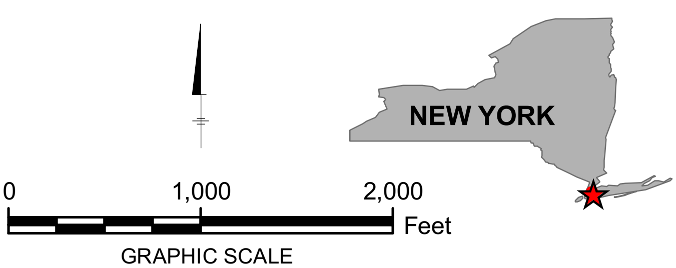
Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

GRA	Technology Type	Technology Process Option	Representative Process Option*
No Action	No Action	No action	No action
Institutional Controls	Institutional Controls	Legal and/or administrative controls	Legal and/or administrative controls
In-Situ Treatment	Natural Recovery Immobilization Sequestration	MNR Solidification/stabilization Sorbent amendment	MNR
In-Situ Containment/Control	Capping	Thin layer cap Engineered cap	Engineered cap
Removal and Material Management	Dredging Gravity Drainage Immobilization Thermal destruction Extraction Recycle/reuse Disposal	Mechanical in the wet, mechanical in the dry, hydraulic Dewatering Solidification Near-site and off-site incineration Low temperature thermal desorption TSCA/RCRA-permitted facility, solid waste landfill	Mechanical in the wet Dewatering Solidification Solid waste landfill
Residual Management	On-/near-site water treatment Off-site water treatment Off-site disposal of construction debris	On-/near-site treatment system/discharge to surface water Discharge to sanitary sewer/WWTP Solid waste landfill	On-/near-site treatment system/discharge to surface water Solid waste landfill

Notes:
* Multiple process options were retained for capping, dredging, and water management. To streamline the alternatives analysis, representative process options were selected for the alternatives analyzed in the Feasibility Study Report. However, if the selected remedy includes capping, dredging, and/or water management, the respective multiple process options will be further evaluated during the design phase to evaluate the most appropriate process option to achieve site-specific remedial action objectives.

GRA = general response action
MNR = monitored natural recovery
RCRA = Resource Conservation and Recovery Act
TSCA = Toxic Substances Control Act
WWTP = wastewater treatment plant

Figures



NOTE: 2010 IMAGERY DOWNLOADED FROM GOOGLE EARTH PRO.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRIAL PARK, OPERABLE UNIT 2

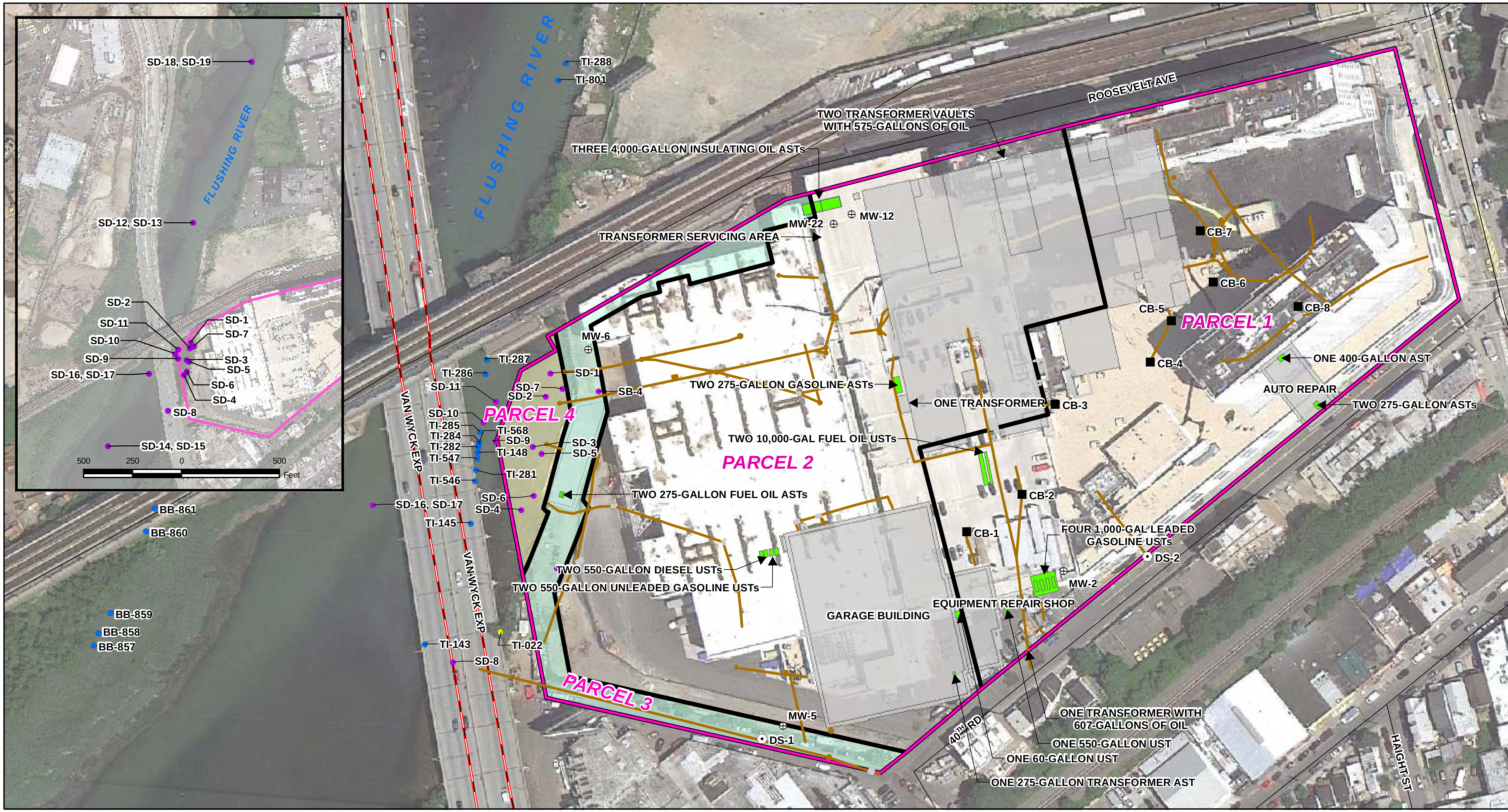
FEASIBILITY STUDY REPORT

SITE LOCATION MAP

ARCADIS

FIGURE
1-1

CITY: SF DIV/GROUP: ENV/IM DB: K ERNST LD: M HAYES PIC: PM: TM: TR:
Project (Project #) B0043018.0000.6000
Q:\ConEd\FlushingRiver\FeasibilityStudy\MXD\SiteMap.mxd - 9/13/2011 @ 2:21:17 PM



LEGEND:

- ⊕ AKRF FORMER MONITORING WELL WITH LNAPL
- COMBINED SEWER OVERFLOW
- STORM SEWER OUTFALL
- AKRF 2005 SEDIMENT SAMPLING LOCATION
- CATCH BASIN
- DRAINAGE STRUCTURE
- CITY STREET
- VEHICLE ONLY STREET
- PRIVATE STREET
- SEWER OR DRAIN LINE
- PROPERTY BOUNDARY
- PARCEL BOUNDARY
- TANK (FORMER)
- BUILDING (DEMOLISHED)

0 100 200 Feet

GRAPHIC SCALE

NOTES:

1. CSO AND STORM SEWER OUTFALL LOCATIONS WERE DOWNLOADED FROM NEW YORK STATE GIS CLEARINGHOUSE AND THEN ADJUSTED BASED ON A SITE RECONNAISSANCE COMPLETED BY ARCADIS IN MAY 2009.
2. PROPERTY BOUNDARY, FEATURES, AND SEWER/DRAIN LINES DIGITIZED FROM AKRF PROJECT NO. 3014 FIGURE TITLED "FORMER TANKS AND DRAINAGE STRUCTURES" DATED 10/12/07.
3. ALL LOCATIONS ARE APPROXIMATE.
4. 2010 IMAGERY DOWNLOADED FROM GOOGLE EARTH PRO.

LNAPL LIGHT NON-AQUEOUS PHASE LIQUIDS

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRIAL PARK, OPERABLE UNIT 2

FEASIBILITY STUDY REPORT

HISTORIC SITE PLAN

ARCADIS

FIGURE **1-2**

CITY: SF DIV/GROUP: ENV/IM DB: K ERNST LD: M HAYES PIC: PM: TM: TR:
Project (Project #) B0043018.0000.6000
Q:\ConEd\FlushingRiver\FeasibilityStudy\MXD\HistoricSitePlan.mxd - 5/17/2012 @ 1:52:47 PM

LEGEND:

- 2010 SEDIMENT CORE LOCATION
- 2009 SEDIMENT CORE LOCATION
- 2009 CO-LOCATED CORE (RADIOCHEMICAL ANALYSIS)
- 2005 AKRF SAMPLING LOCATION
- AKRF MONITORING WELL/SOIL BORING
- CSO OUTFALL
- PROPERTY BOUNDARY
- BATHYMETRIC CONTOUR (DASHED WHERE INFERRED)
- MEAN LOW WATER ELEVATION (-3.8 FT NAVD 88)
- MEAN LOWER LOW WATER ELEVATION (-4.1 FT NAVD 88)
- APPROXIMATE LOCATION OF SHEET PILE WALL (SEE NOTE 4)
- INTERTIDAL ZONE

NOTES:

1. 2010 IMAGERY DOWNLOADED FROM GOOGLE EARTH PRO.
2. COORDINATES ARE BASED ON NORTH AMERICAN DATUM 1983 - NEW YORK LONG ISLAND ZONE
3. BATHYMETRY CONTOURS MODELED USING THE NATURAL NEIGHBOR MODE USING AVAILABLE SEDIMENT CORE AND SAMPLING LOCATIONS; ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
4. LOCATION OF SHEET PILE WALL OBTAINED FROM REMEDIAL PHASE SHEET PILE WALL PLAN AND ELEVATIONS, DRAWING C-804,LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES (JANUARY 6, 2006). THE ELEVATION AT THE TOP OF THE WALL IS +9.1 FT (NAVD 88) AND EXTENDS TO A DEPTH OF 35 FT BELOW GRADE. IT IS ANTICIPATED THAT THE MEAN HIGH WATER ELEVATION (+3.3 FT NAVD 88) AND MEAN HIGHER HIGH WATER (+3.7 FT NAVD 88) OCCUR ALONG THE WALL; THEREFORE THESE LINES ARE NOT SHOWN FOR CLARITY.
5. THE EXTENT OF THE LITTORAL ZONE BELOW ELEVATION-3.8FT NAVD 88 HAS NOT BEEN SHOWN DUE TO LIMITED DATA AVAILABILITY.
6. FLUSHING RIVER MEAN TIDE LEVELS BASED ON NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION TIDE STATION 8516945 (KINGS POINT, NEW YORK).
7. AERIAL IMAGERY IS APPROXIMATE. VISUAL FEATURES MAY BE OFFSET DUE TO THE ANGLE AT WHICH THE IMAGERY WAS OBTAINED

0 50' 100'

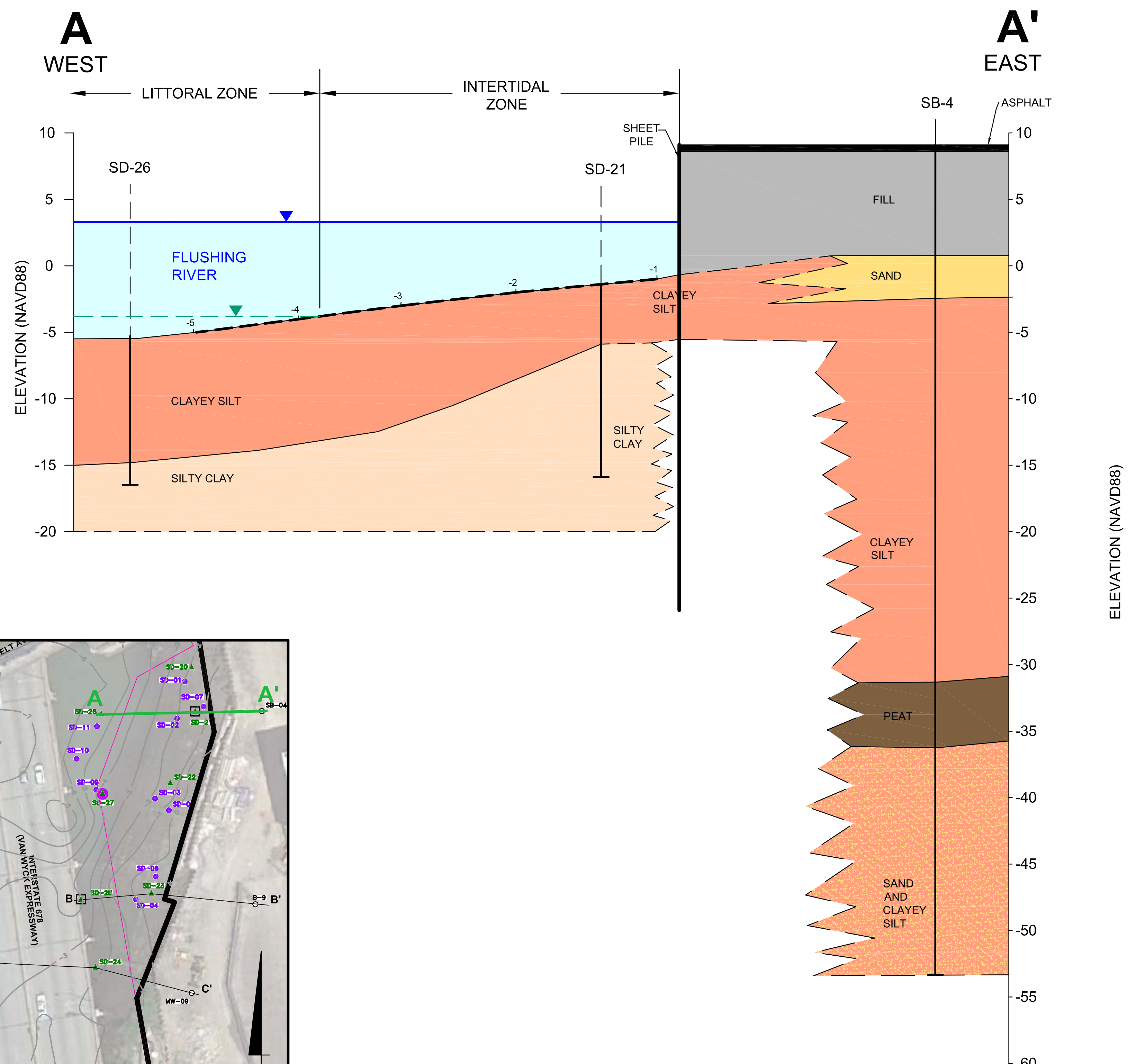
GRAPHIC SCALE

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRIAL PARK, OPERABLE UNIT 2
FEASIBILITY STUDY REPORT

LOCATION OF CROSS-SECTIONS

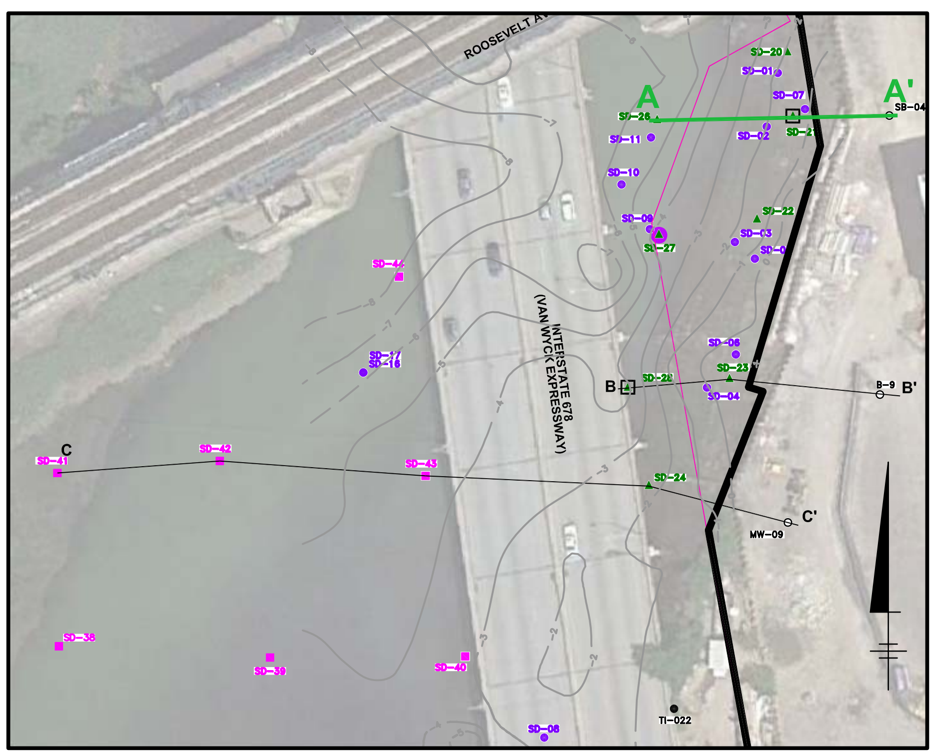
ARCADIS

FIGURE
1-3



LEGEND:

- SB-4 — WELL/SOIL BORING/SEDIMENT CORE
- MEAN HIGH WATER ELEVATION (3.3 FT NAVD 88)
- MEAN LOW WATER ELEVATION (-3.8 FT NAVD 88)
- CONTACT BETWEEN GEOLOGIC UNITS (DASHED WHERE INFERRED)
- BOTTOM OF BORING
- -1 BATHYMETRIC CONTOUR
- FILL - A MIXTURE OF ASH, WOOD, CONCRETE FRAGMENTS WITH SILTY SAND, SOME DENSE CLAY
- CLAYEY SILT - CLAYEY SILT, TRACE ORGANICS
- SILTY CLAY - SILTY CLAY, TRACE ORGANICS AND SHELLS
- SAND - FINE SAND, LITTLE SILT, SHELL FRAGMENTS
- PEAT - ORGANIC CLAYEY SILT



OVERVIEW MAP

NOTES:

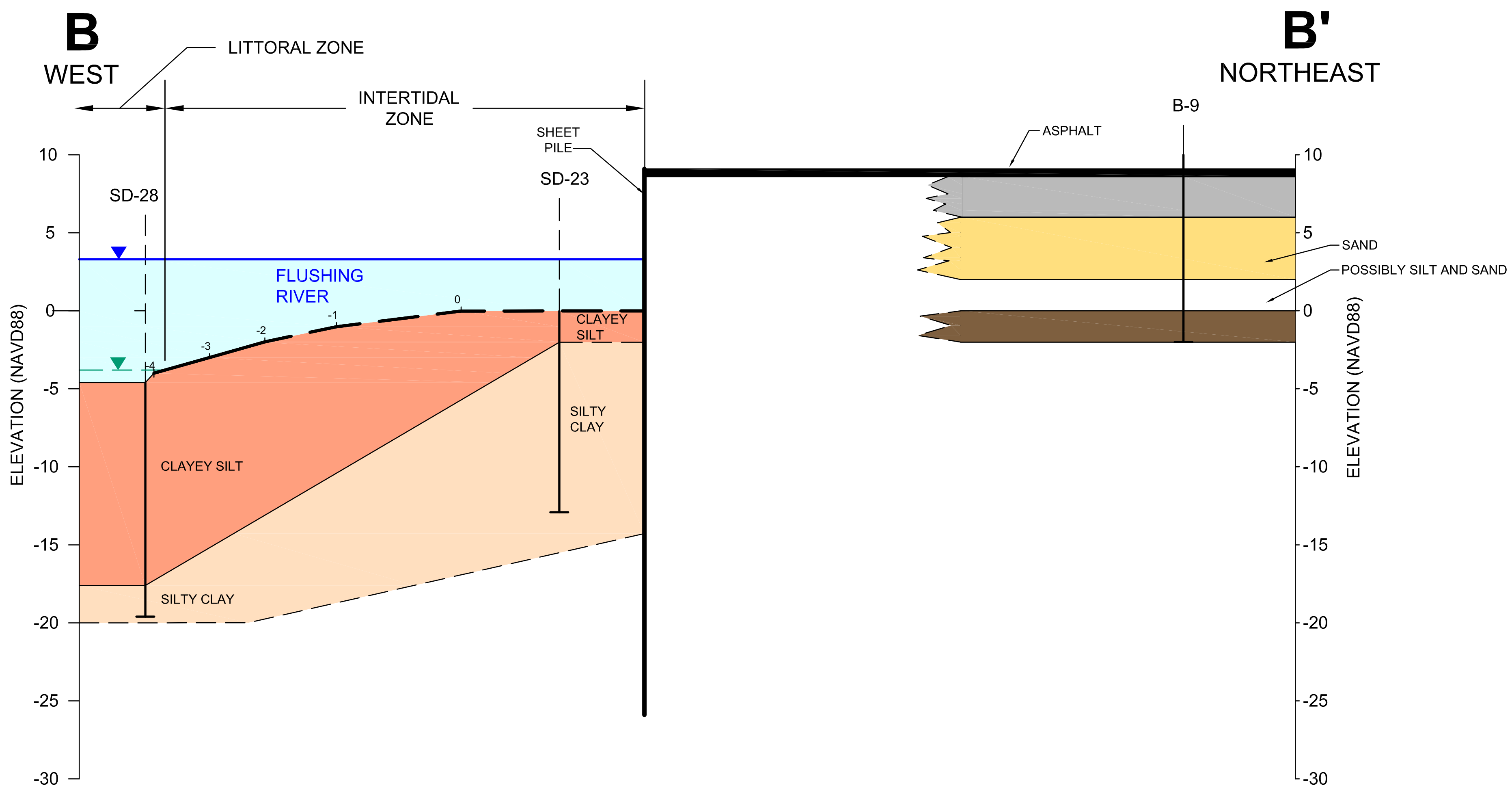
1. BATHYMETRIC CONTOUR BASED ON MODELED DATA SHOWN ON FIGURE 1-3.
2. FLUSHING RIVER MEAN TIDE LEVELS BASED ON NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION TIDE STATION 8516945 (KINGS POINT, NEW YORK).
3. ALL ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
4. APPROXIMATE LOCATION OF SHEET PILE OBTAINED FROM REMEDIAL PHASE SHEET PILE WALL PLAN AND ELEVATIONS, DRAWING C-804, LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES (JANUARY 6, 2006). THE ELEVATION AT THE TOP OF THE WALL IS +9.1 FT (NAVD 88) AND EXTENDS TO A DEPTH OF 35 FT BELOW GRADE.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRIAL PARK, OPERABLE UNIT 2
FEASIBILITY STUDY REPORT

CROSS SECTION A-A'

ARCADIS

FIGURE
1-4a



LEGEND:

SB-4 WELL/SOIL BORING/SEDIMENT CORE

MEAN HIGH WATER ELEVATION (3.3 FT NAVD 88)

MEAN LOW WATER ELEVATION (-3.8 FT NAVD 88)

CONTACT BETWEEN GEOLOGIC UNITS (DASHED WHERE INFERRED)

BOTTOM OF BORING

-1 BATHYMETRIC CONTOUR

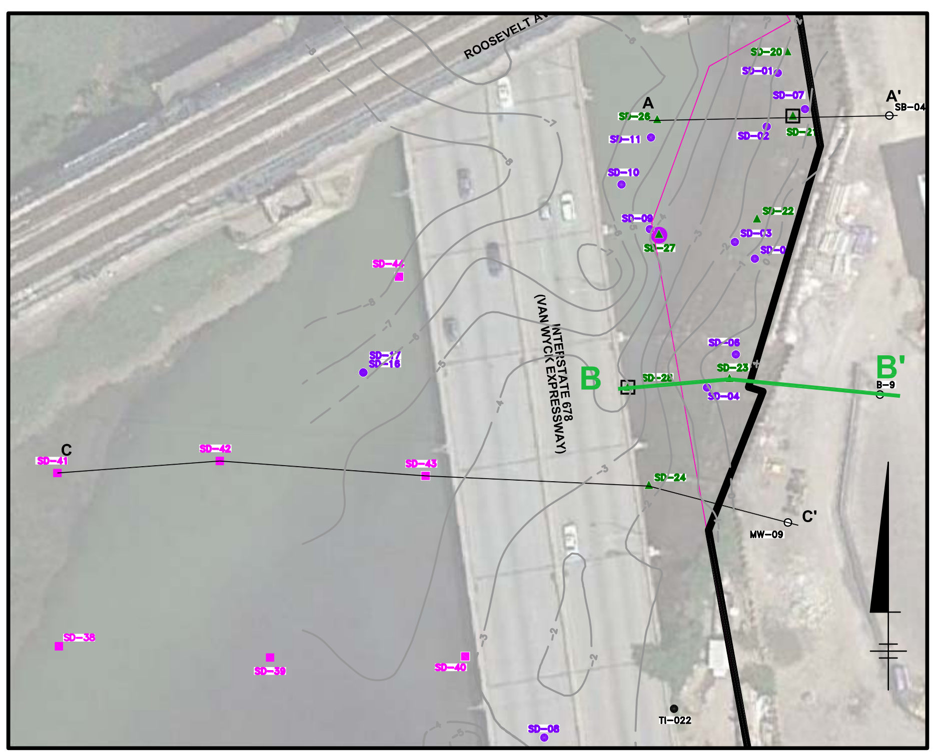
FILL - A MIXTURE OF ASH, WOOD, CONCRETE FRAGMENTS WITH SILTY SAND, SOME DENSE CLAY

CLAYEY SILT - CLAYEY SILT, TRACE ORGANICS

SILTY CLAY - SILTY CLAY, TRACE ORGANICS AND SHELLS

SAND - FINE SAND, LITTLE SILT, SHELL FRAGMENTS

PEAT - ORGANIC CLAYEY SILT



OVERVIEW MAP

0 100' 200'
GRAPHIC SCALE

NOTES:

1. BATHYMETRIC CONTOUR BASED ON MODELED DATA SHOWN ON FIGURE 1-3.
2. FLUSHING RIVER MEAN TIDE LEVELS BASED ON NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION TIDE STATION 8516945 (KINGS POINT, NEW YORK).
3. ALL ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
4. APPROXIMATE LOCATION OF SHEET PILE OBTAINED FROM REMEDIAL PHASE SHEET PILE WALL PLAN AND ELEVATIONS, DRAWING C-804, LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES (JANUARY 6, 2006). THE ELEVATION AT THE TOP OF THE WALL IS +9.1 FT (NAVD 88) AND EXTENDS TO A DEPTH OF 35 FT BELOW GRADE.

0 10' 20'
VERTICAL SCALE: 1" = 10'

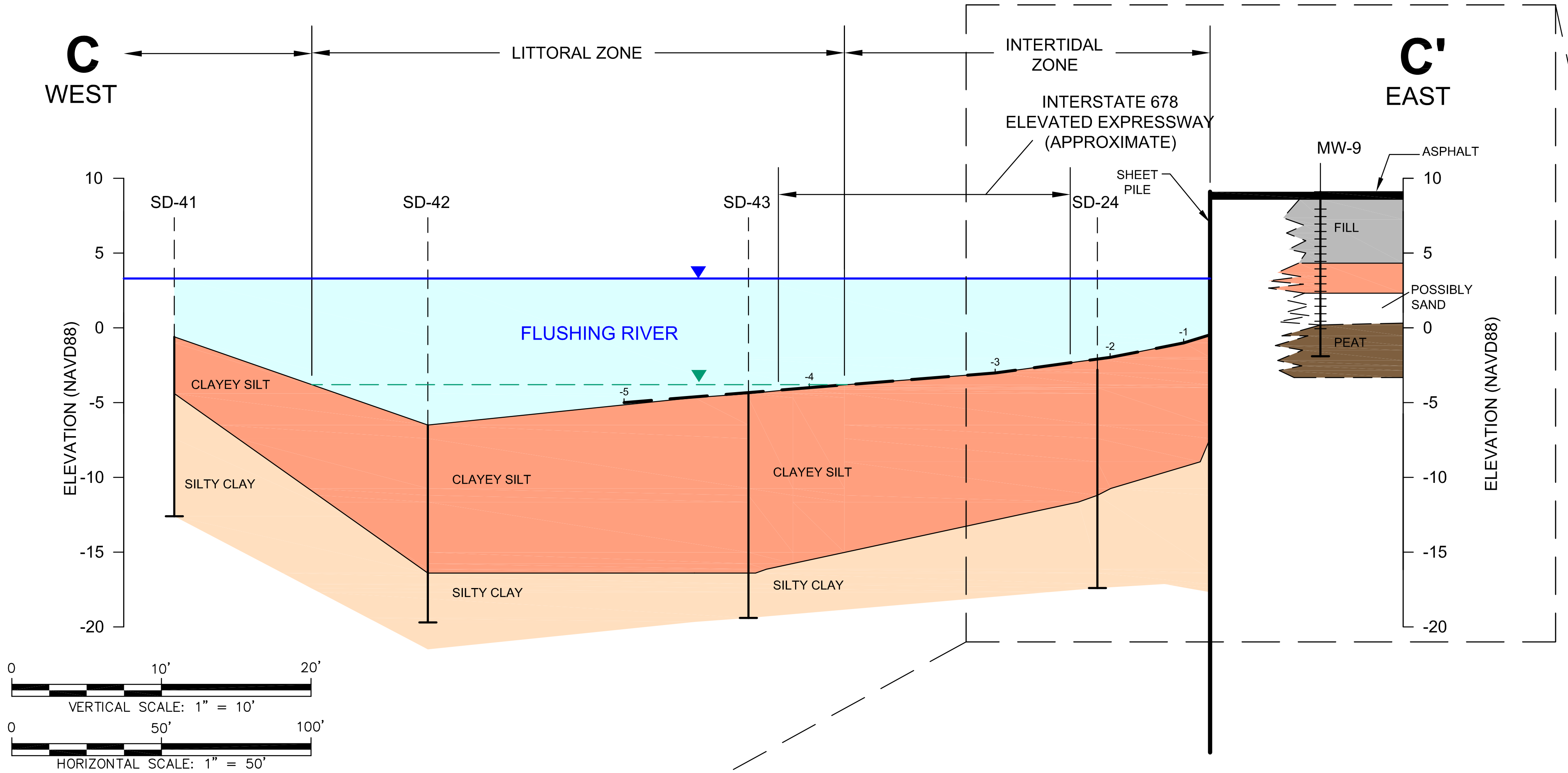
0 20' 40'
HORIZONTAL SCALE: 1" = 20'

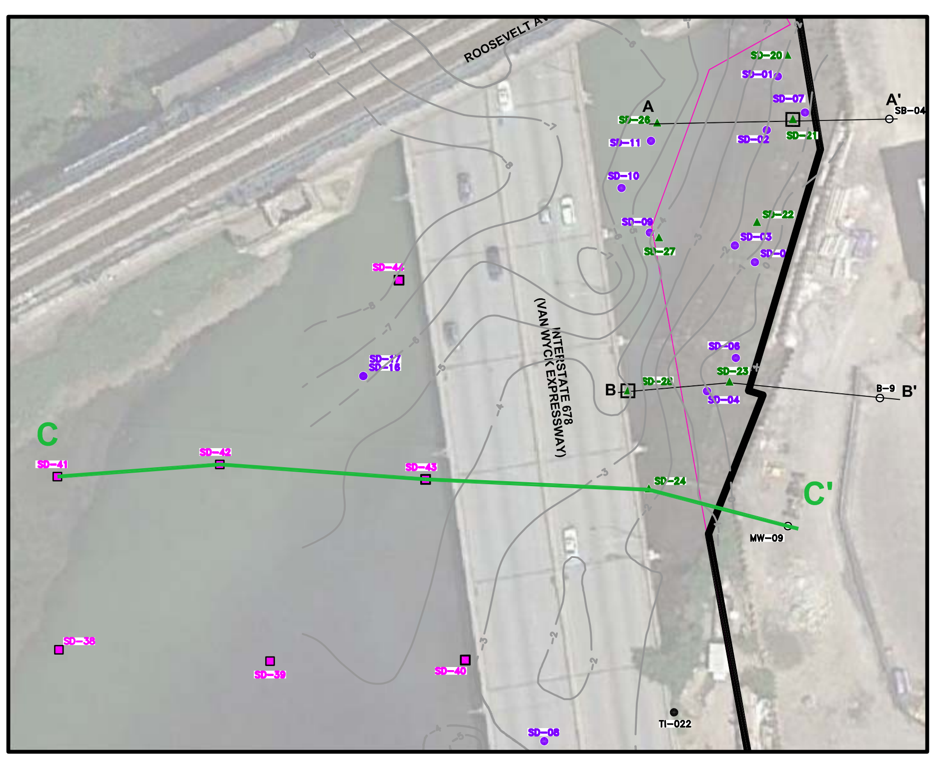
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRIAL PARK, OPERABLE UNIT 2
FEASIBILITY STUDY REPORT

CROSS SECTION B-B'

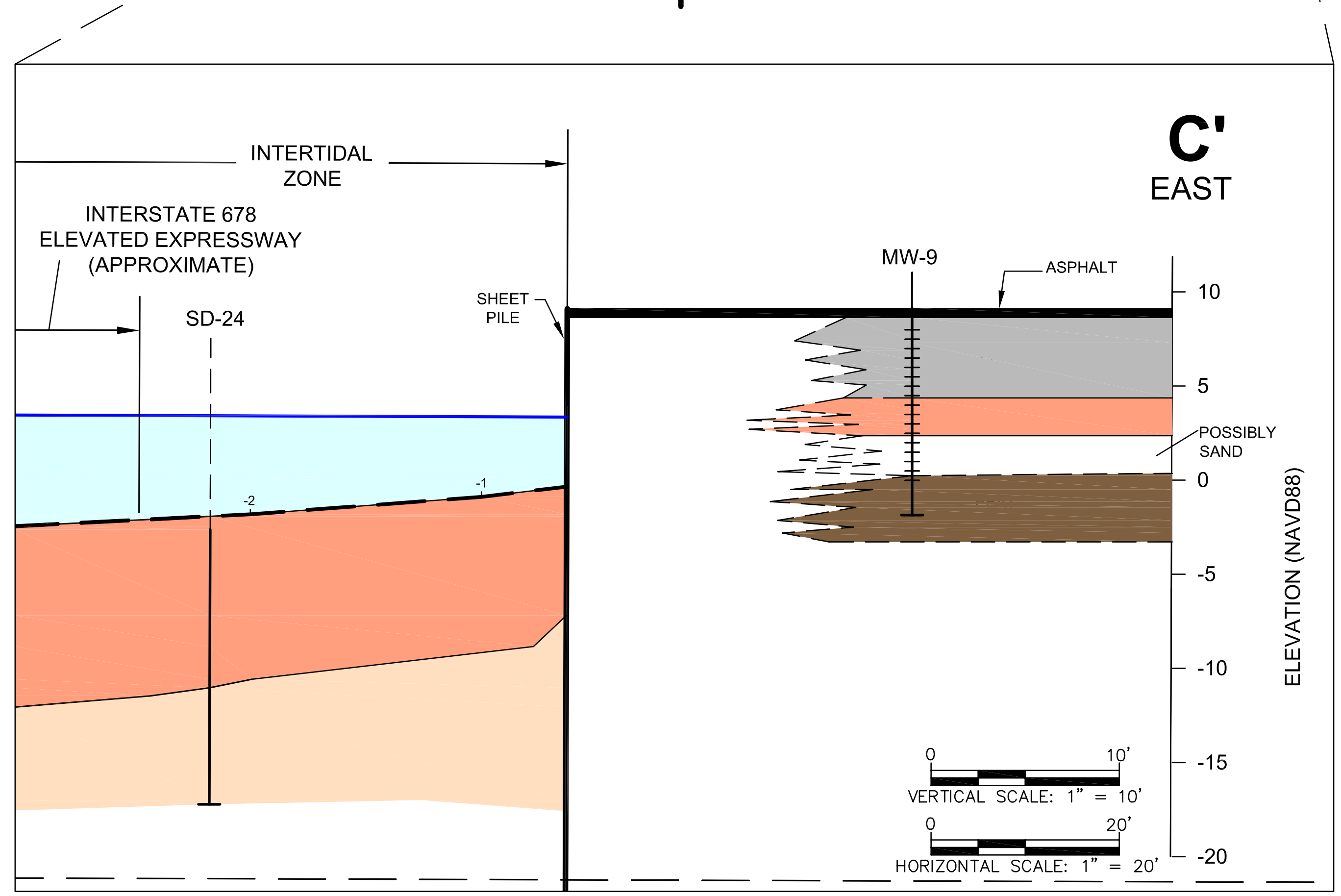
ARCADIS

FIGURE
1-4b





OVERVIEW MAP



DETAIL

LEGEND:

- SB-4 — WELL/SOIL BORING/SEDIMENT CORE
- MEAN HIGH WATER ELEVATION (3.3 FT NAVD 88)
- MEAN LOW WATER ELEVATION (-3.8 FT NAVD 88)
- CONTACT BETWEEN GEOLOGIC UNITS (DASHED WHERE INFERRED)
- SCREENED INTERVAL
- BOTTOM OF BORING
- BATHYMETRIC CONTOUR
- FILL - A MIXTURE OF ASH, WOOD, CONCRETE FRAGMENTS WITH SILTY SAND, SOME DENSE CLAY
- CLAYEY SILT - CLAYEY SILT, TRACE ORGANICS
- SILTY CLAY - SILTY CLAY, TRACE ORGANICS AND SHELLS
- PEAT - ORGANIC CLAYEY SILT

NOTES:

1. BATHYMETRIC CONTOUR BASED ON MODELED DATA SHOWN ON FIGURE 1-3.
2. FLUSHING RIVER MEAN TIDE LEVELS BASED ON NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION TIDE STATION 8516945 (KINGS POINT, NEW YORK).
3. ALL ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
4. APPROXIMATE LOCATION OF SHEET PILE OBTAINED FROM REMEDIAL PHASE SHEET PILE WALL PLAN AND ELEVATIONS, DRAWING C-804, LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES (JANUARY 6, 2006). THE ELEVATION AT THE TOP OF THE WALL IS +9.1 FT (NAVD 88) AND EXTENDS TO A DEPTH OF 35 FT BELOW GRADE.

