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RIWP_Phase 1

GEI Consultants

Geotechnical
Environmental
Water Resources
Ecological

Remedial Investigation Work Plan
Phase 1
Greenpoint Energy Center
Former Manufactured Gas Plant Site

287 Maspeth Avenue
Brooklyn, New York 11211
ACO Index No. A2-0552-0606
Site #224052

Submitted to:
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Project #093260

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must include schedule for FS: 6 mos after RI Rpt Approval

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Abbreviations and Acronyms

ASTM	American Society for Testing and Materials
AWQS	Ambient Water Quality Standards
bgs	Below ground surface
bml	Below mud line
BUG	Brooklyn Union Gas
BTU	British Thermal Unit
CAMP	Community Air Monitoring Program
cf/d	Cubic feet per day
CGI	Combustible Gas Indicator
DER-10	NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation
CLP	Contract Laboratory Program
COCs	Chain Of Custody
COPCs	Contaminants of Potential Concern
DNAPL	Dense Non-Aqueous Phase Liquid
DRO	Diesel Range Organic
DUSRs	Data Usability Summary Report
EDR	Environmental Data Resources
EEA	EEA, Inc.
ELAP	Environmental Laboratory Accreditation Program
ERM	Effects-Range Median Screening Level
ESI	Environmental Subsurface Investigation
FP&M	Fanning, Phillips & Molnar
FSP	Field Sampling Plan
ft	Foot or feet
ft bgs	Feet below ground surface
ft bml	Feet below mud line
FWIA	Fish and Wildlife Impact Analysis
GEI	GEI Consultants, Inc.
GFE	Gannett Fleming Engineers, P.C.
GTI	Groundwater Technology, Inc.
HASP	Health and Safety Plan
HDPE	High Density Polyethylene
HHRA	Human Health Risk Assessment
IDW	Investigation Derived Waste

Abbreviations and Acronyms (continued)

IRM	Interim Remedial Action
LNAPL	Light non-aqueous phase liquid
LNG	Liquefied Natural Gas
LP	Liquid Petroleum
MGP	Manufactured Gas Plant
mg/kg	Milligrams per Kilogram
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAPL	Non-aqueous Phase Liquid
NAD 83	North American Datum 1983
NAVD 88	North American Vertical Datum 1988
NTU	Nephelometric Turbidity Units
NYSDEC	New York State Department of Environmental Conservation
OM&M	Operations Monitoring & Maintenance Plan
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PDI	Pre-Design Investigation
PID	Photoionization Detector
ppm	Parts per Million
PS&S	Paulus Sokolowski and Sartor Engineering, P.C.
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance and Quality Control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RIWP	Remedial Investigation Work Plan
SCO	NYSDEC Subpart 375-6.8 Restricted Use Soil Cleanup Objectives
SIM	Selective Ion Monitoring
SNG	Substitute Natural Gas
SPT	Standard Penetration Test
SVI	Soil-Vapor Intrusion
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TCE	Trichloroethene
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon

Abbreviations and Acronyms (continued)

URS	URS Corporation
USCG	United States Coast Guard
USDOT	United States Department of Transportation
USEPA	Unites States Environmental Protection Agency
UST	Underground Storage Tank
VHB	Vanasse Hangen Brustlin, Inc.
VOC	Volatile Organic Compound

1. Introduction

On behalf of National Grid Corporation (National Grid), GEI Consultants, Inc. (GEI) has prepared this Remedial Investigation Work Plan (RIWP) for the Greenpoint Energy Center Former Manufactured Gas Plant (MGP) site, coking plant, and other historical gas production facilities (Site) located in the Greenpoint neighborhood of Brooklyn, New York. This RIWP was prepared in general accordance with the requirements of the:

- New York State Department of Environmental Conservation (NYSDEC) Division of Environment Remediation *DER-10/ Technical Guidance for Site Investigation and Remediation* (issued May 3, 2010)
- Site Characterization and Remedial Investigation Work Plan Requirements detailed in Exhibits G and H of the Order on Consent and Administrative Settlement for Multiple Sites (The Order, dated March 4, 2007)
- Modification to the Order (dated May 27, 2008).

The purpose of the RIWP is to describe the methods and procedures to be implemented in performing the Remedial Investigation (RI). As agreed upon in a meeting with the NYSDEC Project Manager on June 9, 2011, the RI will be accomplished in three phases addressing Areas of Interest in order of priority. This RIWP presents a detailed scope of work for Phase 1 of the RI. Separate RIWPs will be submitted to NYSDEC for Phases 2 and 3 of the RI. The scopes of work for Phases 2 and 3 will be developed based on historical plant documents and modified based on the findings in each previous phase. In addition, investigation activities may be conducted in areas out of sequence to support capital improvement projects. Plate 1 presents a site plan with historical operation features. Plate 2 shows locations of previous investigations and planned locations of each phase. Descriptions of the Phase 1 investigation areas are provided in Subsection 2.3, Areas of Interest and investigation sequencing is presented in Plate 3.

This RIWP provides the specific scope of work for Phase 1 of the remedial investigation, but also addresses the field investigation procedures that are applicable to all RI phases. As noted, separate RI work plans will be submitted addressing Phase 2 and 3 RI scopes of work.

The overall objectives of all phases of the Remedial Investigation include:

- Evaluation of potential source areas related to former operations at the Site and current and former operations adjacent to the energy facility that may have potentially impacted the Site.
- Evaluate the necessity and potential efficacy of an Interim Remedial Measure (IRM) along the bulkhead.
- Investigating and evaluating the potential need for remediation at the proposed Maspeth Regulator Station area scheduled for capital improvement in 2012.
- Perform a structures soil vapor survey in accordance with NYSDOH Guidance for Evaluating Soil Vapor in the State of New York.
- Determination of the nature and extent of any identified contamination.
- Identification of potential pathways of contaminant migration and possible receptors.
- Characterization and identification of potential contaminant sources.
- Development of an environmental and qualitative human health risk assessment.

In accordance with DER-10 requirements, the RIWP is organized according to the following sections. The content of each section is in general conformance with the requirements of DER-10.

- Section 1: Introduction
- Section 2: Site Background
- Section 3: Scope of Work
- Section 4: RI Report Preparation
- Section 5: Schedule
- Section 6: Project Team
- Section 7: References.

The appendices to the RIWP contain site-related documents and photographs, available environmental investigation reports, environmental records, a field sampling plan (FSP), a quality assurance project plan (QAPP), a site-specific health and safety plan (HASP), and a community air monitoring program (CAMP). A Citizen Participation Plan will be developed for the Site by National Grid and is not a part of this RIWP.

The approximate schedule for the site-wide remedial investigation program and report preparation is as follows:

- RI Phase 1: 1st quarter of 2012 through 2012
- RI Phase 2: 2012 through 2013
- RI Phase 3: 2013 through 2014
- RI Report Preparation: 2014 through 2015.

2. Site Background

2.1 Site Description

The Site is currently a liquefied natural gas (LNG) facility located in the Greenpoint neighborhood of Brooklyn, New York (Figure 1). The Site has been used for industrial purposes throughout a history dating to at least 1888 and generally has included the following operations.