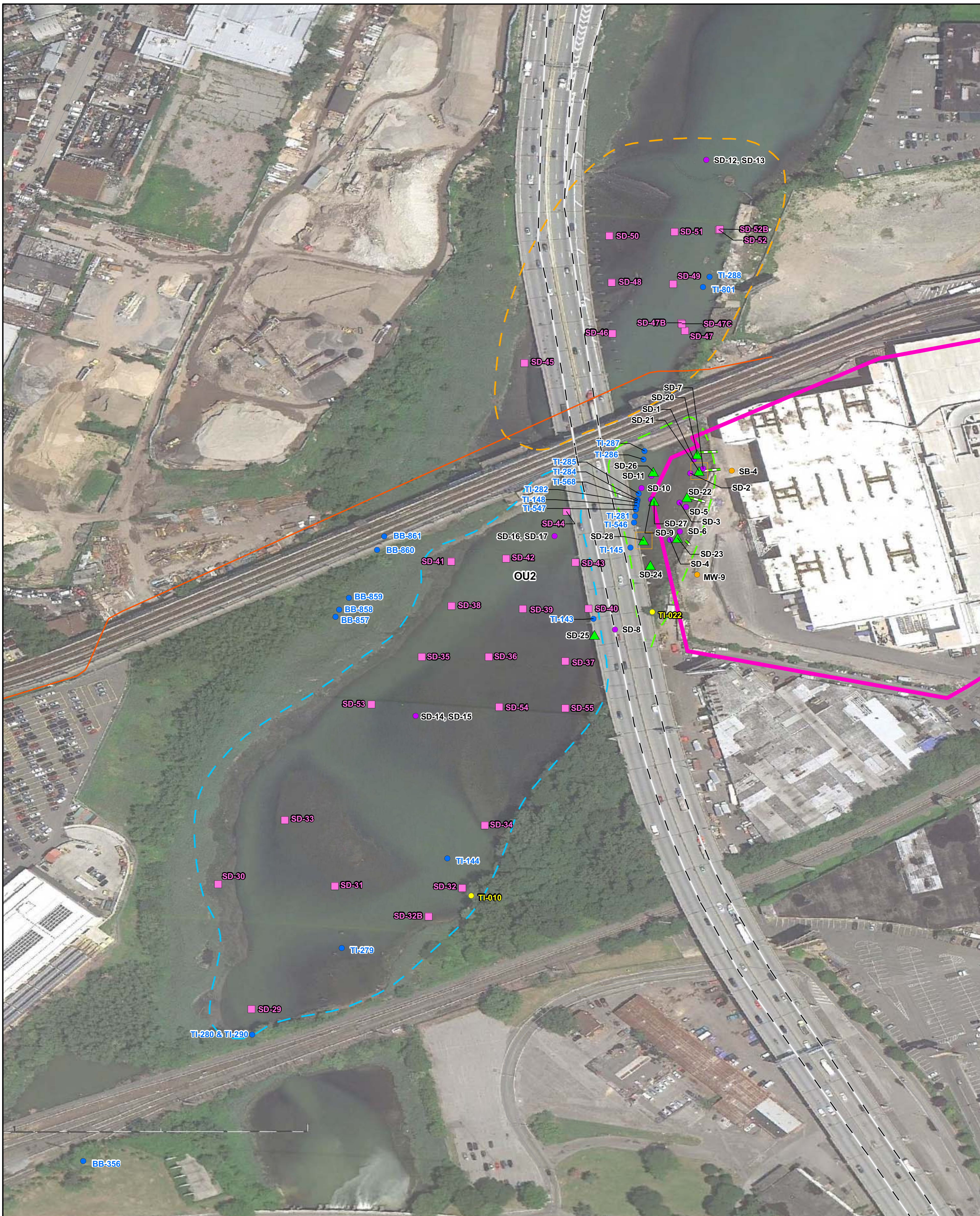
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRIAL PARK, OPERABLE UNIT 2
FEASIBILITY STUDY REPORT

CROSS SECTION C-C'

ARCADIS

FIGURE
1-4c

CITY: SF DIV/GROUP: ENV/IM DB: K ERNST LD: M HAYES PIC: PM: TM: TR:
Project (Project #) B0043018.0000.6000
Q:\ConEd\FlushingRiver\FeasibilityStudy\MXD\CoreLocations.mxd - 9/13/2011 @ 2:20:45 PM



LEGEND:

- AKRF MONITORING WELL/SOIL BORING LOCATION
- 2010 SEDIMENT CORE LOCATION
- 2009 SEDIMENT CORE LOCATION
- 2009 CO-LOCATED CORE (RADIOCHEMICAL ANALYSIS)
- 2005 AKRF SAMPLING LOCATION
- COMBINED SEWER OVERFLOW (CSO)
- STORM SEWER OUTFALL
- SUBMARINE ELECTRICAL CABLES
- APPROXIMATE STORM OUTFALL (BASED ON VISUAL OBSERVATIONS)
- CITY STREET
- VEHICLE ONLY STREET
- PROPERTY BOUNDARY
- NORTH REGION
- NEAR-SITE REGION
- SOUTH REGION

NOTES:

1. DATA FOR AKRF SAMPLE LOCATIONS CAN BE FOUND IN THE PARCEL 4 REMEDIAL INVESTIGATION REPORT (AKRF 2006).
2. CSO AND STORM SEWER OUTFALL LOCATIONS WERE DOWNLOADED FROM NEW YORK STATE GIS CLEARINGHOUSE AND THEN ADJUSTED BASED ON A SITE RECONNAISSANCE COMPLETED BY ARCADIS IN MAY 2009.
3. 2010 IMAGERY DOWNLOADED FROM GOOGLE EARTH PRO.
4. COORDINATES DISPLAYED IN NAD83 DECIMAL DEGREES.
5. LOCATION OF SUBMARINE CABLES ESTIMATED FROM DRAWING PROVIDED BY CON EDISON TITLED "EXISTING SUBMARINE CABLE CROSSING FLUSHING CREEK NORTH OF ROOSEVELT AVE. BRIDGE" DATED 9-12-62.
6. ALL LOCATIONS ARE APPROXIMATE.

0 200 400 Feet
GRAPHIC SCALE

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRIAL PARK, OPERABLE UNIT 2
FEASIBILITY STUDY REPORT

SAMPLE LOCATIONS

ARCADIS

FIGURE
1-5

CITY:SYRACUSE DIV/GROUP:ENVCAD DB:E.KRAHMER PIC: M. CARILLO-SHERIDAN PM: M. BIONDOLILLO TM: M. HAYES TR: M. BELL LYR:(Opt)ON=*;OFF=*REF* PAGESETUP: C-LD2B-PDF-GMS PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/29/2012 10:04 AM BY: STOWELL, GARY
G:\ENVCAD\SYRACUSE\ACT\B0043018\0000\06000\DWG\FEASIBILITY\43018C03.dwg LAYOUT: 1-6 SAVED: 5/29/2012 10:00 AM ACADVER: 18.1S (LMS TECH)
XREFS: 43018X01 IMAGES: 43018X01.JPG PROJECTNAME: ---

SD-26

Depth	Total PCBs
0 – 1	3.14
1 – 2	3.68 J
2 – 3	0.79
3 – 4	1.65 J
4 – 5	3.2 J
5 – 6	1.53
6 – 7	0.103 J
7 – 8	0.103 J
8 – 9	0.075 J
9 – 9.5	0.064 J
9.5 – 10.5	0.062 J
10.5 – 11.5	0.033 U

SD-45

Depth	Total PCBs
0 – 0.5	0.061 U
0.5 – 1	0.068 U
1 – 2	0.337 [0.226]
2 – 3	0.046 J
3 – 4	0.036 U
4 – 5	0.034 U

SD-46

Depth	Total PCBs
0 – 0.5	0.206
0.5 – 1	0.439 J
1 – 2	0.344 J
2 – 3	2.95 J
3 – 4	3.37
4 – 5	3.35
5 – 6	6.8
6 – 7	3.55 [4.59]
7 – 8	4.13
8 – 9	4.02 J
9 – 10.1	3.27

SD-48

Depth	Total PCBs
0 – 0.5	1.48
0.5 – 1	0.488
1 – 2	1.15 J
2 – 3	6
3 – 4	1.77
4 – 5	3.03
5 – 6	3.04
6 – 7	4.48
7 – 8	5.19
8 – 9	3.85
9 – 10	2.4
10 – 11	3.3
11 – 12	3.17
12 – 12.4	0.78 J

SD-50

Depth	Total PCBs
0 – 0.5	0.71 J
0.5 – 1	0.7 J
1 – 2	0.9 J
2 – 3	1.42
3 – 4	1.32
4 – 5	7.2 J
5 – 6	6.57
6 – 7	7.04 [6.38]
7 – 8	3.62
8 – 9	4.51 J
9 – 10	3.52
10 – 10.4	1.31

SD-49

Depth	Total PCBs
0 – 0.5	0.22 J
0.5 – 1	0.457 J
1 – 2	0.425 J
2 – 3	1.31 [2.01 J]
3 – 4	2.06
4 – 5	2.08 J
5 – 6	2.29
6 – 7	2.05
7 – 8	4.26
8 – 9	1.68 J
9 – 10	3.18
10 – 11	5.34
11 – 12	4.58
12 – 13	3.08
13 – 14	7.9
14 – 14.4	4.98

SD-51

Depth	Total PCBs
0 – 0.5	0.95
0.5 – 1	1.76 J
1 – 2	2.33 J
2 – 3	5.4 J
3 – 4	3.81 J
4 – 5	3.13 J
5 – 6	6.3
6 – 7	9.2 J
7 – 8	9.6 [8.3 J]
8 – 9	6
9 – 10	7.6
10 – 11	9.2
11 – 12	13.3
12 – 13.1	3.08 J

SD-52

Depth	Total PCBs
0 – 0.5	4.71
0.5 – 1	3.1
1 – 2	6.4
2 – 3	4.9
3 – 4	6.1
4 – 5	8.4 [5.3 J]
5 – 6	9.3
6 – 7	9.6
7 – 8	8.1
8 – 9	3.27 J
9 – 10	4.8
10 – 11	3.4
11 – 11.6	4.02

SD-52B

Depth	Total PCBs
11 – 12	3.85
12 – 13	4.9
13 – 13.9	3.19

SD-47B

Depth	Total PCBs
0 – 0.5	0.98 J
0.5 – 1	4.82
1 – 2	5.14
2 – 3	4.64
3 – 4	4.21
4 – 5	4.34
5 – 6	4.7
6 – 7	2.86
7 – 8	2.06 J
8 – 9	2.27
9 – 10	1.97
10 – 11	1.81
11 – 12	1.61 [1.43]
12 – 12.8	3.15

SD-47C

Depth	Total PCBs
12 – 13	20.2 J
13 – 14	5.54

SD-20

Depth	Total PCBs
0 – 1	3.1 J
1 – 2	0.916 J
2 – 3	3.66 J
3 – 4	3.06 J
4 – 5	1.16
5 – 6	0.017 J
6 – 7	0.156

SD-21

Depth	Total PCBs
0 – 1	2.21 J
1 – 2	17.8 J [19 J]
2 – 3	3.22 J
3 – 4	10 J
4 – 4.5	32 J
4.5 – 5.5	0.031 U
5.5 – 6.5	0.28 J
6.5 – 7.5	0.032 U

SD-27

Depth	Total PCBs
0 – 1	0.68 J
1 – 2	1.3 J [1.56]
2 – 3	8.8 J
3 – 4	7.1 J
4 – 5	6 J
5 – 6	5.9 J
6 – 7	4.7 J
7 – 8	5.86 J
8 – 9	2.6 J
9 – 10	13.4 J
10 – 11	0.337 J
11 – 12	0.093 J
12 – 13	0.195
13 – 14	0.034 U
14 – 15	0.033 U
15 – 16	0.033 U

SD-44

Depth	Total PCBs
0 – 0.5	0.243
0.5 – 1	0.414
1 – 2	0.122 J
2 – 3	0.85 J [0.29 J]
3 – 4	0.88 J
4 – 5	0.72 J
5 – 6	0.32 J
6 – 7	0.66 J
7 – 8.2	0.54 J

SD-41

Depth	Total PCBs
0 – 0.5	0.363 J
0.5 – 1	0.014 J
1 – 2	0.046 U
2 – 3	0.037 U
3 – 3.6	0.034 U

SD-42

Depth	Total PCBs
0 – 0.5	0.079 J
0.5 – 1	0.44 J
1 – 2	2.09 J
2 – 3	2.8 J [0.35 J]
3 – 4	0.75 J
4 – 5	2.9 J
5 – 6	4.4
6 – 7	1.37 J
7 – 8	0.084 J
8 – 9	0.196 J
9 – 9.9	0.0067 J

SD-43

Depth	Total PCBs
0 – 0.5	0.463 J
0.5 – 1	4.95
1 – 2	5.55
2 – 3	1.89
3 – 4	1.15
4 – 5	4.6 J
5 – 6	2
6 – 7	0.87
7 – 8	1.69
8 – 9	4.65
9 – 10	2.04 J
10 – 11	2.49
11 – 12	2.59 J

SD-38

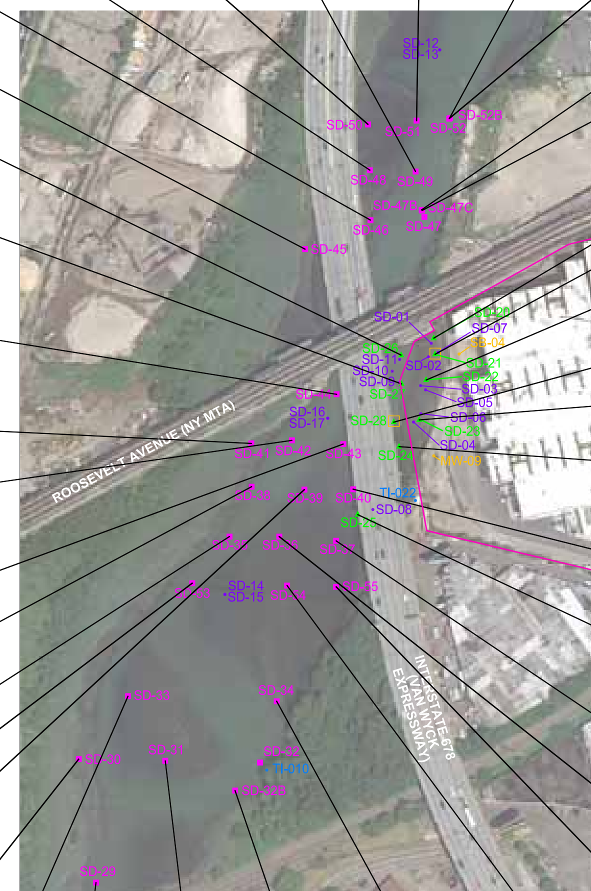
Depth	Total PCBs
0 – 0.5	4.3

SD-35

Depth	Total PCBs
0 – 0.5	0.0351 J
0.5 – 1	2.7 J
1 – 2	3.3 J
2 – 3	4.8 J
3 – 4	2.13 J
4 – 5	0.37 J
5 – 6	0.088
6 – 7	0.23 J
7 – 8	0.054 J

SD-53

Depth	Total PCBs
0 – 0.5	0.082 J
0.5 – 1	0.0893 J
1 – 2	0.0653 J
2 – 3	0.8 J
3 – 4	0.332 J
4 – 5	0.36 J
5 – 6	0.42 J
6 – 7	5.77 J
7 – 8	0.96 J
8 – 9	0.0208 J
9 – 10	0.0069 J



SD-22

Depth	Total PCBs
0 – 1	4.52
1 – 2.1	7.2
2.1 – 3.1	0.29
3.1 – 4.1	0.143

SD-28

Depth	Total PCBs
0 – 1	2.8 J
1 – 2	4.8
2 – 3	8.6
3 – 4	8.7 [12.5 J]
4 – 5	12 J
5 – 6	8.1
6 – 7	7.1
7 – 8	1.35
8 – 9	0.135
9 – 10	0.202
10 – 11	0.026 J
11 – 12	0.03 J
12 – 13.3	0.016 J
13.3 – 14.3	0.033 U
14.3 – 15	0.032 U

SD-23

Depth	Total PCBs
0 – 1	11 J [48 J]
1 – 2	28.3 J
2 – 3	0.67 J
3 – 4	1.17 J
4 – 5	0.34 J
5 – 6	0.44 J

SD-24

Depth	Total PCBs
0 – 1	1.62
1 – 2	1
2 – 3	1.55
3 – 4	3.04 [6.04]
4 – 5	1.41 J
5 – 6	0.737 J
6 – 7	0.472 J
7 – 7.4	0.155
7.4 – 8.4	5.03 J
8.4 – 9.4	0.235
9.4 – 10.4	0.032 U
10.4 – 11.4	0.033 U

SD-40

Depth	Total PCBs
0 – 0.5	0.071 J
0.5 – 1	0.172
1 – 2	1.85
2 – 3	0.313 J [0.255]
3 – 4	1.98
4 – 5	3.94 J
5 – 6	0.83
6 – 7	1.09 J
7 – 8	2.37 J
8 – 9	1.95 J
9 – 10	4.4
10 – 11	0.44
11 – 12	0.032 J
12 – 13	0.023 U

SD-25

Depth	Total PCBs
0 – 1	7.5
1 – 2	3.03
2 – 3	3.61
3 – 4	6.3
4 – 5	4 J
5 – 6	6.15 J
6 – 7	4.1 [5]
7 – 8	0.46 J
8 – 9.3	0.083 J
9.3 – 10.7	0.199 J
10.7 – 11.7	0.02 U
11.7 – 12.7	0.02 U
12.7 – 13.7	0.032 U
13.7 – 14.7	0.032 U
14.7 – 16	0.032 U

SD-39

Depth	Total PCBs
0 – 0.5	0.496
0.5 – 1	0.538
1 – 2	0.73
2 – 3	0.564 J [0.99 J]
3 – 4	0.69
4 – 5	0.63 J
5 – 6	1.14 J
6 – 7	2.3 J
7 – 8	1.58 J
8 – 9	1.97 J
9 – 10	5.16 J
10 – 10.5	8.51 J

SD-30

Depth	Total PCBs
0 – 0.5	0.064 U
0.5 – 1	0.086 U
1 – 2	0.048 U
2 – 3	0.077 U
3 – 4	0.047 U [0.053 U]
4 – 5	0.031 U

SD-33

Depth	Total PCBs
0 – 0.5	0.178 J
0.5 – 1	0.188
1 – 2	0.35
2 – 3	0.491 J
3 – 4	0.204 J
4 – 5	3.35
5 – 6	0.351 J
6 – 7	0.297 J
7 – 8	0.325 J
8 – 9	6.7
9 – 10	4.4 J
10 – 11.3	4.2 J

SD-29

Depth	Total PCBs
0 – 0.5	0.3 J
0.5 – 1	0.37
1 – 2	0.21 J
2 – 3	0.114 J
3 – 3.5	0.032 U

SD-31

Depth	Total PCBs
0 – 0.5	0.209 J
0.5 – 1	0.294 J
1 – 2	0.599 J
2 – 3	2.97 J
3 – 4	1.49
4 – 5	1.04 J
5 – 6	0.537 J
6 – 7	1 J [1.07 J]
7 – 8	0.52 J
8 – 9	2.11 J
9 – 10	0.29
10 – 11	0.049 J
11 – 11.8	0.015 J

SD-32B

Depth	Total PCBs
0 – 0.5	0.033 U
0.5 – 1	0.034 U
1 – 2	0.035 U

SD-34

Depth	Total PCBs
0 – 0.5	0.134 J
0.5 – 1	0.425 J
1 – 2	0.71
2 – 3	0.327 J [0.82 J]
3 – 4	1.45
4 – 5	2.03 J
5 – 6	1.96
6 – 7	1.7
7 – 8	0.372
8 – 9	0.085
9 – 10	1.2 J
10 – 11	0.98 J
11 – 12	1.65 J
12 – 13	0.052 J
13 – 14	1.6 J
14 – 14.8	0.319 J

SD-54

Depth	Total PCBs
0 – 0.5	0.329 J
0.5 – 1	0.98 J
1 – 2	0.183 J
2 – 3	1.41 J [1.63 J]
3 – 4	1.23 J
4 – 5	2.63 J
5 – 6	0.135 J
6 – 7	1.09 J
7 – 8	0.37 J
8 – 9	0.269 J
9 – 10	2.9 J
10 – 11	3.7 J
11 – 11.7	0.33 J

SD-55

Depth	Total PCBs
0 – 0.5	0.303
0.5 – 1	0.55 J
1 – 2	1.02 J
2 – 3	1.09
3 – 4	0.76
4 – 5	0.4 J
5 – 6	1.06 J
6 – 7	3.9
7 – 8	0.037 J [1.4 J]
8 – 9	0.016 J
9 – 10	0.04
10 – 11	0.035 U
11 – 11.9	0.034 U

SD-36

Depth	Total PCBs
0 – 0.5	0.47 J
0.5 – 1	0.399 J
1 – 2	0.328 J
2 – 3	0.431 J [0.535 J]
3 – 4	0.94 J
4 – 5	1.34 J
5 – 6	0.64
6 – 7	0.87 J
7 – 8	0.652 J
8 – 9	0.91 J
9 – 10	2.4 J
10 – 11	2.5
11 – 12	2.4
12 – 13.4	0.521 J

SD-37

Depth	Total PCBs
0 – 0.5	0.67 J
0.5 – 1	0.555 J
1 – 2	0.62 J
2 – 3	0.83
3 – 4	0.97
4 – 5	2.39
5 – 6	4
6 – 7	1.74 J [1.63 J]
7 – 8	1.33
8 – 9	2.09
9 – 10	2.3 J
10 – 10.5	0.012 J

LEGEND:

- 2010 SEDIMENT CORE LOCATION
- 2009 SEDIMENT CORE LOCATION
- 2009 CO-LOCATED CORE (RADIOCHEMICAL ANALYSIS)
- 2005 AKRF SAMPLING LOCATION
- AKRF MONITORING WELL/SOIL BORING LOCATION
- CSO OUTFALL
- PCB SOURCE 1
- PCB SOURCE 2 AND 3
- MIXED/OTHER PCB SOURCE
- CONFINING LAYER
- PROPERTY BOUNDARY

NOTES:

1. TOTAL PCBs EQUAL THE SUM OF AROCLORS 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, AND 1268.
2. GRAY SHADING INDICATES THE DEPTH OF THE CLAY LAYER. IF NO RESULTS ARE PROVIDED WITHIN THE SHADED ROW, THEN A SAMPLE WAS NOT COLLECTED FROM THE CLAY LAYER.
3. UNITS ARE IN MILLIGRAMS PER KILOGRAM (mg/kg).
4. DEPTHS ARE PROVIDED IN FEET.
5. DATA FOR AKRF SAMPLE LOCATIONS CAN BE FOUND IN THE PARCEL 4 REMEDIAL INVESTIGATION REPORT (AKRF 2006).
6. 2010 IMAGERY DOWNLOADED FROM GOOGLE EARTH PRO.
7. U = THE COMPOUND WAS ANALYZED FOR BUT NOT DETECTED. THE PROVIDED VALUE IS THE COMPOUND QUANTITATION LIMIT.
8. J = INDICATES AN ESTIMATED VALUE.
9. CONCENTRATIONS NOT SHADED IN BLUE, GREEN, OR ORANGE WERE NOT EVALUATED FOR POTENTIAL PCB SOURCES.

0 200' 400'
GRAPHIC SCALE

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRAL PARK, OPERABLE UNIT 2
FEASIBILITY STUDY REPORT

SEDIMENT CORE ANALYTICAL RESULTS - PCBs

ARCADIS

FIGURE
1-6

LEGEND:

- 2010 SEDIMENT CORE LOCATION
- 2009 SEDIMENT CORE LOCATION
- 2009 CO-LOCATED CORE (RADIOCHEMICAL ANALYSIS)
- AKRF MONITORING WELL/SOIL BORING
- CSO OUTFALL
- PROPERTY BOUNDARY
- BATHYMETRIC CONTOUR (DASHED WHERE INFERRED)
- MEAN LOW WATER ELEVATION (-3.8 FT NAVD 88)
- MEAN LOWER LOW WATER ELEVATION (-4.1 FT NAVD 88)
- APPROXIMATE LOCATION OF SHEET PILE WALL (SEE NOTE 4)
- THEISSEN POLYGON LINES - 2009 SEDIMENT CORES
- INTERTIDAL ZONE
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 1 PART PER MILLION ENCOUNTERED 0-2 FT BELOW SURFACE SEDIMENT
- TOTAL PCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 0-2 FT BELOW SURFACE SEDIMENT
- TOTAL PCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 2-5 FT BELOW SURFACE SEDIMENT
- TOTAL PCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 5-10 FT BELOW SURFACE SEDIMENT

NOTES:

1. 2010 IMAGERY DOWNLOADED FROM GOOGLE EARTH PRO.
2. COORDINATES ARE BASED ON NORTH AMERICAN DATUM 1983 - NEW YORK LONG ISLAND ZONE
3. BATHYMETRY CONTOURS MODELED USING THE NATURAL NEIGHBOR MODE USING AVAILABLE SEDIMENT CORE AND SAMPLING LOCATIONS; ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
4. LOCATION OF SHEET PILE WALL OBTAINED FROM REMEDIAL PHASE SHEET PILE WALL PLAN AND ELEVATIONS, DRAWING C-804,LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES (JANUARY 6, 2006). THE ELEVATION AT THE TOP OF THE WALL IS +9.1 FT (NAVD 88) AND EXTENDS TO A DEPTH OF 35 FT BELOW GRADE. IT IS ANTICIPATED THAT THE MEAN HIGH WATER ELEVATION (+3.3 FT NAVD 88) AND MEAN HIGHER HIGH WATER (+3.7 FT NAVD 88) OCCUR ALONG THE WALL; THEREFORE THESE LINES ARE NOT SHOWN FOR CLARITY.
5. THE EXTENT OF THE LITTORAL ZONE BELOW ELEVATION-3.8FT NAVD 88 HAS NOT BEEN SHOWN DUE TO LIMITED DATA AVAILABILITY.
6. FLUSHING RIVER MEAN TIDE LEVELS BASED ON NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION TIDE STATION 8516945 (KINGS POINT, NEW YORK).
7. AERIAL IMAGERY IS APPROXIMATE. VISUAL FEATURES MAY BE OFFSET DUE TO THE ANGLE AT WHICH THE IMAGERY WAS OBTAINED

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRIAL PARK, OPERABLE UNIT 2
FEASIBILITY STUDY REPORT

NEAR SITE AREA

ARCADIS

FIGURE
4-1

CITY: (ROSEVILLE, CA), SYRACUSE, NY DIV/GROUP: ENV/IM-DV DB: (B. ROBITAILLE) P. LISTER PM/TM/TR: M. DEGRACIA
G:\ENVCAD\SYRACUSE\ACT\B0043018\0000\06000\DWG\43018G06.dwg LAYOUT: 4-1 SAVED: 8/5/2013 12:52 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 8/5/2013 12:53 PM BY: LISTER, PAUL
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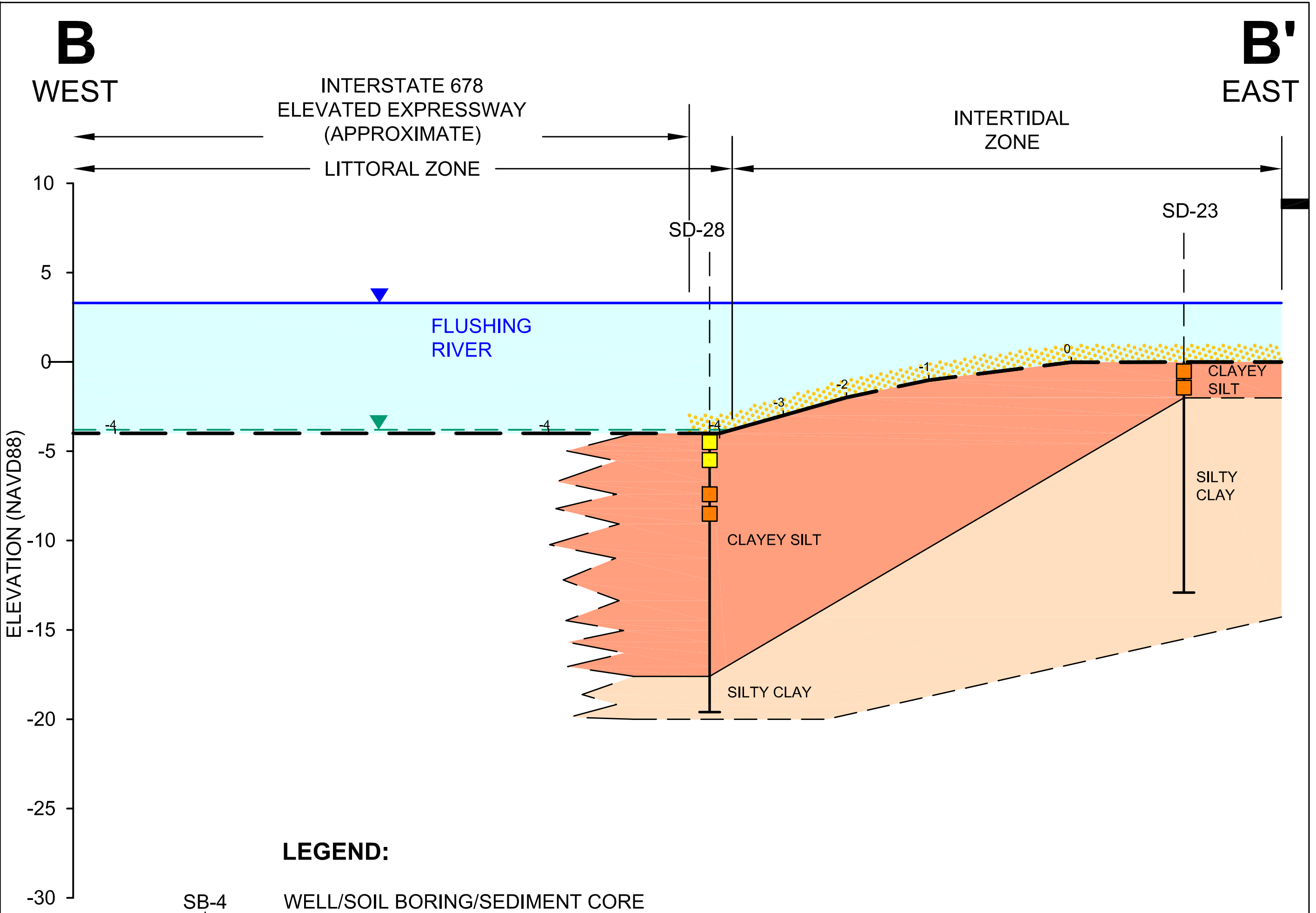


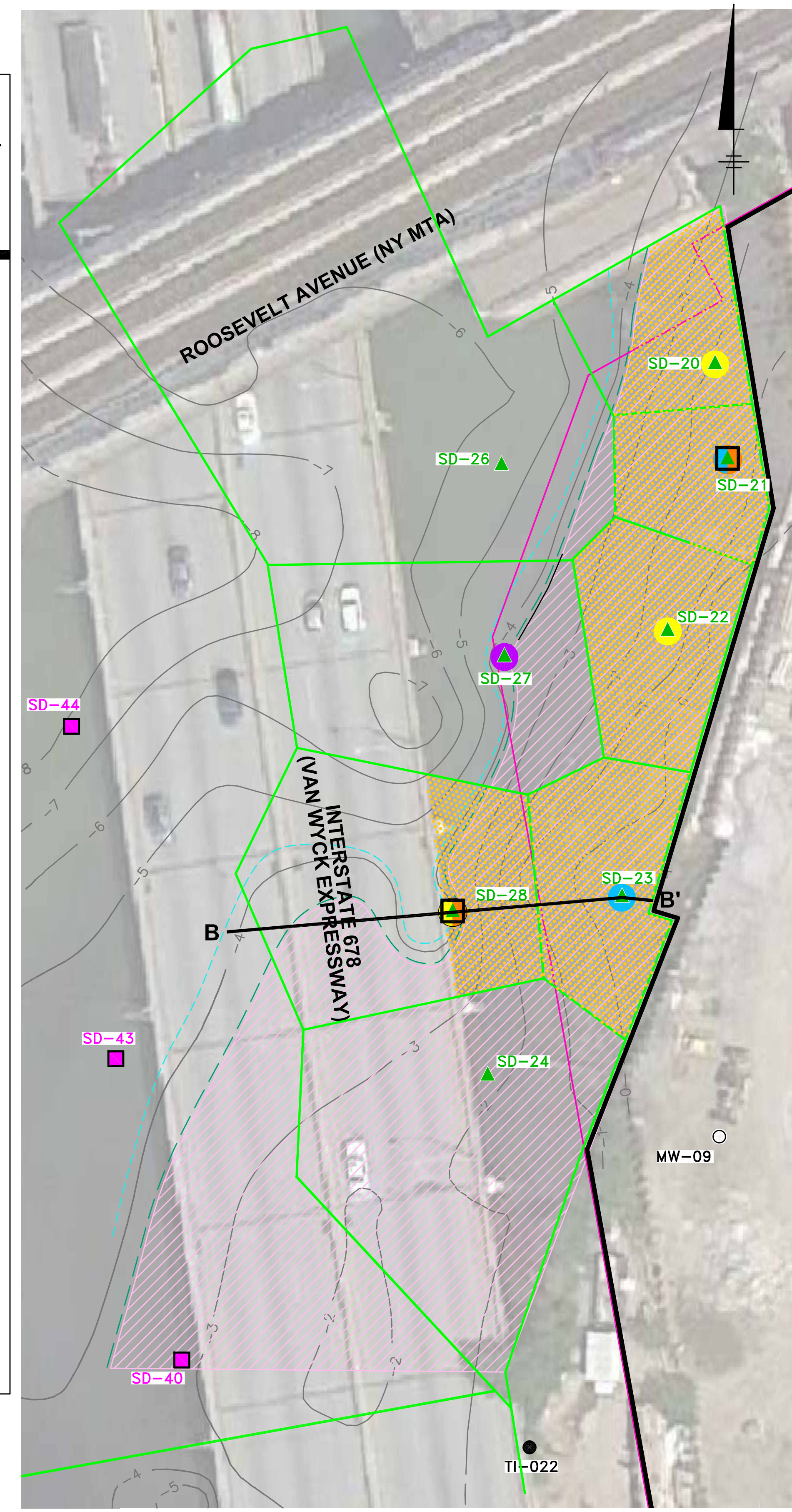
LEGEND:

- SB-4 WELL/SOIL BORING/SEDIMENT CORE
- MEAN HIGH WATER ELEVATION (3.3 FT NAVD 88)
- MEAN LOW WATER ELEVATION (-3.8 FT NAVD 88)
- CONTACT BETWEEN GEOLOGIC UNITS (DASHED WHERE INFERRED)
- GREATER THAN 1 mg/kg SITE-RELATED PCBs DETECTED
- GREATER THAN 10 mg/kg SITE-RELATED PCBs DETECTED
- BOTTOM OF BORING
- -1 BATHYMETRIC CONTOUR
- CLAYEY SILT - CLAYEY SILT, TRACE ORGANICS
- SILTY CLAY - SILTY CLAY, TRACE ORGANICS AND SHELLS
- AREA SUBJECT TO CAPPING

CROSS SECTION B-B'

VERTICAL SCALE: 1" = 10' (0, 10', 20')

HORIZONTAL SCALE: 1" = 20' (0, 20', 40')



LEGEND:

- 2010 SEDIMENT CORE LOCATION
- 2009 SEDIMENT CORE LOCATION
- 2009 CO-LOCATED CORE (RADIOCHEMICAL ANALYSIS)
- AKRF MONITORING WELL/SOIL BORING
- CSO OUTFALL
- PROPERTY BOUNDARY
- —5— BATHYMETRIC CONTOUR (DASHED WHERE INFERRED)
- MEAN LOW WATER ELEVATION (-3.8 FT NAVD 88)
- MEAN LOWER LOW WATER ELEVATION (-4.1 FT NAVD 88)
- APPROXIMATE LOCATION OF SHEET PILE WALL (SEE NOTE 4)
- THEISSEN POLYGON LINES - 2009 SEDIMENT CORES
- B——B' CROSS SECTION LINE
- AREA SUBJECT TO CAPPING
- INTERTIDAL ZONE
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 1 PART PER MILLION ENCOUNTERED 0-2 FT BELOW SURFACE SEDIMENT
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 0-2 FT BELOW SURFACE SEDIMENT
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 2-5 FT BELOW SURFACE SEDIMENT
- TOTAL SITE-RELATEDPCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 5-10 FT BELOW SURFACE SEDIMENT