Approximate Timeframe	Operations
Ca. 1888 – pre-1927	Glass company and glue factory
1927 - 1952	MGP water gas plant
1928 - 1952	Coke oven gas plant
1952	Water gas Plant converted to Oil Gas; Coke ovens decommissioned
1968 - Present	LNG facility
1973 - 1989	SNG Plant

The Site occupies Tax Block 2837; Lot 1 comprised of approximately 117 acres and is bounded on the south by Maspeth Avenue, on the west by Vandervoort and Porter Avenues, on the north by Division Place and Lombardy Street, and on the east by Newtown Creek. The area surrounding the Site is predominantly industrial and manufacturing, with some commercial, and residential buildings to the northwest (Figure 2). The Site is generally flat, with a ground surface elevation between approximately 10 and 20 feet (ft) referenced to North American Vertical Datum of 1988 (NAVD88), except for the northwestern portion of the Site which rises to approximately elevation (El.) 65 ft. The Site is divided internally into two major operational areas: the LNG facility occupying the general northern half of the Site, and gas transmission and operations support facilities in the southern half of the Site. The entire Site is fenced along its perimeter with the LNG facility fenced internally, separating it from the operations area. The Site operates 24-hours per day with full-time site-wide security.

The Site is adjacent to Newtown Creek, a federal Superfund site. An RI focused on the creek is being conducted by ExxonMobil, BP, Texaco, Phelps Dodge, NYC and National Grid under the oversight of the United States Environmental Protection Agency (USEPA). This RI is studying Newtown Creek from bank to bank and the surficial and sediments along the creek as well as the entire length of the creek which is 3.8 miles and includes Dutch Kills, Maspeth Creek, Whale Creek, East Branch, and English Kills. Throughout its industrialized history, more than 50 industrial facilities were located along Newtown Creek, including oil refineries, petrochemical

plants, fertilizer and glue factories, sawmills, and lumber and coal yards. During this time the creek was crowded with commercial vessels, including large boats bringing in raw materials and fuel and taking out oil, chemicals, finished products, and metals. In addition to the impacts that resulted from all of this activity, the City of New York dumped raw sewage directly into the water beginning in 1856 and continues to discharge urban stormwater runoff into the creek.

Various sediment and surface water samples have been taken along the creek during the past 30 years or so by a number of parties. Petroleum hydrocarbons, pesticides, metals, PCBs, volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) have been detected in one or more samples. According to the USEPA, the variety and distribution of the detected contaminants suggests that they originated from a variety of sources. Environmental and analytical chemistry can be used to identify the origin of these chemicals.

Hydrocarbons are one group of chemicals found in Newtown Creek. Crude petroleum, its refined products, coal, coal tar and coal tar products, as well as the products of incomplete combustion consist primarily of hydrocarbons. In environmental chemistry and geochemistry, hydrocarbons are placed in subgroups according to their origins. These groups include diagenic, or recently produced; petrogenic, produced at relatively low temperatures over long periods of time; and pyrogenic, produced at high temperatures with a shortage of oxygen. Petrogenic hydrocarbons are those found in crude oil, coal and their refined products. Pyrogenic hydrocarbons are those found in coal tar and related substances, and from the incomplete combustion of organic matter. The concentrations and distributions of individual compounds in specific petrogenic and pyrogenic substances vary, and can be used to identify the source of those substances.

The oil refineries, petrochemical plants, fertilizer and glue factories, coal yards, and other industrial and urban discharges are all potential, and in some cases substantial sources of both petrogenic and pyrogenic hydrocarbons (as well as other types of chemicals).

Figure 2 shows the surrounding land use and location of sensitive human and ecological receptors (residential areas, schools, parks, public places and wetlands) within a half mile radius of the Site boundary.

2.2 Site History

The Site was owned and operated by Brooklyn Union Gas (BUG, a predecessor company of National Grid) through most of the 20th century, except for a period of years when the coke oven gas plant was operated by Koppers. GEI has performed a historical record review for the Site which included Sanborn Fire Insurance (Sanborn) maps, old plant drawings, Brown's Directories

of American Gas Companies, aerial photographs, BUG annual reports and early Reports to the New York Public Service Commission from BUG. Based on the records review, the following is a general description of the Site development and history.

Prior to the purchase of the property by BUG, the Site contained two other industries in the late 1800s. Peter Cooper, a major New York industrialist, built a glue factory on Maspeth Avenue near Newtown Creek prior to 1865. It appears on both the 1888 and 1907 Sanborn maps. The Peter Cooper Glue Factory was noted to be the largest in the country in the mid 1800s. To the north of the glue factory was the Demuth Glass Manufacturing Company near Lombardy Street and Newtown Creek. It appears on the 1888 Sanborn map.

During the late 1880s, the shoreline of the Site was different than existed when the facility was built in the 1920s. Newtown Creek to the east consisted of two channels that wrapped around an island, named Mussel Island. There was also a drainage feature from the central part of the Site which flowed south into what is now the English Kills channel of Newtown Creek. Both the original pre-1900 creek channel to the east and the drainage to the south may have some bearing on the groundwater flow regime at the Site today. By 1925 both of these features were eliminated, i.e., Mussel Island and the channel between the island and the mainland were filled and made part of the Site when a bulkhead system (relieving platform) was constructed and the southern drainage feature was filled in. Plate 1 shows the location of Mussel Island.

Gas was manufactured at the Site over a 62 year period between 1927 and 1989. During that time, gas was made using the carbureted water gas, coke oven gas, oil gas, liquid petroleum (LP) gas, propane air gas, substitute natural gas (a naphtha conversion), and refinery air gas processes in different time frames and stages. When the first plant was built in 1927 (discussed in further detail below), carbureted water gas production was 20 million cubic feet per day (cf/d). Peak production from manufactured gas occurred in 1947 when approximately 98 million cf/d was being manufactured using six different processes. As natural gas was brought into Brooklyn in the early 1950s the original water gas and coke oven plants were retired and demolished. Some of the other processes, i.e. LP, oil gas and refinery gas, were used only for standby purposes. By the late 1960s LNG was stored at the Site and in the mid 1970s a modern substitute natural gas (SNG) plant was built which produced 60 million cf/d. The SNG was used for base load conditions. It operated for approximately 15 years before it was shut down in 1989, due mainly to economical reasons. The LNG facility still stands today and the Site is used as a major regional regulator station for the natural gas network.

Constrnction started on the water gas plant in 1925 and by 1927 the plant was operational as was the first of two large waterless (tar-seal) gas holders in the southwest corner of the Site. The 15 million cf gas holder, at the time, was one of the largest in the world measuring 254 ft in

diameter and over 330 ft tall. This distribution gas holder and eventually a second 17 million cf waterless gas holder built in 1949, made up what was called the Maspeth Station. The water gas plant included a boiler house separate from the generator house. Coal used to fire the boilers and provide fuel for the water gas generators was brought in by ships that were docked along the bulkhead on the creek. A large coal and coke storage yard separated the gas generator building from the creek by a distance of over 625 ft. The relief holder for the water gas plant held 1 million cf of gas and was located directly to the west of the generator house. The purifiers were situated well to the west of the generator house on the other side of Varick Avenue, a plant road that ran north to south through the center of the Site. The tar separator, tar pump house and storage tanks were placed to the north of the generator house. Carburetion oil tanks were located on Varick Avenue.