NOTES:

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2. COORDINATES ARE BASED ON NORTH AMERICAN DATUM 1983 - NEW YORK LONG ISLAND ZONE
3. BATHYMETRY CONTOURS MODELED USING THE NATURAL NEIGHBOR MODE USING AVAILABLE SEDIMENT CORE AND SAMPLING LOCATIONS; ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
4. LOCATION OF SHEET PILE WALL OBTAINED FROM REMEDIAL PHASE SHEET PILE WALL PLAN AND ELEVATIONS, DRAWING C-804,LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES (JANUARY 6, 2006). THE ELEVATION AT THE TOP OF THE WALL IS +9.1 FT (NAVD 88) AND EXTENDS TO A DEPTH OF 35 FT BELOW GRADE. IT IS ANTICIPATED THAT THE MEAN HIGH WATER ELEVATION (+3.3 FT NAVD 88) AND MEAN HIGHER HIGH WATER (+3.7 FT NAVD 88) OCCUR ALONG THE WALL; THEREFORE THESE LINES ARE NOT SHOWN FOR CLARITY.
5. THE EXTENT OF THE LITTORAL ZONE BELOW ELEVATION-3.8FT NAVD 88 HAS NOT BEEN SHOWN DUE TO LIMITED DATA AVAILABILITY.
6. FLUSHING RIVER MEAN TIDE LEVELS BASED ON NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION TIDE STATION 8516945 (KINGS POINT, NEW YORK).
7. AERIAL IMAGERY IS APPROXIMATE. VISUAL FEATURES MAY BE OFFSET DUE TO THE ANGLE AT WHICH THE IMAGERY WAS OBTAINED
8. CAP ELEVATIONS ARE ESTIMATED FOR POST-PLACEMENT CONDITIONS. IT IS ANTICIPATED THAT THE UNDERLYING MATERIAL WILL COMPACT, RETURNING THE BATHYMETRY TO ELEVATIONS SIMILAR TO THOSE ENCOUNTERED PRE-PLACEMENT.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRIAL PARK, OPERABLE UNIT 2
FEASIBILITY STUDY REPORT

REMEDIAL ALTERNATIVE 3

ARCADIS

FIGURE **5-1**

CITY: (ROSEVILLE, CA) SYRACUSE, NY DIV/GROUP: ENV/IM-DV DB: (B. ROBITAILLE) P. LISTER PM/TM/TR: M. DEGRACIA LAYOUT: 5-1 SAVED: 8/5/2013 12:54 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 8/5/2013 12:54 PM BY: LISTER, PAUL
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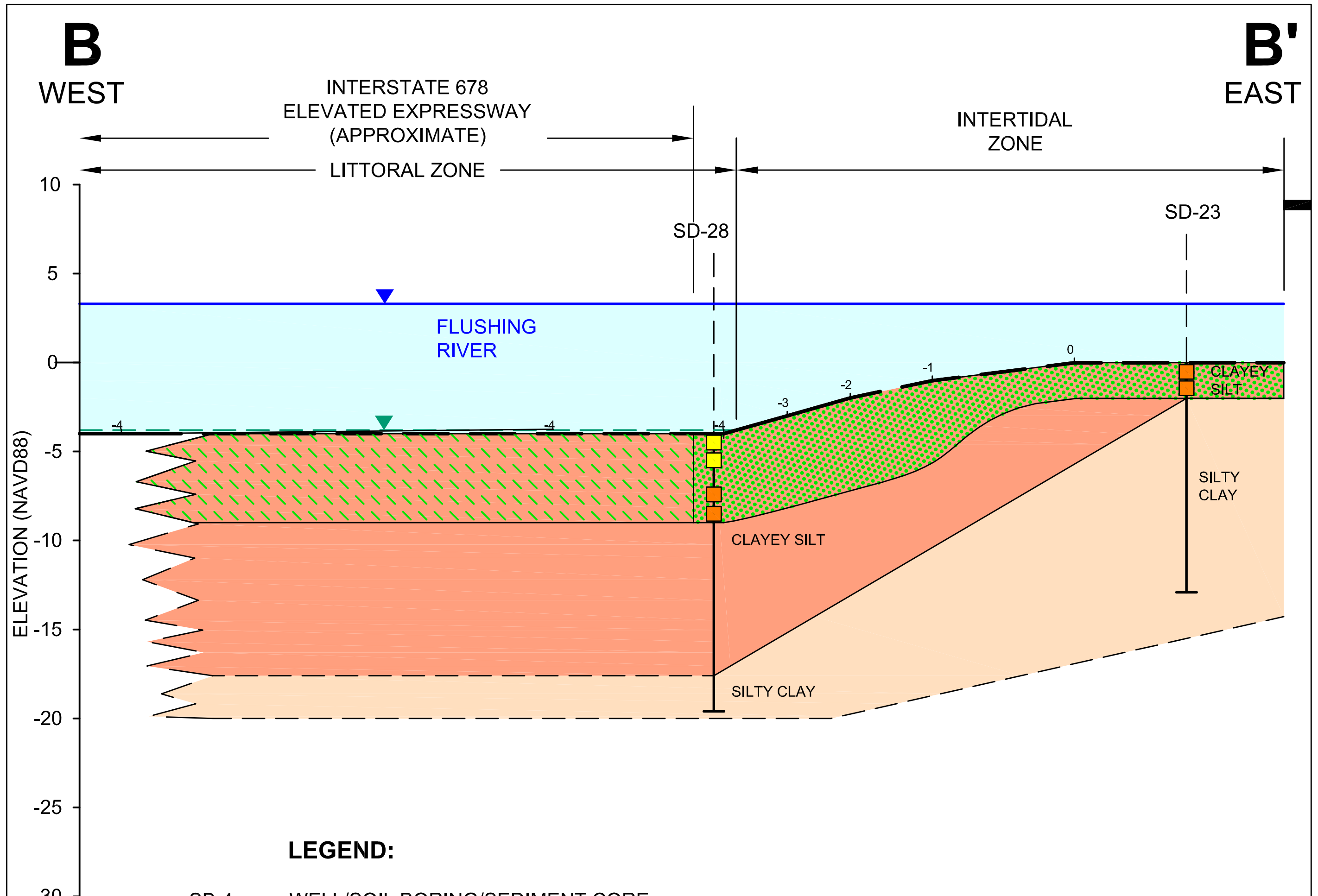
XREFS: 43018X00 43018X01 IMAGES: 43018X02.jpg



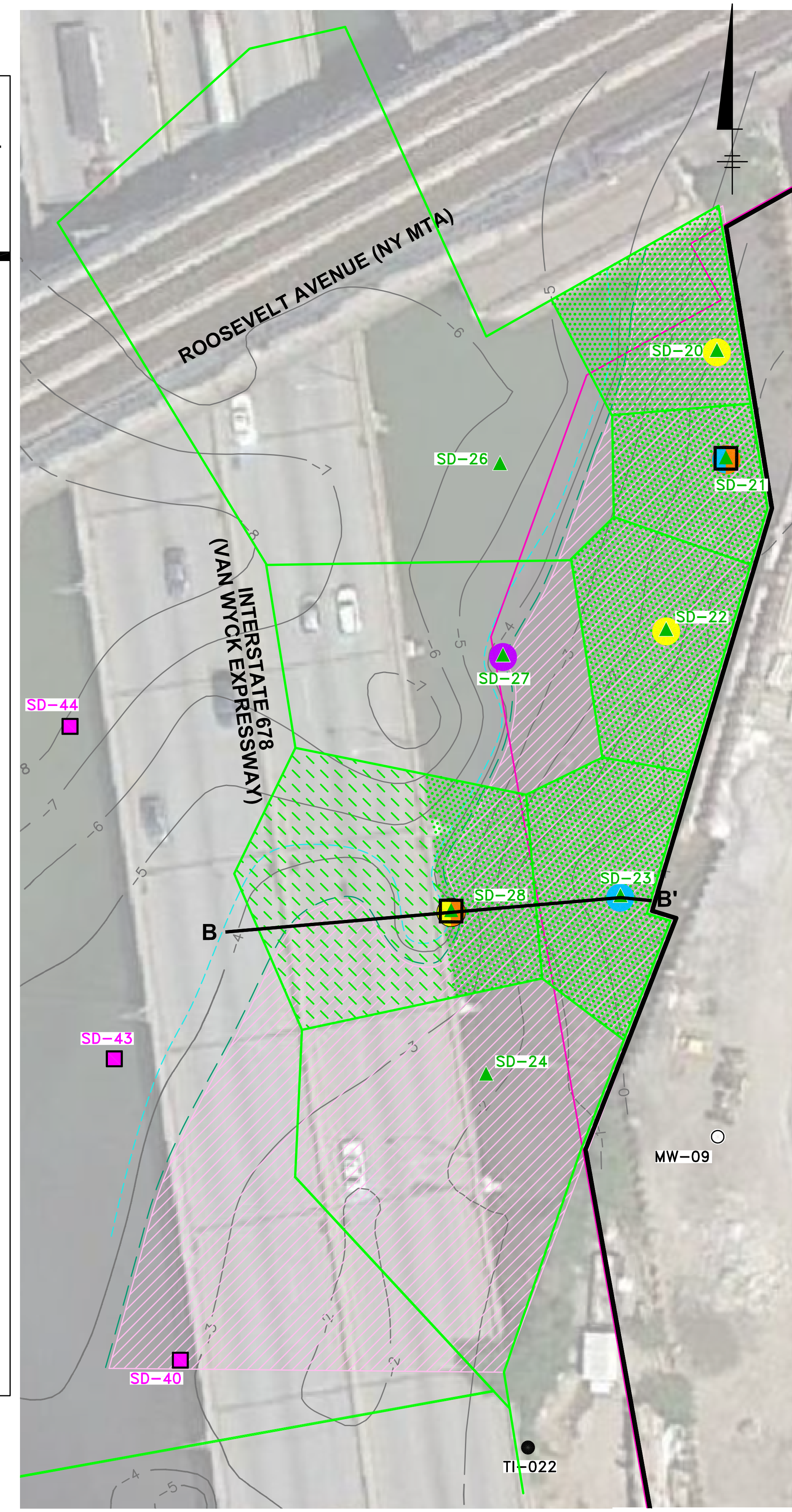
LEGEND:

- SB-4 WELL/SOIL BORING/SEDIMENT CORE
- MEAN HIGH WATER ELEVATION (3.3 FT NAVD 88)
- MEAN LOW WATER ELEVATION (-3.8 FT NAVD 88)
- CONTACT BETWEEN GEOLOGIC UNITS (DASHED WHERE INFERRED)
- GREATER THAN 1 mg/kg SITE-RELATED PCBs DETECTED
- GREATER THAN 10 mg/kg SITE-RELATED PCBs DETECTED
- BOTTOM OF BORING
- BATHYMETRIC CONTOUR
- CLAYEY SILT - CLAYEY SILT, TRACE ORGANICS
- SILTY CLAY - SILTY CLAY, TRACE ORGANICS AND SHELLS
- AREA SUBJECT TO DREDGING AND BACKFILL
- AREA SUBJECT TO DREDGING AND BACKFILL TO EXTENT PRACTICABLE

CROSS SECTION B-B'

0 10' 20'
VERTICAL SCALE: 1" = 10'

0 20' 40'
HORIZONTAL SCALE: 1" = 20'



0 50' 100'
GRAPHIC SCALE

LEGEND:

- 2010 SEDIMENT CORE LOCATION
- 2009 SEDIMENT CORE LOCATION
- 2009 CO-LOCATED CORE (RADIOCHEMICAL ANALYSIS)
- AKRF MONITORING WELL/SOIL BORING
- CSO OUTFALL
- PROPERTY BOUNDARY
- BATHYMETRIC CONTOUR (DASHED WHERE INFERRED)
- MEAN LOW WATER ELEVATION (-3.8 FT NAVD 88)
- MEAN LOWER LOW WATER ELEVATION (-4.1 FT NAVD 88)
- APPROXIMATE LOCATION OF SHEET PILE WALL (SEE NOTE 4)
- THEISSEN POLYGON LINES - 2009 SEDIMENT CORES
- B—B' CROSS SECTION LINE
- AREA SUBJECT TO DREDGING AND BACKFILL
- AREA SUBJECT TO DREDGING AND BACKFILL TO EXTENT PRACTICABLE
- INTERTIDAL ZONE
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 1 PART PER MILLION ENCOUNTERED 0-2 FT BELOW SURFACE SEDIMENT
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 0-2 FT BELOW SURFACE SEDIMENT
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 2-5 FT BELOW SURFACE SEDIMENT
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 5-10 FT BELOW SURFACE SEDIMENT

NOTES:

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3. BATHYMETRY CONTOURS MODELED USING THE NATURAL NEIGHBOR MODE USING AVAILABLE SEDIMENT CORE AND SAMPLING LOCATIONS; ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
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5. THE EXTENT OF THE LITTORAL ZONE BELOW ELEVATION-3.8FT NAVD 88 HAS NOT BEEN SHOWN DUE TO LIMITED DATA AVAILABILITY.
6. FLUSHING RIVER MEAN TIDE LEVELS BASED ON NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION TIDE STATION 8516945 (KINGS POINT, NEW YORK).
7. AERIAL IMAGERY IS APPROXIMATE. VISUAL FEATURES MAY BE OFFSET DUE TO THE ANGLE AT WHICH THE IMAGERY WAS OBTAINED
8. THE EXTENT OF DREDGING WILL BE EVALUATED DURING DESIGN TO DETERMINE APPROPRIATE OFFSETS FROM EXISTING FEATURES TO ENSURE STABILITY. DREDGE PRISMS FOR THE FS ASSUME A SLOPE BACK OF 3:1.
9. THE EXTENT OF THE DREDGING AND BACKFILL NEAR AND BENEATH THE INTERSTATE 678 (VAN WYCK EXPRESSWAY) BRIDGE WILL BE EVALUATED DURING DESIGN.

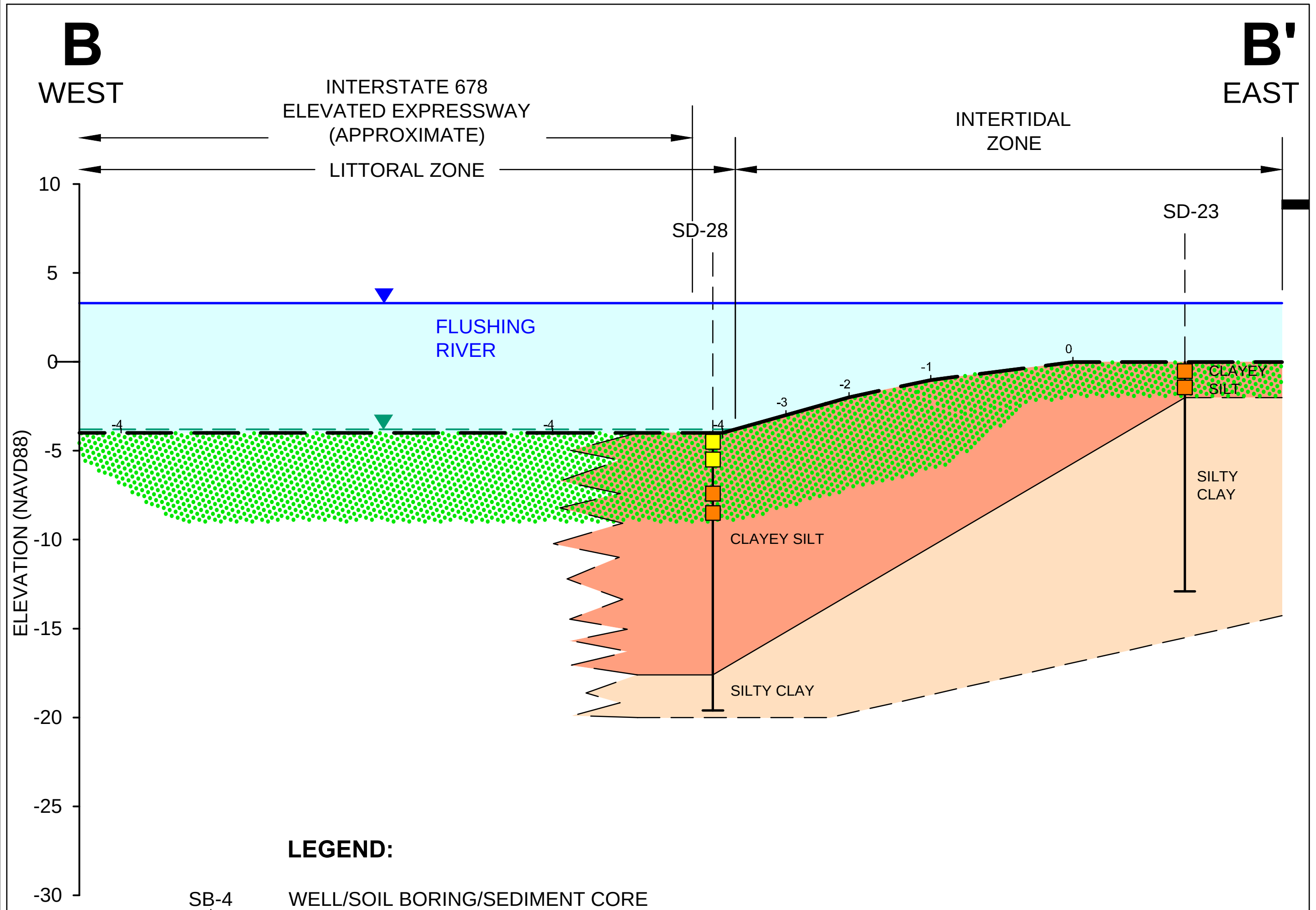
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRIAL PARK, OPERABLE UNIT 2
FEASIBILITY STUDY REPORT

REMEDIAL ALTERNATIVE 4

ARCADIS

FIGURE
5-2

CITY: (ROSEVILLE_CA) SYRACUSE, NY DIV/GROUP: ENV/IM-DV DB: (B. ROBITAILLE), P. LISTER, R.PETRIE PM/TM:M.BIONDOLILLO TR: M.BELL
G:\ENVCAD\SYRACUSE\ACT\B0043018\0002\06001\DWG\43018G05.DWG LAYOUT: 5-2 SAVED: 5/14/2013 10:45 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/14/2013 10:45 AM BY: PETRIE, RICH
XREFS: 43018X01 IMAGES: 43018X02.jpg