A year after the water gas plant was built, the Koppers coke oven gas plant and by-product plant were built and operational. The coke plant was adjacent to and south of the water gas plant. The by-product plant was south of the coke oven batteries and close to Maspeth Avenue. The coke plant had two batteries of 25 ovens each along with all the ancillary facilities, i.e. quenching tower, gas coolers, gas scrubbers, coke sizing mill, and related facilities. A separate producer gas plant which provided another source of raw gas to the coke ovens was built between the boiler house of the water gas plant and the coke plant. It had its own 40,000 cf relief holder, gas scrubbing and condensing facility. The by-product plant contained ammonia liquor tanks, tar storage tanks, ammonia coolers, and related facilities. A salt water pump house, designed to withdraw water from Newtown Creek, was located where Maspeth Avenue met Newtown Creek. A 1933 photograph of the Greenpoint Works and the Koppers Coke Oven gas plant, presented in Appendix B, Aerial Photographs shows most of the unit operations listed above.

The gas works at the Site remained with the same configuration through the 1930s, then in 1941, at the start of World War II, a light oil plant was built adjacent and to the west of the by-product plant. As with other light oil plants around the country at the time, it produced ingredients for the manufacture of munitions. The by-products and light oil plants remained at the site until 1952 when the coke plant was decommissioned. The next significant change to the gas works began in 1945 when the water gas plant was fitted to manufacture gas from heavy oil. Over a five year period ending in 1950 the heavy oil plant gradually replaced the water gas sets with oil gas generators. Along with this a number of ancillary facilities were built which included additional tar storage tanks, tar emulsion containment areas, a tar dehydrator facility, an oil storage tank farm, a conveyance system to off-load heavy oil from tankers docked on the north end of the Newtown Creek bulkhead and to pump tar into barges for processing off Site.

The exact amount of tar produced at the Site can only be estimated, but based on data reported to the Public Service Commission in 1950, the combined gas plants probably produced close to 20

million gallons of tar in that year, of which approximately 40 percent was used as on-site boiler fuel. The remaining tar was shipped off Site. After 1950 with the introduction of natural gas and LNG, the use of coal and oil to manufacture gas was shortly eliminated.

Some of the operations at the Site used a number of feedstock materials (e.g., coal and oil) and generated a variety of products and byproducts; some of these materials were petrogenic in nature and some pyrogenic. Given the number and nature of other commercial and industrial operations (i.e., oil refineries, petrochemical plants, coal yards, scrap yards, service stations, and other industrial and general urban sources) in the immediate vicinity of the Site, it is expected that hydrocarbons and other chemicals from many or all of these sources have impacted Newtown Creek and possibly the Site itself.

2.3 Areas of Interest

The following section describes areas of interest for investigation based on an evaluation of the operating footprint and structures related to the MGP, coking operation, and other gas production facilities formerly located at the Site. As discussed in Section 1, the investigation has been divided into three phases based on priority.

The following discussion is divided into Areas of Interest that will be evaluated during Phase 1 of the Remedial Investigation. However, due to Site Operations needs two borings and monitoring wells planned for the Phase I investigation were installed in November 2011. One boring and monitoring well were installed approximately 70 ft east of the Fleet Transportation building in the area of a proposed UST installation (Area of Interest 1). A boring and a shallow monitoring well were required to evaluate subsurface conditions related to excavation and water quality for dewatering discharge permitting. Also, a boring and shallow monitoring well were installed at the location of a planned gas regulator station (Area of Interest 3). The area is targeted for construction in early 2012 and the boring and the monitoring well were installed to assure that the area was delineated prior to construction.

The boring at the UST area was installed to 83 ft below ground surface (bgs), and the boring at the planned regulator station was installed to 75 ft bgs. No visual impacts were observed at either drilling location. Soil and groundwater quality testing are underway.

Proposed investigation procedures outlined in this RIWP were followed during the boring and monitoring well installations. Plate 3 presents the location and sequence of intended investigation for each area of interest.

Area of Interest 1

Area of Interest 1 (Area 1) of Phase 1 of the RI covers an area approximately 350 ft by 320 ft at the southeast corner of the Site adjacent to and inland of the Newtown Creek bulkhead. This area was first designated due to an observation of dense non-aqueous phase liquid (DNAPL) found in monitoring well MW-01, its proximity to Newtown Creek, and potential relationship to the former light oil plant operations. Historically, Area 1 was an open yard between the coke by-product plant and the pier line where coal and coke freighters docked. The closest historical strnctures include the tar storage tanks on the northeast side of the by-product building and the former light oil plant. These tanks existed for about 30 years when they were retired with the by-product building in 1957. Also nearby are underground gasoline and diesel tanks that are currently in use, located on the south and east side of the transportation building.

Borings/monitoring wells will be installed in the monitoring well MW-01 area to further delineate subsurface conditions related to DNAPL observed in the well. Subsurface piping within Area 1 related to the historical development of the Site will also be evaluated to determine whether the piping potentially influences the extent and migration of any observed impacts; this will include the review of related drawings/documents and the installation of test pits, as appropriate.

It is important to note that each of the processes or materials, such as DNAPL, gasoline, coal, and light oil, have physical and chemical characteristics that can be generally described, and specific signatures that can be determined by chemical analysis. This RIWP includes sampling and analyses to aid in identifying and classifying potential sources of hydrocarbons at the Site and discriminate them from the many nearby sources.

Area of Interest 2

Area of Interest 2 (Area 2) consists of the portion of land north of Area 1 inland from the bulkhead approximately 150 ft, extending north to Lombardy Street. Historically, much of this area was part of the creek channel before it was filled in 1928 by Brooklyn Union Gas just after the construction of the Koppers Coal Gas Plant. As the gas works became operational, this area was used primarily for coal and ash storage. Coal was delivered by ship and off loaded into a coal yard. Substantial volumes of coal were brought into the plant to fuel the water gas generators, the producer gas plant and the coke ovens.

In 1945 the water gas plant began conversion from carbureted water gas to heavy oil gas. In 1946 a barge loading facility for tar was built at the northern end of the pier line just south of Lombardy Street. Pipelines either fed oil from tankers docked at the bulkhead to the tank farms located in the center of the Site on Varick Avenue or they were used to pump by-products (tars and light oil) into barges and shipped off Site for processing.

Borings/monitoring wells will be installed along the bulkhead to supplement existing borings/monitoring wells to further delineate subsurface conditions. Subsurface piping within Area 2 related to the historical development of the Site will be evaluated to determine whether the piping potentially influences the extent and migration of any observed impacts; this will include the review of related drawings/documents and the installation of test pits, as appropriate.

Area of Interest 3

As discussed above, Phase 1work in this area has been completed.

2.4 Local Environment

The surficial geology of the Site is characterized as the Raritan Formation, Upper Cretaceous period and is a part of the coastal plain sediment deposits. These deposits are underlain by glacial till and outwash deposits. The surficial geology underlying the Site is described as Quaternary till deposits of variable texture. The till was generally deposited beneath glacial ice and consists of variable textured material (clay, silt-clay, boulder clay) (Surficial Geologic Map of New York, Lower Hudson Sheet (1989), *The State Education Department, University of the State of New York, Compiled by Donald H. Cadwell*).

The Gardiners Clay underlies the glacial deposits. The Jameco Gravel underlies the Gardiners Clay. Drinking water is supplied by the New York City (NYC) aqueduct system (which receives water from upstate New York) and is the sole source of drinking water within a 3-mile radius of the Site.

Site geology and hydrogeology have been evaluated based on research and results from previous investigations.

2.4.1 Site Geology

The geology of the Site consists of approximately 200 ft of overburden underlain by bedrock. Site geology has been investigated to a limited extent as part of the IRM pre-design program (discussed below), which included soil borings, groundwater sampling and testing, and groundwater elevation gauging.