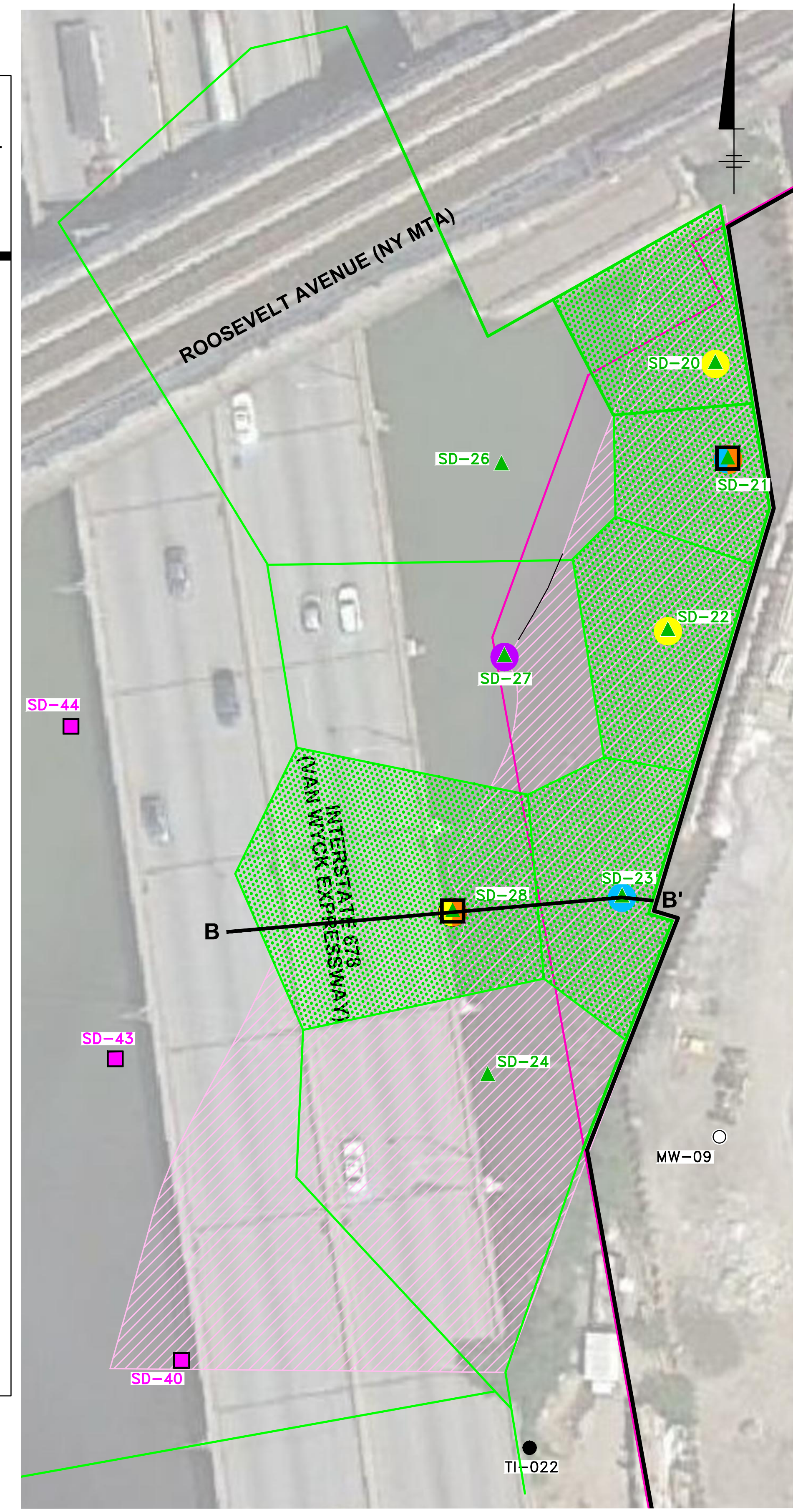
LEGEND:

- SB-4 WELL/SOIL BORING/SEDIMENT CORE
- MEAN HIGH WATER ELEVATION (3.3 FT NAVD 88)
- MEAN LOW WATER ELEVATION (-3.8 FT NAVD 88)
- CONTACT BETWEEN GEOLOGIC UNITS (DASHED WHERE INFERRED)
- GREATER THAN 1 mg/kg SITE-RELATED PCBs DETECTED
- GREATER THAN 10 mg/kg SITE-RELATED PCBs DETECTED
- BOTTOM OF BORING
- BATHYMETRIC CONTOUR
- CLAYEY SILT - CLAYEY SILT, TRACE ORGANICS
- SILTY CLAY - SILTY CLAY, TRACE ORGANICS AND SHELLS
- AREA SUBJECT TO DREDGING AND BACKFILL

CROSS SECTION B-B'

0 10' 20'
VERTICAL SCALE: 1" = 10'

0 20' 40'
HORIZONTAL SCALE: 1" = 20'



LEGEND:

- 2010 SEDIMENT CORE LOCATION
- 2009 SEDIMENT CORE LOCATION
- 2009 CO-LOCATED CORE (RADIOCHEMICAL ANALYSIS)
- AKRF MONITORING WELL/SOIL BORING
- CSO OUTFALL
- PROPERTY BOUNDARY
- BATHYMETRIC CONTOUR (DASHED WHERE INFERRED)
- MEAN LOW WATER ELEVATION (-3.8 FT NAVD 88)
- MEAN LOWER LOW WATER ELEVATION (-4.1 FT NAVD 88)
- APPROXIMATE LOCATION OF SHEET PILE WALL (SEE NOTE 4)
- THEISSEN POLYGON LINES - 2009 SEDIMENT CORES
- B—B' CROSS SECTION LINE
- AREA SUBJECT TO DREDGING AND BACKFILL
- INTERTIDAL ZONE
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 1 PART PER MILLION ENCOUNTERED 0-2 FT BELOW SURFACE SEDIMENT
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 0-2 FT BELOW SURFACE SEDIMENT
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 2-5 FT BELOW SURFACE SEDIMENT
- TOTAL SITE-RELATEDPCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 5-10 FT BELOW SURFACE SEDIMENT

NOTES:

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2. COORDINATES ARE BASED ON NORTH AMERICAN DATUM 1983 - NEW YORK LONG ISLAND ZONE
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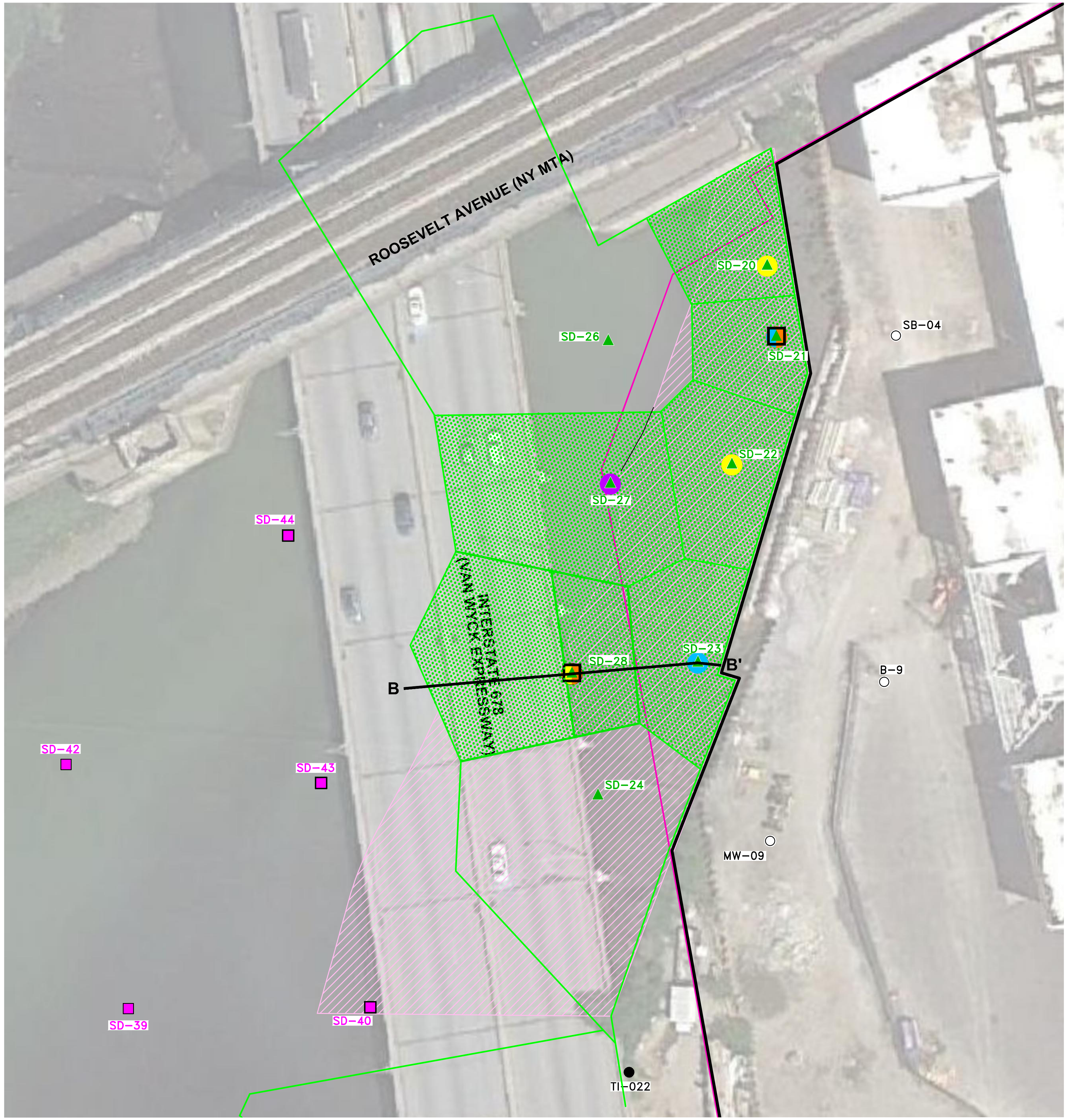
5. THE EXTENT OF THE LITTORAL ZONE BELOW ELEVATION-3.8FT NAVD 88 HAS NOT BEEN SHOWN DUE TO LIMITED DATA AVAILABILITY.
6. FLUSHING RIVER MEAN TIDE LEVELS BASED ON NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION TIDE STATION 8516945 (KINGS POINT, NEW YORK).
7. AERIAL IMAGERY IS APPROXIMATE. VISUAL FEATURES MAY BE OFFSET DUE TO THE ANGLE AT WHICH THE IMAGERY WAS OBTAINED
8. THE EXTENT OF DREDGING WILL BE EVALUATED DURING DESIGN TO DETERMINE APPROPRIATE OFFSETS FROM EXISTING FEATURES TO ENSURE STABILITY. DREDGE PRISMS FOR THE FS ASSUME A SLOPE BACK OF 3:1.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRIAL PARK, OPERABLE UNIT 2
FEASIBILITY STUDY REPORT

REMEDIAL ALTERNATIVE 5

ARCADIS

FIGURE
5-3



0 50' 100'
GRAPHIC SCALE

LEGEND:

- 2010 SEDIMENT CORE LOCATION
- 2009 SEDIMENT CORE LOCATION
- 2009 CO-LOCATED CORE (RADIOCHEMICAL ANALYSIS)
- AKRF MONITORING WELL/SOIL BORING
- CSO OUTFALL
- PROPERTY BOUNDARY
- —5— BATHYMETRIC CONTOUR (DASHED WHERE INFERRED)
- MEAN LOW WATER ELEVATION (-3.8 FT NAVD 88)
- MEAN LOWER LOW WATER ELEVATION (-4.1 FT NAVD 88)
- APPROXIMATE LOCATION OF SHEET PILE WALL (SEE NOTE 4)
- THEISSEN POLYGON LINES - 2009 SEDIMENT CORES
- B——B' CROSS SECTION LINE
- AREA SUBJECT TO DREDGING AND BACKFILL
- INTERTIDAL ZONE
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 1 PART PER MILLION ENCOUNTERED 0-2 FT BELOW SURFACE SEDIMENT
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 0-2 FT BELOW SURFACE SEDIMENT
- TOTAL SITE-RELATED PCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 2-5 FT BELOW SURFACE SEDIMENT
- TOTAL SITE-RELATEDPCB CONCENTRATION GREATER THAN 10 PARTS PER MILLION ENCOUNTERED 5-10 FT BELOW SURFACE SEDIMENT

NOTES:

1. 2010 IMAGERY DOWNLOADED FROM GOOGLE EARTH PRO.
2. COORDINATES ARE BASED ON NORTH AMERICAN DATUM 1983 - NEW YORK LONG ISLAND ZONE
3. BATHYMETRY CONTOURS MODELED USING THE NATURAL NEIGHBOR MODE USING AVAILABLE SEDIMENT CORE AND SAMPLING LOCATIONS; ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
4. LOCATION OF SHEET PILE WALL OBTAINED FROM REMEDIAL PHASE SHEET PILE WALL PLAN AND ELEVATIONS, DRAWING C-804,LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES (JANUARY 6, 2006). THE ELEVATION AT THE TOP OF THE WALL IS +9.1 FT (NAVD 88) AND EXTENDS TO A DEPTH OF 35 FT BELOW GRADE. IT IS ANTICIPATED THAT THE MEAN HIGH WATER ELEVATION (+3.3 FT NAVD 88) AND MEAN HIGHER HIGH WATER (+3.7 FT NAVD 88) OCCUR ALONG THE WALL; THEREFORE THESE LINES ARE NOT SHOWN FOR CLARITY.
5. THE EXTENT OF THE LITTORAL ZONE BELOW ELEVATION-3.8FT NAVD 88 HAS NOT BEEN SHOWN DUE TO LIMITED DATA AVAILABILITY.
6. FLUSHING RIVER MEAN TIDE LEVELS BASED ON NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION TIDE STATION 8516945 (KINGS POINT, NEW YORK).
7. AERIAL IMAGERY IS APPROXIMATE. VISUAL FEATURES MAY BE OFFSET DUE TO THE ANGLE AT WHICH THE IMAGERY WAS OBTAINED
8. THE EXTENT OF DREDGING WILL BE EVALUATED DURING DESIGN TO DETERMINE APPROPRIATE OFFSETS FROM EXISTING FEATURES TO ENSURE STABILITY. DREDGE PRISMS FOR THE FS ASSUME A SLOPE BACK OF 3:1.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FLUSHING INDUSTRIAL PARK, OPERABLE UNIT 2
FEASIBILITY STUDY REPORT

REMEDIAL ALTERNATIVE 6

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FIGURE
5-4

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Appendices

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Appendix A

Evaluation of Sediment Deposition Rates and Potential Reduction of PCBs in Sediment

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MEMO

To:
David Rubin, Consolidated Edison Company of New York, Inc.

Copies:
Ken Kaiser, Consolidated Edison Company of New York, Inc.

From:
Chuck Barnes

Date:
October 10, 2011

ARCADIS Project No.:
B0043018.0000

Subject:
Appendix A – Evaluation of Sediment Deposition Rates and Potential Reduction of PCBs in Sediment
Feasibility Study Report
Flushing Industrial Park, Operable Unit 2
Flushing, New York

Sediment deposition rates and the potential migration of polychlorinated biphenyl- (PCB-) impacted sediment were evaluated. Sediment deposition rates were assessed within the Intertidal Zone (core locations SD-20, SD-21, SD-22, and SD-23) and the Littoral Zone (SD-26, SD-27, and SD-28) using PCB and dichlorodiphenyltrichloroethane (DDT) concentration profiles within each core (Figure 4-1 of the *Feasibility Study Report* [FS Report]). Total DDT (sum of 4,4'-dichlorodiphenyldichloroethane [DDD], 4,4'-dichlorodiphenyldichloroethylene [DDE], and 4,4'-DDT) and total PCBs were used as chemical markers to estimate sedimentation rates. Based on the initiation of United States production, DDT and related compounds (e.g., DDD and DDE) should not be detected in environmental media prior to approximately 1940 (Agency for Toxic Substances and Disease Registry, 2002). PCBs should not be detected in environmental media prior to the onset of United States production in approximately 1930. Assuming that sediment deposition is also constant through time and using 1940 as an estimate of the first onset of DDT and PCBs, average deposition rates in the intertidal zone over the last half-century were estimated at 0.3 to 0.7 inches per year (in/yr), and average sediment deposition rates in the Littoral Zone were estimated at 1.1 to 1.7 in/yr. These values are in agreement with the geochronology assessment completed as part of the remedial investigation, where sediment deposition at core SD-21B located in the Intertidal Zone on the mudflat near the Parcel 4 shoreline was estimated at 0.6 in/yr based on initial appearance of caesium-137 (Cs-137) activity in the environment in approximately 1954. While discontinuities in the lead-210 (Pb-210) profile show some disruption to and reworking of the sediment bed in the upper approximately 10 inches, the total amount of Cs-137 activity in the sediment column was fairly close to the anticipated amount that would be accounted for by direct atmospheric deposition over time (measured 7 pCi/cm^2 vs an atmospheric loading of 6 pCi/cm^2). Sediment deposition at core SD-28B located in the Littoral Zone by the Van Wyck Expressway Bridge was estimated at 0.6 in/yr based on the Pb-210 profile and at 1.5 in/yr based on the first measurable occurrence of Cs-137. The Cs-137 method of dating is more similar to the chemical marker technique using PCBs and DDT. The very strong depositional nature of core SD-28B is also indicated by the high cumulative Cs-137 activity in the sediment column, which is approximately 15 times more than that attributable to atmospheric deposition alone. This is an indication of favorable long-term transport to and deposition of sediment in this area.