Overburden has been observed to consist of, in order of increasing depth:

- Fill and recent sand deposits
- Drumlin or Moraine deposits (northwest corner of Site)
- Marsh deposits (along Newtown Creek and English Kills)

- Glacial outwash sands with discontinuous silt and till lenses
- Gardiner's Clay
- Deep sand.

The Site is generally flat, with a ground surface between approximately El.10 and 20 ft NAVD88, except for the northwestern portion of the Site which rises to approximately El.65 ft. The observed thickness of the fill ranges from about 30 to 40 ft along Newtown Creek, and 10 to 15 ft inland. Native sand was observed beneath the fill in some locations.
Marsh deposits consisting of peat, silt, and clay are located within the footprint of the former tidal marsh adjacent to Newtown Creek and English Kills. Because higher groundwater potentiometric elevations appear to be associated with thicker marsh deposits, marsh deposit thicknesses are described by location:

- Along Newtown Creek near the LNG process area, 15 to 45 ft thick.
- Along Newtown Creek near the former MGP process area, 5 to 10 ft thick
- Along Maspeth Ave. west of the Transportation Building, 10 to greater than 45 ft thick
- Along Maspeth Ave. east of the Transportation Building, marsh deposits were generally not observed.

Glacial outwash is present throughout the Site, with measured thicknesses of 50 to 70 ft. The glacial outwash was observed to consist of sand, silty sand, and gravel, with occasional gravel seams. The glacial outwash is underlain by the Gardiner's Clay, observed on Site to be comprised of silty sand and clay with thicknesses ranging from 5 to at least 15 ft. The Site is at the northern extent of the Gardiner's Clay as mapped by USGS (USGS, 1986), which may explain the minimal thickness and low clay content observed in some locations. The deep sand unit located beneath the Gardiner's Clay may be related to the Jameco Gravel aquifer; however, the northern extent of the Jameco Gravel as mapped by USGS is about a mile south of the Site. The Fordham Gneiss bedrock was encountered once at 116 ft bgs in a boring installed by GEI along Maspeth Avenue. A historical investigation indicates the depth of bedrock at about 132 to 185 ft bgs in the northern part of the Site. The regional USGS bedrock surface map shows bedrock surface dipping downward from northwest to southeast at about 100 vertical feet per 1.5 miles.

2.4.2 Site Hydrogeology

Two regional aquifers are present in the area of the Site: the Upper Glacial Aquifer and the Jameco Aquifer. The Upper Glacial Aquifer is unconfined, and includes ground water within the fill, marsh deposits, and glacial outwash units. Ground water in the Upper Glacial Aquifer generally flows southwesterly toward New York Harbor, but locally converges toward the area of Newtown Creek [USGS, 1997]. The Jameco Gravel is a confined or semi-confined aquifer,

generally located beneath the Gardiner's Clay. The Site is located about a mile north of the mapped extent of the Jameco Gravel; however, sand present beneath the Gardiner's Clay on Site may be connected to the Jameco Aquifer.

Groundwater elevation measurements were taken during the Pre-Design Investigation (PDI) in 2009 and 2010. For purposes of this investigation, the Upper Glacial Aquifer has been subdivided into shallow, intermediate, and deep groundwater zones to evaluate the relationships between potentially different flow regimes within the aquifer.

The water table was measured to range from approximately 5 to 10 ft bgs on most of the Site, to a maximum observed depth of 60 ft bgs beneath the hill in the northwest corner of the Site. The water table is part of the Upper Glacial Aquifer. The water table was measured to be highest in the south-central portion of the Site east of Varick Avenue, where ground water appears to be mounded (perched) over the marsh deposits described above. The shallow-zone flow direction was observed to be northeasterly (toward Newtown Creek) except within the LNG process area, where flow was observed to be southwesterly, away from the creek.

Groundwater flow direction within the intermediate zone was observed on Site to be southerly toward Maspeth Avenue and English Kills. However, ground water within the intermediate zone at the adjacent BCF Oil site, south of Maspeth Avenue, was observed to be northerly, toward the Site, suggesting possible convergence of flow along Maspeth Avenue. Comparison of shallow and intermediate zone potentiometric surfaces suggests a downward gradient at inland portions of the Site, and an upward gradient along Newtown Creek.

Deep zone groundwater measurements were limited to the former MGP process area, as deep well installation was limited to this area. Where measured, ground water within the deep zone was observed on Site to be southeasterly toward the confluence of English Kills and Newtown Creek. Deep zone potentiometric elevations and gradients were similar to those measured in the intermediate zone, indicating a similar flow regime within these two depth zones within the former MGP process area.

Tidal response was measured by continuous electronic gauging in several on-site monitoring wells along Newtown Creek and Maspeth Ave. The measured tidal fluctuation was 4 to 5 ft during the tidal response monitoring. The greatest response to tidal fluctuation was measured along Newtown Creek near the former MGP process area, where ground water was measured to fluctuate from 2 to 3 ft in two intermediate zone wells, and 1.4 ft in a deep zone well. Lesser fluctuations were observed along the creek closer to the LNG process area, suggesting lesser connectivity due to lower-permeability soil. Minimal tidal response (0.03 to 0.2 ft) was observed

in shallow wells along Maspeth Avenue, suggesting minimal tidal influencing extending along utilities within the street.

Shallow zone monitoring wells were installed adjacent to major storm drain lines at two locations to assess potential drawdown associated with utilities along Maspeth Avenue and within the former MGP process area. No significant drawdown in the water table was apparent in the utility corridors, indicating that the utility corridors in these areas are not preferential drainage paths for ground water.

2.5 Supplemental Document Review

The initial effort of the investigation has involved collecting and reviewing background information to supplement the existing historical information utilized to prepare this RI scope of work. This background information has aided in focusing the field investigation, particularly with respect to determining potential source areas. The following is a list of sources of information and investigation techniques that have been utilized in order to better understand the Site history and to identify potential areas of environmental concern.

- Prior environmental studies/reports
- Local agency files
- State and federal environmental databases
- Interviews with past/present property owners/operators
- Interviews with representatives of Greenpoint Energy Center
- Historical aerial photographs
- Site plans and construction drawings
- Historical Sanborn maps
- Historical BUG information available from Greenpoint Energy Center files.

2.5.1 Environmental Records Information Summary

GEI completed a search of environmental records for the Site as part of the preparation of this RIWP. An Environmental Data Resources (EDR) report has been compiled for the Site and is provided in Appendix B. A search of the NYSDEC spill incidents and environmental site remediation databases was conducted by GEI on July 12, 2011. The following environmental records were found for the Site.

NYSDEC Environmental Site Remediation Database Search

The Site has two records in the NYSDEC Environmental Site Remediation Database. The first record provides the Site Code 224052 under the State Superfund Program, Classification 02. The record mentions a preliminary investigation report submitted to NYSDEC in June 2004 for the northeast corner of the Site, which is a part of the newly built gas liquefaction plant. According to the first record, impacts were observed across the plant area predominantly in the shallow depths and a few soil samples have exceeded applicable standards for semivolatile organic compounds (SVOCs), namely naphthalene, benzo(a)pyrene, and benzo(a)anthracene.

The second Environmental Site Remediation Database record refers to the LNG Expansion IRM as the Site Code V00631 under Voluntary Cleanup Program, Classification A. The record contains information about the LNG site characterization in June 2006 and April 2007, as well as the Remedial Action dated June 2006.

NYSDEC Spill incident Database Search

There have been 19 spills registered from January 1978 through June 2011, which are reported in the NYSDEC Spill Incident Database for the Site. Most spills at the Site were either gasoline or diesel and the reported quantities varied from 1 to 200 gallons (some spills do not have amounts listed). Only one spill is reported to have affected ground water and none – surface water. All the spills reported for the Site are closed.

There have been over 50 spills at the properties adjacent to the Site registered from January 1978 through June 2011, some of which have resulted in spillage to the surface water, namely English Kills. Materials spilled off Site included #2 and #4 fuel oils, waste oil, gasoline, diesel, dielectric fluid and unknown petroleum, and other fluids. Some of the spills reported for the properties within one block of the Site have not been closed as indicated by the NYSDEC spill incident database.

2.5.2 Previous Investigations

A limited number of environmental investigations have been performed at the Site to-date and they largely were limited in area and scope. Such investigations originated starting in 1979, prior to that the investigations were geotechnical in nature and intended to support the facility construction. Below is a summary of the environmental Site investigation reports which were available for review.

Brooklyn Union Gas Naphtha Study Boring Results, Brooklyn Union Gas Company, February 1979

Starting in January 1979, BUG, at the request of the United States Coast Guard (USCG), drilled soil borings in the Naphtha Tank Farm Area in the north-west part of the Site. These borings assisted the USCG in defining the extent of an underlying hydrocarbon deposit located in the Greenpoint area of Brooklyn. The study was prompted by the USCG observation of large quantities of oil in Newtown Creek on September 2, 1978 and the fact that the BUG Site hosted oil and gas operations and was situated along Newtown Creek less than a half- mile away from the location of observed oil seepage at the foot of Meeker Street. Ultimately, as described below (Geraghty and Miller investigation), it was concluded the observed oil seepage was unrelated to BUG and the Site.

A total of 17 borings were drilled at the Naphtha Tank Farm Area. The investigation targeted the depth interval at and slightly below the water table. All borings were installed utilizing hollow stem augers. When the water table was encountered, a well with a 10 ft screen was installed. No contaminants were found in either the water or the soil samples taken from the available test points in the Naphtha Tank Farm Area. The samples were examined by both BUG and the USCG. The boring locations are shown in Plate 2.

Investigation of Underground Accumulation of Hydrocarbons along Newtown Creek, Brooklyn, New York. Geraghty and Miller, Inc., July 1979

The report summarizes the results of a study carried out by Geraghty and Miller on behalf of the USCG which investigated a large accumulation of hydrocarbons in the subsurface of Brooklyn, New York. The investigation began in September 1978 and continued until June 1979. The horizontal and vertical extent of the petroleum product was mapped through installation of test borings and collection of field measurements. The t Site was one of the facilities under investigation. The other possible sources of hydrocarbon accumulation were thought to be oil terminals, and pipelines which are present throughout the area.

A total of six borings were installed around the tank farm in the north-west part of the property and one additional boring along Lombardy Street at the foot of Stewart Avenue to a depth of up to 53 ft bgs. According to the report, no traces of hydrocarbons were found in any of the soil or water samples collected from the wells installed at the boring locations. Based on these results, Geraghty and Miller concluded that the spill did not originate at the Site. The boring locations are shown in Plate 2.

Ground-Water Contingency Plan for the Brooklyn Union Gas Company Petroleum Bulk Storage Facility, Roux Associates, 1990

Roux Associates was retained by BUG in June 1989 to install and sample five ground-water monitoring wells at the petroleum bulk storage facility in the north-west part of the Site. The purpose of the monitoring wells was to determine groundwater quality, to determine if any petroleum hydrocarbons were present near above-ground storage tanks, and to monitor for future leaks at the Site.

The five wells were initially sampled in July 1989 and then re-sampled during January 1990 and May 1990. During the July 1989 sampling event, the five wells were sampled for BTEX and petroleum products (i.e., gasoline, kerosene, and fuel oil). During the January sampling event, the five monitoring wells were sampled for BTEX, gasoline, kerosene, fuel oil, and lubrication oil. During the May sampling event, the five monitoring wells were sampled for BTEX and for polycyclic aromatic hydrocarbons (PAH). No above-mentioned constituents were detected during the three sampling events. No free product had been found in the five monitoring wells when measurements were taken by Roux Associates' personnel or during monitoring of the wells for free product by BUG personnel. The boring locations are shown in Plate 2.

Underground Storage Tank Closure Report, Lexicon Environmental Associates, 1993

In July 1993 Lexicon Environmental Associates observed the removal of two 4,000- and two 550-gallon tanks located at the south-west side of the Transportation Building. The 550-gallon tanks were in service from 1959 to 1988 and were only used for gasoline storage. The 4,000-gallon tanks were in service from 1977 to 1993 and were also only used for gasoline storage. The excavation outside of the concrete vaults that housed the 550-gallon tanks exposed contaminated soils that exhibited an odor not characteristic of gasoline-contaminated soils. Five soil samples were collected following the tank removal from depths of between 3 to 45.5 ft bgs, and one soil sample exhibiting the highest field VOC reading was additionally submitted for characterization and identification of potential contaminant sources. All five samples identified the presence of several VOCs in varying quantities. Naphthalene was identified at concentration of 20,000 µg/L in one of the soil samples. A petroleum hydrocarbon analysis obtained from one of the tank pit soil samples did not match gasoline, fuel oil, or diesel fuel reference standard patterns. The peaks identified in the analysis were heavy molecular weight hydrocarbons.

The boring locations are shown in Plate 2.

Underground Storage Tank Groundwater investigation, Fanning, Phillips & Molnar, 1993-1995

Fanning, Phillips & Molnar (FP&M) were retained by BUG to perform an underground storage tank (UST) groundwater investigation following the removal of four USTs located at the south-west side of the Transportation Building in July of 1993. The investigation findings noted:

- USTs tested tight, tank steel in excellent condition
- Regarding the condition of the 550-gallon tank concrete vaults: clean sand backfill, no gasoline contamination evident
- Regarding the condition of the concrete encasing of the 4,000-gallon tanks; no staining
- Soil samples exhibited naphthalene levels not indicative of gasoline.

The NYSDEC required BUG to install groundwater monitoring wells at the southwest UST area based on the levels of hydrocarbons present in soils. Four wells were installed following this request in 1993 and 1994. Free product was encountered in monitoring wells W-1 and W-2 (noted on Plate 2 as 13-GPEC-W-1 and 13-GREC-W-2) one week after development. During drilling of monitoring wells W-3 and W-4, petroleum-contaminated soils were encountered at the water table. Free product was not detected in wells W-3 or W-4.

The closest previously-existing monitoring well to the tank excavation was GPW-7, located 365 feet west of the UST area, it was installed in 1987. The drilling log for the well indicates that soil samples obtained from the vadose zone, water table, and the saturated zone exhibited a weathered gasoline odor and the cuttings had a slight sheen. The depth to water was approximately 7 ft bgs. The groundwater sample at GPW-7 had 1,800,000 ug/l of benzene present (FP&M, 1995).

Investigation of Proposed UST Locations East of Transportation Building, Groundwater Technology, Inc., 1995

Groundwater Technology, Inc. (GTI) installed five geotechnical borings and a monitoring well at the request of BUG to support the replacement of the existing USTs at the east side of the Transportation building. Soil samples were collected during the boring installation at 5 to 7 and 10 to 12 ft bgs intervals. A monitoring well was completed to a depth of 20 ft and a groundwater sample was collected following the well installation.