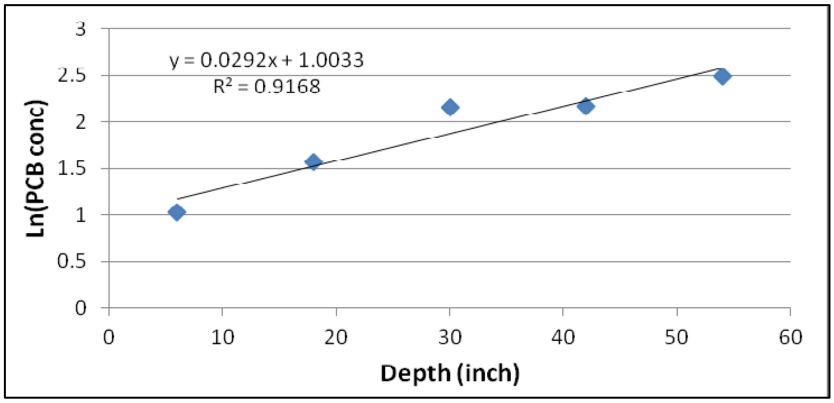
The potential long term reduction of PCBs in sediment within the Littoral Zone (core location SD-28; Figure 4-1 of the FS Report) due to new deposition was also evaluated. An exponential equation was used to describe the anticipated first-order decay of PCB surface concentrations due to mixing and deposition within the core:

$$PCBconc = b(e)^{(m*depth)}$$

or

$$Ln(PCBconc) = m(depth) + b\,.$$

Using the PCB concentrations detected in core SD-28 and the mid-point of the sampling interval, the unknowns m (slope value) and b (y-intercept) can be calculated based on the regression line.



m = 0.0292 (this represents an increase of approximately 0.028%/(inch depth) in PCB concentration)

b= 1.00

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Based on the slope value (m), the half life of PCBs at the surface (time for half of the PCBs concentrations at the surface to decay via burial) was calculated as approximately 30 years, showing there is a long-term rate of reduction of PCB concentrations in surface sediments.

Additionally, using an active capping model (Lambert and Reible, 2009) the potential migration of deeper PCBs to the surface sediments was also evaluated. This analysis is not intended to show a particular capping scenario or a particular core location, but to illustrate how the highly organic sediment present in the upper few feet of the Littoral Zone significantly retards any upward movement of PCBs due to advective/diffusive migration. The following values were assumed for the evaluation:

Upwelling = 1 m/year upwelling (assumed for littoral zone only)

Organic carbon partition coefficient (log Koc) = 5.5

Surface sediment total organic carbon (TOC) concentration = 9%

PCB concentration in surface sediments initially = 0 parts per million (ppm)

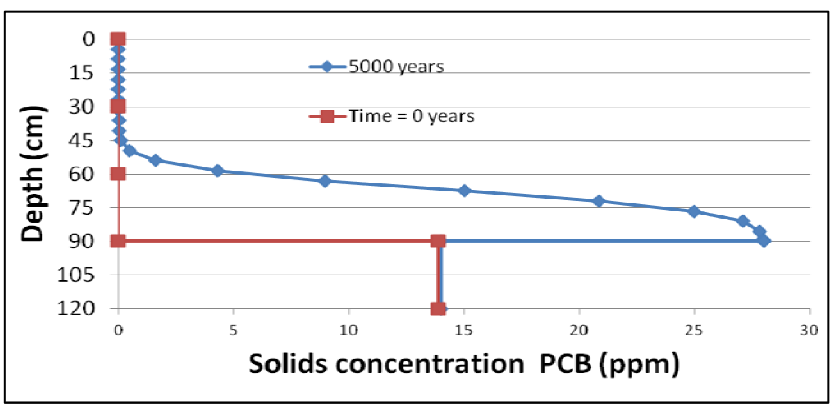
Bioturbation layer thickness = 30 centimeters (cm)

PCB concentration in underlying sediment = 14 ppm

TOC in underlying sediment = 4.5%

Depth of contamination = 90 cm or 3 feet (selected to provide material into which the PCBs could migrate and to be similar to conditions at core location SD-28)

The graph below shows the current (time = 0) PCB profile, and the PCB profile at 5,000 years.



Long-term PCB near-surface concentrations (upper 2 feet) remain low, showing long-term migration of PCBs from the deeper sediments to the surface is extremely slow. In addition, the model assumes no sediment deposition, which would have a tendency to bury elevated PCB concentrations faster than the migration upward. Considering the highly depositional nature of the Flushing River, PCBs at depth would be expected to remain at depth. Note that the higher PCB concentration in the sediment immediately above the PCB layer greater than 10 mg/kg is a result of the higher TOC and higher sorptive capacity of the surface sediments.

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Appendix B

Cost Estimates

Table B-1
Cost Estimate for Alternative 1
No Action

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	No Action	1	LS	$0	$0
				Subtotal Capital Cost	$0
2				Administration and Engineering (15%)	$0
				Total Capital Cost	$0
Operation and Maintenance Costs					
3	No Action	1	LS	$0	$0
				Subtotal O&M Cost	$0
				Contingency (20%)	$0
				Total Annual O&M Cost	$0
4				30-Year Total Present Worth Cost of O&M	$0
				Total Estimated Cost:	**$0**
				Rounded To:	**$0**

General Notes:

1. Cost estimate is based on ARCADIS' past experience and vendor estimates using 2012 dollars.
2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services, as such, this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.
3. All costs assume field work to be conducted by non-union labor.

LS = lump sum
O&M = operation and maintenance

Assumptions:

1. The "No Action" alternative serves as the baseline for comparison of the overall effectiveness of the other remedial alternatives. The "No Action" alternative would not involve implementation of any remedial activities to treat, remove, contain, or monitor impacted sediment within the area for remedial consideration, and no effort would be made to change or monitor future site conditions.

Table B-2
Cost Estimate for Alternative 2
MNR of Sediments Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals and Institutional Controls

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Sediment Monitoring Work Plan	1	LS	$30,000	$30,000
2	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$130,000
3				Administration and Engineering (15%)	$19,500
				Total Capital Cost	$150,000
Operation and Maintenance Costs					
4	MNR Monitoring and Reporting	1	LS	$36,000	$36,000
5	Annual Verification and Certification of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$46,000
				Contingency (20%)	$9,200
				Total O&M Cost	$55,200
6				30-Year Total Present Worth Cost of O&M	$400,000
				Total Estimated Cost:	**$550,000**
				Rounded To:	**$550,000**

General Notes:

1. Cost estimate is based on ARCADIS' past experience and vendor estimates using 2012 dollars.
2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services, as such, this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.
3. All costs assume field work to be conducted by non-union labor.

LS = lump sum
MNR = monitored natural recovery
O&M = operation and maintenance

Assumptions:

1. The Sediment Monitoring Work Plan cost estimate includes labor necessary to prepare a work plan for submittal to the New York State Department of Environmental Conservation (NYSDEC) identifying the scope and sampling plans to perform the MNR alternative.
2. Establish institutional controls cost estimate includes legal expenses to establish appropriate institutional controls, as well as address requirements for future activities that could encounter impacted sediments (e.g., repairs for utilities crossing the river).
3. Administration and engineering cost is equal to 15% of the total capital costs. Cost includes preparation of a Site Management Plan.
4. MNR monitoring and reporting cost estimate includes labor, equipment, and materials necessary to conduct chemical sampling and/or visual inspection and elevation monitoring via traditional surveying method activities at six locations and submittal of a summary report for the site area. Assumes monitoring will be conducted biennially for the first 5 years and then once every 5 years until year 30. Cost estimate assumes two workers will be required to complete the monitoring activities.
5. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective, annually for 30 years.
6. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation) in accordance with Office of Solid Waste and Emergency Response Directive 9355.3-20 "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis" (United States Environmental Protection Agency, 1993).

Table B-3
Cost Estimate for Alternative 3

Capping of Sediments Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals and Institutional Controls

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Pre-Design Investigation	1	LS	$51,000	$51,000
2	Permits and Approvals	1	LS	$50,000	$50,000
3	Mobilization/Demobilization	1	LS	$159,000	$159,000
4	Construction Support Facilities	1	LS	$182,000	$182,000
5	Floating Work Platform	1	LS	$100,000	$100,000
6	Absorbent Booms/Turbidity Curtains	1	LS	$21,000	$21,000
7	Debris Removal	0.3	AC	$10,000	$3,000
8	Sediment Cap	12,400	SF	$80	$992,000
9	Water Vessel Support	1	LS	$77,200	$77,200
10	Post-Construction Survey	1	LS	$15,000	$15,000
11	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$1,750,200
12				Administration and Engineering (15%)	$262,530
13				Construction Management (10%)	$175,020
				Contingency (20%)	$350,040
				Total Capital Cost	$2,600,000
Operation and Maintenance Costs					
14	Post-Construction Monitoring and Reporting	1	LS	$30,000	$30,000
15	Cap Maintenance	1	LS	$36,000	$36,000
16	Annual Verification and Certification of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$76,000
				Contingency (20%)	$15,200
				Total O&M Cost	$91,200
17				30-Year Total Present Worth Cost of O&M	$600,000
				Total Estimated Cost:	**$3,200,000**
				Rounded To:	**$3,200,000**

General Notes:

1. Cost estimate is based on ARCADIS' past experience and vendor estimates using 2012 dollars.
2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services, as such, this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.
3. All costs assume field work to be conducted by non-union labor.

AC = acres
LS = lump sum
O&M = operation and maintenance
SF = square feet

Table B-3
Cost Estimate for Alternative 3

Capping of Sediments Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals and Institutional Controls

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Assumptions:

1. Pre-design investigation cost estimate includes labor, equipment, materials, lodging, subsidence, and oversight necessary to conduct pre-design investigation: laboratory analysis, bathymetric and debris survey prior to cap placement, and hydrodynamic modeling. Cost estimate assumes work to be completed via a barge-mounted rig, which includes vibracore rig operator and crew.
2. Permits and approvals cost estimate includes preparation and procurement of the required permits and approvals from federal, state, and local agencies. Access agreement costs not included.
3. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to install a sediment cap. For cost estimating purposes, mobilization/demobilization costs are assumed to be 10% of the capital costs.
4. Construction support facilities cost estimate includes construction of the following: decontamination area (60-foot by 30-foot), consisting of a 12-inch gravel fill layer bermed and sloped to a sump and covered with a 40-mil high-density polyethylene liner and a 6-inch layer of gravel; material staging area (75-foot by 150-foot), consisting of a 6-inch gravel sub-base and 6-inch asphalt pavement and equipped with a 12-inch berm and sloped to a sump for staging dredged material to facilitate waste characterization sampling and materials handling/stabilization; and temporary access roads (up to 200 feet long, 25 feet wide, and 1-foot-thick) constructed of graded and compacted run-of-crusher material. Cost estimate includes all labor, equipment, and materials necessary to construct the support facilities.
5. Floating work platform cost estimate includes labor, equipment, and materials to construct a temporary floating work platform to facilitate the water-based capping operations. Assumes structure will consist of flexi-floats and piles.
6. Absorbent booms/turbidity curtains includes all labor, equipment, and materials necessary to construct and maintain absorbent booms/turbidity curtains around the active work area. Cost assumes 50% replacement of absorbent booms during construction.
7. Debris removal includes labor, materials, equipment, disposal, and services necessary for or incidental to handling/removing obstacles and debris (e.g., boulders, wood pilings) from the capping area.
8. Sediment cap cost estimate includes labor, materials, and equipment necessary for, or incidental to, the construction and placement of the engineered sediment cap. The cap material will be comprised of the following layers, top to bottom: 12-inch-thick layer of medium to coarse sand and gravel and organoclay reactive core mat. Cap placement is assumed to be completed utilizing general construction equipment.
9. Water vessel support cost estimate includes labor and equipment necessary to perform materials handling operations to and from the work site and the off-site Consolidated Edison Company of New York, Inc.'s Astoria facility.
10. Post-construction survey cost estimate includes labor and materials to perform a survey via traditional methods over the remedial area to verify, confirm, and document post-construction conditions.
11. Establish institutional controls cost estimate, which includes legal expenses to institute environmental easements and deed restrictions to control the future development adjacent to river and use of the river, as well as limit future activities that could damage the sediment cap.
12. Administration and engineering cost is equal to 15% of the total capital costs. Cost includes Site Management Plan and Final Engineering Report.
13. Construction management cost is based on an assumed 10% of the total capital costs.
14. Post-construction monitoring and reporting cost estimate includes labor, equipment, and materials necessary to conduct visual inspection and elevation monitoring via traditional surveying method activities and submittal of a summary report for capped areas only. Assumes monitoring will be conducted biennially for the first 5 years and then once every 5 years until year 30. Cost estimate assumes two workers will be required to complete the monitoring activities.
15. Cap maintenance cost estimate assumes 2% of the total capital cost of the alternative to be performed biennially for the first 5 years and once every 5 years until year 30.
16. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the New York State Department of Environmental Conservation to demonstrate that the institutional controls are being maintained and remain effective, annually for 30 years.
17. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation) in accordance with Office of Solid Waste and Emergency Response Directive 9355.3-20 "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis" (United States Environmental protection Agency, 1993).

Table B-4
Cost Estimate for Alternative 4
Dredging of Sediments (up to 5.0 feet bss) Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals, Management of Dredged Material, Backfilling Within Dredged Areas, and Institutional Controls

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Pre-Design Investigation	1	LS	$50,000	$50,000
2	Permits and Approvals	1	LS	$50,000	$50,000
3	Mobilization/Demobilization	1	LS	$217,000	$217,000
4	Construction Support Facilities	1	LS	$182,000	$182,000
5	Floating Work Platform	1	LS	$100,000	$100,000
6	Absorbent Booms/Turbidity Curtains	1	LS	$21,000	$21,000
7	Temporary Water Treatment System	16	WEEKS	$38,000	$591,000
8	Debris Removal	0.38	AC	$10,000	$4,000
9	Sediment Excavation and Handling	2,520	CY	$250	$630,000
10	Sediment Dewatering and Stabilization				
	Blending Operations	2,520	CY	$30	$76,000
	Stabilization Admixture	380	TON	$115	$44,000
11	Backfill	2,520	CY	$35	$89,000
12	Water Vessel Support	1	LS	$191,000	$191,000
13	Transportation and Disposal - Solid Waste Landfill	4,160	TON	$150	$624,000
14	Solid Waste Characterization	9	each	$1,200	$10,800
15	Confirmatory Sampling	1	LS	$16,200	$16,200
16	Post-Construction Survey	1	LS	$15,000	$15,000
17	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$3,011,000
18				Administration and Engineering (15%)	$451,650
19				Construction Management (10%)	$301,100
				Contingency (20%)	$602,200
				Total Capital Cost	$4,400,000
Operation and Maintenance Costs					
20	Post-Construction Monitoring and Reporting	1	LS	$25,000	$25,000
21	Annual Verification and Certification of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$35,000
				Contingency (20%)	$7,000
				Total O&M Cost	$42,000
22				30-Year Total Present Worth Cost of O&M	$300,000
				Total Estimated Cost:	**$4,700,000**
				Rounded To:	**$4,700,000**

General Notes:

1. Cost estimate is based on ARCADIS' past experience and vendor estimates using 2012 dollars.
2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services, as such, this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.
3. All costs assume field work to be conducted by non-union labor.

AC = acres
CY = cubic yard
LS = lump sum
O&M = operationg and maintenance

Table B-4
Cost Estimate for Alternative 4
Dredging of Sediments (up to 5.0 feet bss) Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals, Management of Dredged Material, Backfilling Within Dredged Areas, and Institutional Controls

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Assumptions:

1. Pre-design investigation cost estimate includes labor, equipment, materials, subsidence, lodging and oversight to support the design of the remedy:sediment sampling and analysis, one bathymetric survey (pre-excavation), debris survey, and backfill characterization. Cost estimate assumes work to be completed via a barge-mounted rig, which includes vibracore rig operator and crew.
2. Permits and approvals cost estimate includes preparation and procurement of the required permits and approvals from federal, state, and local agencies. Access agreement costs not included.
3. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to excavate and transport excavated sediments off site for treatment/disposal and backfill the dredged areas with suitable fill material. For cost estimating purposes, mobilization/demobilization costs are assumed to be 10% of the capital costs, not including waste transportation and disposal.
4. Construction support facilities cost estimate includes construction of the following: decontamination area (60-foot by 30-foot), consisting of a 12-inch gravel fill layer bermed and sloped to a sump and covered with a 40-mil high-density polyethylene liner and a 6-inch layer of gravel; material staging area (75-foot by 150-foot), consisting of a 6-inch gravel sub-base and 6-inch asphalt pavement and equipped with a 12-inch berm and sloped to a sump for staging dredged material to facilitate waste characterization sampling and materials handling/stabilization; and temporary access roads (up to 200 feet long, 25 feet wide, and 1-foot-thick) constructed of graded and compacted run-of-crusher material. Cost estimate includes all labor, equipment, and materials necessary to construct the support facilities.
5. Floating work platform cost estimate includes labor, equipment, and materials to construct a temporary floating work platform to facilitate the water-based excavation and backfill operations. Assumes structure will consist of flexi-floats and piles.
6. Absorbent booms/turbidity curtains includes all labor, equipment, and materials necessary to construct and maintain absorbent booms/turbidity curtains around the active work area. Cost assumes 50% replacement of absorbent booms during construction.
7. Temporary water treatment system cost estimate includes installation and operation of a temporary water treatment system. Cost estimate assumes water treatment system includes pumps, influent piping and hoses, frac tanks, carbon filters, bag filters, discharge piping and hoses, and flow meter. Cost estimate assumes bag filters will require change out approximately once per day of operation. Estimate assumes treated water would be discharged under a State Pollutant Discharge Elimination System permit equivalent at no additional cost.
8. Debris removal includes labor, materials, equipment, disposal, and services necessary for or incidental to handling/removing obstacles and debris (e.g., boulders, wood pilings) from the dredging area.
9. Excavation cost estimate includes labor, equipment, and materials necessary to excavate targeted sediment via mechanical dredging in the wet, load into scows, and transport scows to the floating work platform for offloading via a long-reach excavator. Volume estimate assumes 3:1 side slopes around the excavation area.
10. Sediment dewatering and stabilization activities includes the dewatering and stabilization of material following excavation activities. Dewatering will occur passively at the materials staging area. Stabilization admixture (Portland cement) will be added at ratio of 10% of the volume of material to be stabilized. It is assumed that any water generated in association with sediment management will be treated on site through the temporary water treatment system.
11. Backfill cost estimate includes labor, materials, equipment, and services necessary for, or incidental to, the placement of suitable fill material within the dredged area. The fill material will consist of medium to coarse sand and gravel that is backfilled to pre-construction elevation. Fill material will be suitable for placement as backfill or capping. Fill placement is assumed to be completed utilizing general construction equipment within containment. No backfill amendments (e.g., organoclay and/or activated carbon) have been assumed.
12. Water vessel support cost estimate includes labor and equipment necessary to perform materials handling operations to and from the work site and the off-site Consolidated Edison Company of New York, Inc.'s Astoria facility.
13. Transportation and disposal cost estimate includes labor, equipment, materials, and services required for the transportation and disposal of the dewatered and stabilized excavation material. Assumes in-situ sediment excavation volume increased by 10% by weight to account for stabilizing agents in sediment and a density of 1.5 tons per cubic yard. Cost estimate assumes dewatered sediment will be disposed at a permitted solid waste landfill.
14. Solid waste characterization cost estimate includes the analysis of samples (including, but not limited to, toxicity leaching characteristic procedure metals, polychlorinated biphenyls [PCBs], volatile organic compounds, semivolatile organic compounds, ignitability, reactivity, and corrosivity). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site disposal.
15. Post-construction survey cost estimate includes labor and materials to perform survey via traditional methods over remedial area to verify, confirm, and document that removal areas have been restored to pre-construction conditions.
16. Confirmatory sample cost estimate includes the 24-hour rush analysis of samples for PCBs. Costs assumes that confirmatory samples would be collected at a frequency of 10 samples per Theissen polygon.
17. Establish institutional controls cost estimate includes legal expenses to institute environmental easements and deed restrictions to control the future development adjacent to the river and use of the river.
18. Administration and engineering cost is equal to 15% of the total capital costs. Cost includes Site Management Plan and Final Engineering Report.
19. Construction management cost is based on an assumed 10% of the total capital costs.
20. Post-construction monitoring and reporting cost estimate includes labor, equipment, and materials necessary to conduct visual inspection and elevation monitoring via traditional surveying method activities and submittal of a summary report. Assumes monitoring will be conducted biennially for the first 5 years and then once every 5 years until year 30. Cost estimate assumes two workers will be required to complete the monitoring activities.
21. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the New York State Department of Environmental Conservation to demonstrate that the institutional controls are being maintained and remain effective, annually for 30 years.
22. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation) in accordance with Office of Solid Waste and Emergency Response Directive 9355.3-20 "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis" (United States Environmental Protection Agency, 1993).