The soils encountered in the bore holes and monitoring well consisted of fill deposits. The water table was located at approximately 11 ft bgs. Soil samples indicated elevated concentrations of

benzene, xylene, 1,2,4, trimethylbenzene, and naphthalene. The groundwater sample only had elevated benzene and none of the other abovementioned compounds.

A memorandum related to the boring installation indicates observation of elevated VOC field readings in soil below the water table starting at 15 ft bgs. The highest VOC field reading of 600 milligram per kilogram (mg/kg) was observed at 27 ft bgs. The memorandum describes soil at that depth as "saturated with a black liquid" and having a visible sheen. The VOCs levels reduced at 32 ft bgs, where a clay layer was encountered. The boring locations are shown in Plate 2.

Preliminary Evaluation of Maspeth Holder Demolition Impacts, Vanasse Hangen Brustlin, Inc., 2001.

At the request by KeySpan Energy (the owner of the Greenpoint Energy Center at the time) Vanasse Hangen Brustlin (VHB) performed a preliminary evaluation of KeySpan's analytical data collected prior, during and after the demolition of the Maspeth Holders which were demolished by implosion on July 15, 2001. Surface samples were collected prior and after the demolition of Holders 1 and 2 from the depth interval 0 to 1.5 centimeters bgs from 76 locations near the holders, including areas outside the Site. All soil samples were analyzed for lead addressing a concern of elevated lead concentrations which could have originated from paint chips flaking from the Maspeth Holders. The surface soil sampling locations are shown in Plate 2. Surface wipe samples were collected from a variety of hard surfaces and also analyzed for lead.

Lead concentrations in surface soils ranged from 1 mg/kg to 2,600 mg/kg. The highest lead concentration of 2,600 mg/kg registered in a surface soil sample collected outside the Site a few days before the Maspeth Holders implosion. The overall average lead concentration for surface soil samples collected pre-demolition was 339 mg/kg while the post-demolition overall average concentration was 322 mg/kg. VHB concluded, that based on analytical results, pre- and post-demolition lead concentrations in soil were not significantly different on a statistical basis.

Greenpoint Holder Soil Sampling Results, Miller Environmental Group, 2002.

A soil sampling program was carried out by Miller Environmental Group in November 2002 in the vicinity of the Maspeth Holder Station Holders 1 and 2. Soil samples were collected from 27 locations to a depth of 1 ft bgs and analyzed by KeySpan Laboratory Services for lead. No formal report was found, but according to the available lab analytical reports, lead concentrations ranged from 35 mg/kg to 12,100 mg/kg. The sample with highest lead concentration was collected from the ground surface. No map of sampling locations was provided.

Preliminary Subsurface Investigation at the Greenpoint Operations Center, Miller Environmental Group, 2003.

Miller Environmental Group was retained by KeySpan Energy Corporation to perform a preliminary subsurface investigation at the Site in December 2002. Three borings and one temporary well were installed in the vicinity of LNG Tank 2 to a maximum depth of 13 ft bgs. Three soil and two groundwater samples were analyzed for Resource Conservation and Recovery Act (RCRA) metals, VOCs, SVOCs, cyanide, and diesel range compounds (DRO). Soil was also analyzed for petroleum products, and dielectric compounds. An Oil/NAPL sample was recovered and identified by the lab as a #6 fuel oil. The sampling locations are shown in Plate 2. According to the Miller Environmental Group, the investigation indicated residual MGP waste at each sampling location both by field observations and analytical results.

Northeast Corner of the Greenpoint Energy Center (Liquefaction Plant), Paulus Sokolowski & Sartor Engineering, PC

Site investigation activities were conducted by the Paulus Sokolowski & Sartor (PS&S) Engineering Company from 2004 to 2007 at the request of National Grid in the area of the proposed LNG liquefaction facility in the north-east part of the Site. The investigation activities were intended to support a remedial investigation of the area, and an IRM design and implementation. Investigation activities included the installation of 58 soil borings, multiple test pits, soil vapor monitoring points, groundwater monitoring wells and the collection and laboratory analysis of soil, soil vapor and groundwater samples. Soil samples were analyzed for VOCs, SVOCs, polychlorinated biphenyls (PCBs), RCRA metals and cyanide. The sampling locations are shown on Plate 2. A summary of the observations based on the available PS&S report is presented below:

- Within the investigation area underlying the proposed LNG liquefaction facility, areas of subsurface soil exhibiting tar fragments, saturation, staining or coating, were encountered primarily in the first 5 ft bgs. Visual impacts were observed to a maximum depth of 18 ft bgs.
- The highest VOCs and SVOCs concentrations were observed in the subsurface soil samples collected from 0 to 6 inches above the groundwater table. VOC and SVOC concentrations decrease below a depth of 5 ft bgs.
- Naphthalene odors were observed to a maximum depth of 3 ft bgs while fuel-like odors were observed to a maximum depth of 45 ft bgs.

Subsequently, an IRM was implemented under the approval of the NYSDEC addressing the impacted soil prior to the construction of the liquefaction facility.

Pre-Design Investigation Program, GEI Consultants, 2009-2010

In accordance with a NYSDEC-approved Pre-Design Investigation (PDI) Work Plan, Cutoff Wall Interim Remedial Measure dated January 9, 2009, GEI conducted a pre-design investigation to assess the need for a bulkhead IRM. The investigation is not complete; however, the present findings indicate a limited potential area of concern in the vicinity of MW-01, which will be further delineated as discussed in this work plan and as agreed upon by the NYSDEC in a meeting on June 9, 2011. Data to be gathered in Phase 1 of the RI will be used to finalize the investigation and develop an IRM plan, as appropriate.

Interim Remedial Measure Pre-Design Investigation, 2009

GEI Consultants conducted an IRM pre-design investigation (PDI) from March through October 2009. The design program included the following elements:

- Assessment of existing Site conditions including a focused bulkhead and Maspeth Avenue property survey, utility geophysical survey and stormwater system evaluation
- Implementation of field investigations to gather geotechnical, hydrogeologic and environmental data
- Groundwater modeling and stormwater runoff analysis to define the effects of the potential cutoff wall on the groundwater regime.

Field observations during the investigation indicated the presence of NAPL and chemical odors in the subsurface soils along the bulkhead structure. Twenty-two soil borings and 15 groundwater monitoring wells were installed from April through June 2009 at the Site. Along the bulkhead the borings were installed up to a depth of 114 ft bgs or approximately El.-103 ft (NAVD88). The deepest visual impact along the bulkhead was observed between El.-90 and -95 ft. Based upon field observations, NAPL-saturated soil was observed at El.-40 to -44 ft in the southern part of the bulkhead (area of MW-01), between approximately El.-91 and -94.5 ft in MW-03D, and at approximately El.-21 to -23 ft in the area north of LNG Tank 1 (MW-05D). No NAPL-saturated soil was observed above the mud line elevation of the creek.

A series of wells were installed along Maspeth Avenue in July 2009 to monitor groundwater elevations. Eight wells were installed to a depth of up to 18 ft bgs. Locations of the wells are presented in Plate 2. One boring indicated the presence of black staining between 0 and 2 ft bgs but the field PID measurements registered only slightly elevated VOCs at that soil interval.

A series of geotechnical borings were installed from August through October of 2009. Twenty-eight borings were installed during this time to a depth of up to 121.9 ft bgs and eight borings were completed as groundwater monitoring wells. Thirteen locations were subjected to cone penetrometer test. Of the twenty eight borings installed between August and October 2009, fourteen indicated presence of visual impact or odors.