Table B-5
Cost Estimate for Alternative 5

Dredging of Sediments (up to 5.0 feet bss) Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals, Management of Dredged Material, Backfilling Within Dredged Areas, and Institutional Controls

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Pre-Design Investigation	1	LS	$50,000	$50,000
2	Permits and Approvals	1	LS	$50,000	$50,000
3	Mobilization/Demobilization	1	LS	$241,000	$241,000
4	Construction Support Facilities	1	LS	$182,000	$182,000
5	Floating Work Platform	1	LS	$100,000	$100,000
6	Absorbent Booms/Turbidity Curtains	1	LS	$26,000	$26,000
7	Temporary Water Treatment System	19	WEEKS	$38,000	$716,000
8	Debris Removal	0.38	AC	$10,000	$4,000
9	Sediment Excavation and Handling	2,520	CY	$250	$630,000
10	Sediment Dewatering and Stabilization				
	Blending Operations	2,520	CY	$30	$76,000
	Stabilization Admixture	380	TON	$115	$44,000
11	Backfill	2,520	CY	$35	$89,000
12	Water Vessel Support	1	LS	$297,000	$297,000
13	Transportation and Disposal - Solid Waste Landfill	4,160	TON	$150	$624,000
14	Solid Waste Characterization	9	each	$1,200	$10,800
15	Post-Construction Survey	1	LS	$15,000	$15,000
16	Confirmatory Sampling	1	LS	$18,000	$18,000
17	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$3,272,800
18				Administration and Engineering (15%)	$490,920
19				Construction Management (10%)	$327,280
				Contingency (20%)	$654,560
				Total Capital Cost	$4,800,000
Operation and Maintenance Costs					
20	Post-Construction Monitoring and Reporting	1	LS	$25,000	$25,000
21	Annual Verification and Certification of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$35,000
				Contingency (20%)	$7,000
				Total O&M Cost	$42,000
22				30-Year Total Present Worth Cost of O&M	$300,000
				Total Estimated Cost:	**$5,100,000**
				Rounded To:	**$5,100,000**

General Notes:

1. Cost estimate is based on ARCADIS' past experience and vendor estimates using 2012 dollars.
2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services, as such, this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.
3. All costs assume field work to be conducted by non-union labor.

AC = acres
CY = cubic yard
LS = lump sum
O&M = operation and maintenance

Table B-5
Cost Estimate for Alternative 5

Dredging of Sediments (up to 5.0 feet bss) Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals, Management of Dredged Material, Backfilling Within Dredged Areas, and Institutional Controls

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc

Assumptions:

1. Pre-design investigation cost estimate includes labor, equipment, materials, subsidence, lodging and oversight to support the design of the remedy:sediment sampling and analysis, one bathymetric survey (pre-excavation), debris survey, and backfill characterization. Cost estimate assumes work to be completed via a barge-mounted rig, which includes vibracore rig operator and crew.
2. Permits and approvals cost estimate includes preparation and procurement of the required permits and approvals from federal, state, and local agencies. Access agreement costs not included.
3. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to excavate and transport excavated sediments off site for treatment/disposal and backfill the dredged areas with suitable fill material. For cost estimating purposes, mobilization/demobilization costs are assumed to be 10% of the capital costs, not including waste transportation and disposal.
4. Construction support facilities cost estimate includes construction of the following: decontamination area (60-foot by 30-foot), consisting of a 12-inch gravel fill layer bermed and sloped to a sump and covered with a 40-mil high-density polyethylene liner and a 6-inch layer of gravel; materials staging area (75-foot by 150-foot), consisting of a 6-inch gravel sub-base and 6-inch asphalt pavement and equipped with a 12-inch berm and sloped to a sump for staging dredged material to facilitate waste characterization sampling and materials handling/stabilization; and temporary access roads (up to 200 feet long, 25 feet wide, and 1-foot-thick) constructed of graded and compacted run-of-crusher material. Cost estimate includes all labor, equipment, and materials necessary to construct the support facilities.
5. Floating work platform cost estimate includes labor, equipment, and materials to construct a temporary floating work platform to facilitate the water-based excavation and backfill operations. Assumes structure will consist of flexi-floats and piles.
6. Absorbent booms/turbidity curtains includes all labor, equipment, and materials necessary to construct and maintain absorbent booms/turbidity curtains around the active work area. Cost assumes 50% replacement of absorbent booms during construction.
7. Temporary water treatment system cost estimate includes installation and operation of a temporary water treatment system. Cost estimate assumes water treatment system includes pumps, influent piping and hoses, frac tanks, carbon filters, bag filters, discharge piping and hoses, and flow meter. Cost estimate assumes bag filters will require change out approximately once per day of operation. Estimate assumes treated water would be discharged under a State Pollutant Discharge Elimination System permit equivalent at no additional cost.
8. Debris removal includes labor, materials, equipment, disposal, and services necessary for or incidental to handling/removing obstacles and debris (e.g., boulders, wood pilings) from the dredging area.
9. Excavation cost estimate includes labor, equipment, and materials necessary to excavate targeted sediment via mechanical dredging in the wet, load into scows, and transport scows to the floating work platform for offloading via a long-reach excavator. Volume estimate assumes 3:1 side slopes around the excavation area.
10. Sediment dewatering and stabilization activities include the dewatering and stabilization of material following excavation activities. Dewatering will occur passively at the materials staging area. Stabilization admixture (Portland cement) will be added at ratio of 10% of the volume of material to be stabilized. It is assumed that any water generated in association with sediment management will be treated on site through the temporary water treatment system.
11. Backfill cost estimate includes labor, materials, equipment, and services necessary for, or incidental to, the placement of suitable fill material within the dredged area. The fill material will consist of medium to coarse sand and gravel that is backfilled to pre-construction elevation. Fill placement is assumed to be completed utilizing general construction equipment within containment.
12. Water vessel support cost estimate includes labor and equipment necessary to perform materials handling operations to and from the work site and the off-site Consolidated Edison Company of New York, Inc.'s Astoria facility.
13. Transportation and disposal cost estimate includes labor, equipment, materials, and services required for the transportation and disposal of the dewatered and stabilized excavation material. Assumes in-situ sediment excavation volume increased by 10% by weight to account for stabilizing agents in sediment and a density of 1.5 tons per cubic yard. Cost estimate assumes dewatered sediment will be disposed at a permitted solid waste landfill.
14. Solid waste characterization cost estimate includes the analysis of samples (including, but not limited to, toxicity characteristic leaching procedure metals, polychlorinated biphenyls [PCBs], volatile organic compounds, semivolatile organic compounds, ignitability, reactivity, and corrosivity). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site disposal.
15. Post-construction survey cost estimate includes labor and materials to perform the survey via traditional methods over the remedial area to verify, confirm, and document that removal areas have been restored to pre-construction conditions.
16. Confirmatory sample cost estimate includes the 24-hour rush analysis of samples for PCBs. Costs assume that confirmatory samples would be collected at a frequency of 10 samples per Theissen polygon.
17. Establish institutional controls cost estimate includes legal expenses to institute environmental easements and deed restrictions to control the future development adjacent to the river and use of the river.
18. Administration and engineering cost is equal to 15% of the total capital costs. Cost includes Site Management Plan and Final Engineering Report.
19. Construction management cost is based on an assumed 10% of the total capital costs.
20. Post-construction monitoring and reporting cost estimate includes labor, equipment, and materials necessary to conduct visual inspection and elevation monitoring via traditional surveying method activities and submittal of a summary report. Assumes monitoring will be conducted biennially for the first 5 years and then once every 5 years until year 30. Cost estimate assumes two workers will be required to complete the monitoring activities.
21. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the New York State Department of Environmental Conservation to demonstrate that the institutional controls are being maintained and remain effective, annually for 30 years.
22. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation) in accordance with Office of Solid Waste and Emergency Response Directive 9355.3-20 "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis" (United States Environmental Protection Agency, 1993).

Table B-6
Cost Estimate for Alternative 6
Dredging of Sediments (up to 10.0 feet bss) Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals, Management of Dredged Material, and Backfilling Within Dredged Areas

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Pre-Design Investigation	1	LS	$62,000	$62,000
2	Permits and Approvals	1	LS	$50,000	$50,000
3	Mobilization/Demobilization	1	LS	$435,000	$435,000
4	Construction Support Facilities	1	LS	$182,000	$182,000
5	Floating Work Platform	1	LS	$100,000	$100,000
6	Absorbent Booms/Turbidity Curtains	1	LS	$23,000	$23,000
7	Temporary Water Treatment System	34	WEEKS	$38,000	$1,275,000
8	Debris Removal	0.53	AC	$10,000	$6,000
9	Sediment Excavation and Handling	6,200	CY	$250	$1,550,000
10	Sediment Dewatering and Stabilization				
	Blending Operations	6,200	CY	$30	$186,000
	Stabilization Admixture	930	TON	$115	$107,000
11	Backfill	6,200	CY	$35	$217,000
12	Water Vessel Support	1	LS	$529,000	$529,000
13	Transportation and Disposal - Solid Waste Landfill	10,230	TON	$150	$1,535,000
14	Solid Waste Characterization	21	each	$1,200	$25,200
15	Post-Construction Survey	1	LS	$15,000	$15,000
16	Sampling	1	LS	$21,600	$21,600
				Subtotal Capital Cost	$6,318,800
17				Administration andd Engineering (15%)	$947,820
18				Construction Management (10%)	$631,880
				Contingency (20%)	$1,263,760
				Total Capital Cost	$9,200,000
Operation and Maintenance Costs					
19	None	--	--	--	--
				Subtotal O&M Cost	$0
				Contingency (20%)	$0
				Total O&M Cost	$0
				30-Year Total Present Worth Cost of O&M	$0
				Total Estimated Cost:	**$9,200,000**
				Rounded To:	**$9,200,000**

General Notes:

1. Cost estimate is based on ARCADIS' past experience and vendor estimates using 2012 dollars.
2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services, as such, this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.
3. All costs assume field work to be conducted by non-union labor.

AC = acres
CY = cubic yard
LS = lump sum
O&M = operation and maintenance

Table B-6
Cost Estimate for Alternative 6
Dredging of Sediments (up to 10.0 feet bss) Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals, Management of Dredged Material, and Backfilling Within Dredged Areas

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Assumptions:

1. Pre-design investigation cost estimate includes labor, equipment, materials, subsidence, lodging and oversight to support the design of the remedy:sediment sampling and analysis, one bathymetric survey (pre-excavation), debris survey, and backfill characterization. Cost estimate assumes work to be completed via a barge-mounted rig, which includes vibracore rig operator and crew.
2. Permits and approvals cost estimate includes preparation and procurement of the required permits and approvals from federal, state, and local agencies. Access agreement costs not included.
3. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to excavate and transport excavated sediments off site for treatment/disposal and backfill the dredged areas with suitable fill material. For cost estimating purposes, mobilization/demobilization costs are assumed to be 10% of the capital costs, not including waste transportation and disposal.
4. Construction support facilities cost estimate includes construction of the following: decontamination area (60-foot by 30-foot), consisting of a 12-inch gravel fill layer bermed and sloped to a sump and covered with a 40-mil high-density polyethylene liner and a 6-inch layer of gravel; materials staging area (75-foot by 150-foot), consisting of a 6-inch gravel sub-base and 6-inch asphalt pavement and equipped with a 12-inch berm and sloped to a sump for staging dredged material to facilitate waste characterization sampling and material handling/stabilization; and temporary access roads (up to 200 feet long, 25 feet wide, and 1-foot-thick) constructed of graded and compacted run-of-crusher material. Cost estimate includes all labor, equipment, and materials necessary to construct the support facilities.
5. Floating work platform cost estimate includes labor, equipment, and materials to construct a temporary floating work platform to facilitate the water-based excavation and backfill operations. Assumes structure will consist of flexi-floats and piles.
6. Absorbent booms/turbidity curtains includes all labor, equipment, and materials necessary to construct and maintain absorbent booms/turbidity curtains around the active work area. Cost assumes 50% replacement of absorbent booms during construction.
7. Temporary water treatment system cost estimate includes installation and operation of a temporary water treatment system. Cost estimate assumes water treatment system includes pumps, influent piping and hoses, frac tanks, carbon filters, bag filters, discharge piping and hoses, and flow meter. Cost estimate assumes bag filters will require change out approximately once per day of operation. Estimate assumes treated water would be discharged under a State Pollutant Discharge Elimination System permit equivalent at no additional cost.
8. Debris removal includes labor, materials, equipment, disposal, and services necessary for or incidental to handling/removing obstacles and debris (e.g., boulders, wood pilings) from the dredging area.
9. Excavation cost estimate includes labor, equipment, and materials necessary to excavate targeted sediment via mechanical dredging in the wet, load into scows, and transport scows to the floating work platform for offloading via a long-reach excavator. Volume estimate assumes 3:1 side slopes around the excavation area.
10. Sediment dewatering and stabilization activities includes the dewatering and stabilization of material following excavation activities. Dewatering will occur passively at the materials staging area. Stabilization admixture (Portland cement) will be added at ratio of 10% of the volume of material to be stabilized. It is assumed that any water generated in association with sediment management will be treated on site through the temporary water treatment system.
11. Backfill cost estimate includes labor, materials, equipment, and services necessary for or incidental to the placement of suitable fill material within the dredged area. The fill material will consist of medium to coarse sand and gravel that is backfilled to pre-construction elevation. Fill placement is assumed to be completed utilizing general construction equipment within containment.
12. Water vessel support cost estimate includes labor and equipment necessary to perform materials handling operations to and from the work site and the off-site Consolidated Edison Company of New York, Inc.'s Astoria facility.
13. Transportation and disposal cost estimate includes labor, equipment, materials, and services required for the transportation and disposal of the dewatered and stabilized excavation material. Assumes in-situ sediment excavation volume increased by 10% by weight to account for stabilizing agents in sediment and a density of 1.5 tons per cubic yard. Cost estimate assumes dewatered sediment will be disposed at a permitted solid waste landfill.
14. Solid waste characterization cost estimate includes the analysis of samples (including, but not limited to, toxicity leaching characterization procedure metals, polychlorinated biphenyls [PCBs], volatile organic compounds, semivolatile organic compounds, ignitability, reactivity, and corrosivity). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site disposal.
15. Post-construction survey cost estimate includes labor and materials to perform survey via traditional methods over remedial area to verify, confirm, and document removal areas have been restored to pre-construction conditions.
16. Allowance for pre- or post-remediation samples for PCB analysis at a frequency of 10 samples per Theissen polygon. Cost esimate includes 24-hour rush analysis of samples for PCBs.
17. Administration and engineering cost is equal to 15% of the total capital costs. Cost includes Site Management Plan and Final Engineering Report.
18. Construction management cost is based on an assumed 10% of the total capital costs.

Table B-7
Summary of Alternatives

Feasibility Study Report
Flushing Industrial Park - Operable Unit 2
Consolidated Edison Company of New York, Inc.

Remedial Alternative	Description	Approximate Remediation Area, Square Feet (Acres)	Approximate Dredge Volume (with slope back), Cubic Yards	Capital	O&M	Total
1	No Action	-	-	$ -	$ -	$ -
2	MNR of Sediments Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals and Institutional Controls	-	-	$ 150,000	$ 400,000	$ 550,000
3	Capping of Sediments Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals and Institutional Controls	12,400 (0.29)	-	$ 2,600,000	$ 600,000	$ 3,200,000
4	Dredging of Sediments (up to 5.0 feet bss) Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals, Management of Dredged Material, Backfilling Within Dredged Areas, and Institutional Controls	16,700 (0.39)	2,600	$ 4,400,000	$ 300,000	$ 4,700,000
5	Dredging of Sediments (up to 5.0 feet bss) Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals, Management of Dredged Material, Backfilling Within Dredged Areas, and Institutional Controls	16,700 (0.39)	2,600	$ 4,800,000	$ 300,000	$ 5,100,000
6	Dredging of Sediments (up to 10.0 feet bss) Containing Site-Related PCBs Greater Than the Sediment Clean-Up Goals, Management of Dredged Material, and Backfilling Within Dredged Areas	23,000 (0.53)	6,200	$ 9,200,000	$ -	$ 9,200,000

Notes:

1. Assumed slopes of 3:1 were used to determine the approximate dredge volume with slope backs to maintain excavation stability.

bss = below sediment surface
mg/kg = milligrams per kilogram
O&M = operation and maintenance
PCB = polychlorinated biphenyl

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Appendix C

Preliminary Schedule

Preliminary Schedule

Remediation - Flushing Industrial Park [OU-2]

Order on Consent No. W2-1174-07-02

Site No. - C241078A

Activity	Task	Anticipated Start Date	Duration
Pre-Design Investigation	Scoping	August 1, 2013	2 months
	Fieldwork	November 1, 2013	1 month
Remedial Design (including DEC and internal reviews)		September 2, 2013	6 months
Permitting & Access Agreements		December 2, 2013	3 months
Contractor	Preparation of Bid Package	March 1, 2014	2 months
	Procurement	May 1, 2014	8 months
	Award of Contract	January 1, 2015	--
	Submittals	February 15, 2015	3 months
Remediation		May 15, 2015	6 months
Overall Remediation Schedule		**August 1, 2013**	**November 15, 2015**
Post-Remediation Submittals	Site Management Plan	March 15, 2016	--
	Final Engineering Report	April 15, 2016	--

Note:

1. This schedule is tentative and subject to change due to numerous considerations including access, permitting, NYSDEC document reviews, procurement, contactor avilability, and other potential unforseen circumstances.