Soil analytical results indicate that VOCs, SVOCs, PCBs, metals, and cyanide are present at detectable concentrations in one or more of soil samples collected during the investigation. Several PAHs, benzene, dibenzofuran, and five metals were detected at concentrations which exceed NYSDEC Subpart 375-6.8 Restricted Use Soil Cleanup Objectives - Industrial (SCO).

Groundwater analytical results indicate that VOCs, SVOCs, metals, and cyanide are present at detectable concentrations in one or more of the groundwater samples collected during the investigation. PCBs were not detected in any of the samples collected. BTEX compounds, a subset of other VOCs, several PAHs, three SVOCs, a subset of metals and cyanide were detected at concentrations which exceed NYSDEC Ambient Water Quality Standards (AWQS) and Guidance Values for GA ground water.

Locations of the borings are presented in Plate 2. Soil boring logs, analytical results and cross sections are presented in Appendix B, GEI Investigation Data.

Supplemental Interim Remedial Measure Pre-Design Investigation: Cutoff Wall, Newtown Creek, 2010

GEI performed a Cutoff Wall IRM Supplemental Pre-Design Investigation (PDI) in 2010 in accordance with a NYSDEC-approved Supplemental Pre-Design Investigation Work Plan, Cutoff Wall Interim Remedial Measure dated April 8, 2010. The Supplemental Investigation was required to further define geotechnical, geologic, hydrogeologic, and environmental conditions at the Site. The area of specific interest was the southern bulkhead area along Newtown Creek. The focus of investigations was to further assess the subsurface presence of NAPL inboard and outboard of the bulkhead/dock structure, and in the sediments offshore along the southern alignment of the structure.

Sixteen soil borings were installed along the bulkhead as a part of the supplemental IRM pre-design investigations. The borings were installed to a depth of up to 135 ft bgs. Eight borings were finished as groundwater monitoring wells. In addition, the existing polyvinyl chloride (PVC) monitoring well MW-01 was replaced with a 4-inch-diameter stainless steel well. Either

odors or visual impacts were observed in 10 of the installed borings. The findings confirmed results of the 2009 investigation in that, based upon field observations, no NAPL-saturated soil was observed above the mud line elevation of Newtown Creek. Tar saturated soil was observed below the mud line at approximately El.-64 to -68.5 in SB-105(MW-02D) in the bulkhead area.

Soil analytical results indicate that VOCs, SVOCs, PCBs, and metals were present at detectable concentrations in one or more of soil samples collected during the investigation. Several PAHs and arsenic were detected at concentrations which exceed NYSDEC SCO.

Groundwater analytical results indicate that VOCs, SVOCs, metals, and cyanide are present at detectable concentrations in one or more of groundwater samples collected during the investigation. PCBs were not detected in any of the samples collected. BTEX compounds, a subset of other VOCs, several PAHs, three SVOCs, a subset of metals and cyanide were detected at concentrations which exceed NYSDEC AWQS.

A sediment sampling program was carried out in July 2010 in Newtown Creek along the bulkhead. Sediment samples were collected from 31 locations primarily focused in a grid pattern about 600 ft long along the bulkhead extending about 300 ft into the creek. Surface sediment samples were obtained with a Ponar sampler from 0 to 6 inches below mud line (bml). In addition, Vibracore sampling was completed from the mud line to a depth of 20 ft. All sediment samples were analyzed for VOCs, SVOCs, PAHs, PCBs, pesticides, herbicides, metals, total cyanide and other parameters including ammonia, black carbon, pH, Sulfide, total nitrogen, total organic carbon, and total phosphorus. Selected sediment samples were analyzed for dioxins and furans. In addition, selected samples were analyzed for total petroleum hydrocarbons (TPH), diesel-range organics (DRO), normal alkanes and isoprenoid hydrocarbons, and alkylated PAHs consistent with the USEPA Remedial Investigation/Feasibility Study Work Plan Newtown Creek, June 2011. These data may be used to characterize the nature and potential sources of hydrocarbons in Newtown Creek.

Sediment analytical results indicate that VOCs, SVOCs, PCBs, dioxins, pesticides, herbicides, petroleum hydrocarbons, cyanide and metals were present at detectable concentrations in one or more of sediment samples collected during the investigation. Three VOC compounds, several PAHs, bis(2-ethylhexyl)phthalate, total PCBs, a subset of pesticides, and a number of metals were detected at concentrations which exceed National Oceanic and Atmospheric Administration effects-range-median screening level (ERM).

In general, non-native sediment was about 10-feet thick containing mixed petrogenic (i.e., petroleum-derived) and pyrogenically-derived hydrocarbons. The upper few feet of sediment generally contained lower PAH concentrations in petrogenic patterns consistent with weathered

petroleum products and urban background. Mixtures of petrogenic and pyrogenic PAHs were observed in the middle depths, grading to more pyrogenic PAHs at depth. There was a range of pyrogenic PAH patterns in the deeper sediments. The PAH patterns were compared to the DNAPL collected from on-site monitoring well MW-01; few matched. More specifically, a few sediment samples contained pyrogenic PAHs in a tar-like pattern similar to the DNAPL from MW-01. There was no clear pattern or specific area where the samples were located except that all of the samples were from the deepest portions of their respective sediment cores, and the sediment cores were north of MW-01 and south of LNG Tank No. 1.

The origin of these impacts is, at this time, unknown given the industrial setting of Newtown Creek, surface water and sediment transport within the creek, and the upstream location of a major combined sewer overflow (CSO) discharge point at Maspeth Avenue.

Sediment sampling locations are presented in Plate 2. Soil boring logs, analytical results and cross sections are presented in Appendix A, GEI Investigation Data. The figure showing the potential extent of impacts in the Newtown Creek sediment is provided in Appendix B, GEI Investigations.

Ball Field Human Health Risk Assessment Program, GEI Consultants, June 2010

GEI conducted an assessment of human health risk in December 2010 for the Site baseball field located at the intersection of Maspeth and Vandervoort Avenues. The human health risk assessment was conducted in response to the results of the evaluation of soil samples collected adjacent to the ball field which identified the presence of chemicals of potential concern. Prior to the start of this assessment, the baseball field was used by National Grid employees for a summer baseball league. In addition, the baseball field had been leased by Saint Joseph's College for their women's softball team practices and home games during the fall and spring seasons.

GEI evaluated the potential exposure of receptor populations to surface soils and soils immediately beneath the baseball field. The receptor populations evaluated in this assessment included: child visitor, adult worker, and student player. To evaluate soil conditions, GEI collected 42 soil samples on June 25, 2010, from the 0 to 2 inch and 2 to 6 inch depth intervals in a grid across the baseball field. The samples were analyzed for SVOCs, PAHs, PCBs, and metals. Based on the evaluation of potential exposures to the human receptors at the baseball field, the cancer risk estimates for a child visitor, adult worker and student player at the baseball field are within the USEPA acceptable cancer risk range of $1x10^{-4}$ to $1x10^{-6}$. However, to be conservative, National Grid subsequently suspended use of the ball field.

Maspeth Regulator Station Investigation: April 2011

GEI performed a soil reuse sampling program in April of 2011 within the proposed Maspeth Regulator Station footprint in support of the construction of the station in 2012. A total of 8 borings were installed to the depth of up to 8 ft bgs. Soil samples were collected from the 0 to 2 ft bgs interval and from the 5 to 6 ft bgs interval for a total of 16 samples. All soil samples were analyzed for VOCs, SVOCs, PAHs, metals, PCBs, pesticides, herbicides, and cyanide.

Soil analytical results indicate that VOCs, SVOCs, pesticides, metals, and cyanide are present at detectable concentrations in one or more of soil samples collected during the investigation. PCBs and herbicides were not detected in any of the samples collected. Several PAHs and two metals were detected at concentrations which exceed NYSDEC Industrial SCO. The boring locations are shown in Plate 2.

Off-Site Potential Source Areas

The following section addresses areas of known contamination located in close proximity to the Site.

Newtown Creek/Greenpoint Oil Spill Study, U.S. Environmental Protection Agency, 2007

The Newtown Creek oil spill was discovered in September 1978 by a USGS routine patrol (Geraghty & Miller, 1979). Oil accumulation was observed in Newtown Creek that on further investigation was found to be seeping from a bulkhead at the foot of Meeker Avenue. The firm of Geraghty & Miller completed the initial investigation of the oil spill extent on land in 1979 at the request of the USCG and produced the first map of the spill extent (Geraghty and Miller, 1979). According to their estimates the most product accumulation occurred under the Exxon Mobil facility with the oil plume limit extending to within 1 block of the northern border of the Site. Geraghty & Miller indicated that the minimum spill volume was about 17 million gallons. Product recovery estimates and the present free-product extent suggest that the 1979 estimate may have been somewhat low. Smaller additional spills have occurred after the discovery of the Meeker Avenue seep and have been documented in various reports (USEPA, 2007).

Over 20 additional investigative studies were completed by 2007 and numerous work plans, progress reports, and information packages were issued since 1979 in the area of the spill (USEPA, 2007). Approximately 35 product and groundwater recovery wells and over 200 monitoring or observation wells were installed since 1978. Parties to the investigations have

included major petroleum companies that have operated terminals or other facilities in the area for many decades, both before and after the spill discovery. In the early stages of the investigation BUG was considered to be a potentially responsible party for the oil spill. The area under investigation was the tank farm area in the north-west part of the Site and the pipelines connecting the oil spill area and the Site. Subsequent soil and groundwater sampling and analysis did not confirm that allegation (Geraghty & Miller, 1979). Locations of the soil borings at the Site from 1979 study are presented in Plate 2.

At present, the extent of the free-product petroleum plume is divided into four specific areas of responsibility: (1) the "on-site" area which includes the Exxon Mobil properties that overlie the northern portion of the plume, (2) the BP Amoco terminal that borders Newtown Creek to the southeast of the Exxon Mobil facility, (3) the "off-site" area which includes commercial and residential areas in the central and southern portion of the plume for which Exxon Mobil has taken remedial responsibility, and (4) the former Paragon Oil Property (now Peerless Importers and Steel Equities facilities) bordering Newtown Creek, now being remediated by Chevron Texaco. Close to 11,400,000 gallons of oil have been recovered to-date. Remediation efforts by the abovementioned parties are on-going.

Meeker Avenue Plume Trackdown, URS Corporation, 2008, 2009

The Meeker Avenue Plume Trackdown Site (NYSDEC Site No. 2-24-121) is located in the residential area of the Greenpoint/East Williamsburg Industrial Area section of the Borough of Brooklyn, New York, to the north-west of the Site. The investigation area is located in a region of historical petroleum refining and storage. Based on results of several investigations by the URS Corporation (URS) conducted in the area chlorinated solvents such as tetrachloroethene (PCE) and trichloroethene (TCE) were found in soil vapor, soil and ground water in the areas outside the Exxon Mobil petroleum spill. As these chemicals are not related to petroleum, NYSDEC initiated investigation to determine the source(s) of this contamination. The investigation area closest to the Site is the residential area located south of the Brooklyn-Queens Expressway and is the area of the soil-vapor intrusion (SVI) investigation.

To the south of Meeker Avenue, soil vapor samples indicate potential sources of PCE and TCE as follows: near a former and current metal working facility on the east end of Vandervoort Avenue between Anthony and Lombardy Streets (1,100 $\mu g/m^3$ PCE, 1,00 $\mu g/m^3$ TCE), near a former dry cleaner in the block bound by Richardson and Frost Streets between Morgan and Vandervoort Avenues (310,000 $\mu g/m^3$ PCE, 19,000 $\mu g/m^3$ TCE); and near a former dry cleaner in the block bound by Beadel Street and Division Place between Morgan and Vandervoort Avenues (13,000 $\mu g/m^3$ PCE, 370 $\mu g/m^3$ TCE). A potential source of 1,1,1-trichloroethane (1,1,1-TCA)(6,600 $\mu g/m^3$) and 1,1 –dichloroethane (1,1-DCA)(2,000 $\mu g/m^3$) was also identified

near a former drum storage area and current metal recycling facility on the east side of Vandervoort Avenue between Lombardy and Beadel Streets (URS, June 2008).

URS completed a residential air sampling effort to further assess soil vapor intrusion in the Greenpoint/East Williamsburg Industrial Area neighborhood in February through March 2008. The investigation area was located immediately north-west of the Site, and was bounded by Lombardy Street and Division Place between Morgan Avenue and Porter Avenue. Twelve residential properties were investigated for vapor intrusion. PCE concentrations in the sub-slab samples ranged from 51 $\mu g/m^3$ to 70, 000 $\mu g/m^3$, TCE concentrations in the sub-slab samples ranged from 1.2 $\mu g/m^3$ to 3,300 $\mu g/m^3$; 1,1,1- TCA concentrations in the sub-lab samples ranged from 2.6$\mu g/m^3$ to 580 $\mu g/m^3$. Freons (i.e., 1,1,2-tricloro-1,2,2-trifluoroethane, dichlorodifluoromethane, and trichlorofluoromethane) in the sub-slab samples were detected at concentrations ranging from not detected to 18,000 $\mu g/m^3$.

The analytical results were compared to the ingredients in the household product inventories. URS concluded that the presence of the household products did not appear to contribute to the presence of chlorinate compounds of interest in the indoor air samples.

Figure "Meeker Ave PCE TCE Plume Extent" provided in the Appendix A, Off-Site Investigations shows the location of the chlorinated solvents plume.

BCF Oil Refining Site, Data Collection Plan, RI/FS Study, Newtown Creek, Anchor QEA, 2011

BCF Refining Site is located at 360-362 Maspeth Avenue on English Kills in Brooklyn, New York across the street from the Site. The site is a 1.9-acre former petroleum distribution and oil recycling facility. The facility refined used oil and "tank bottoms" for use in boilers and other energy recovery applications.

A number of site investigations were conducted from1992 through 2009. Results of investigations indicated PCB contamination at the site. VOCs, SVOCs, metals and PAHs were also present in on-site soils. VOCs and a measurable thickness of NAPL were identified in ground water. PCBs were also detected in shoreline sediments and porewater. Sheen was observed on Newtown Creek near the BCF facility. Beginning in May 2000, USEPA conducted an emergency response action at the BCF Oil Site to address concerns about possible leakage from abandoned USTs, ASTs, and drums. The emergency response action removed more than 800,000 gallons of contaminated oil and 65,000 pounds of scrap metal from the BCF Oil Site. (Anchor QEA, 2011). Multiple releases of waste and used oil to English Kills surface water are recorded in the NYSDEC Spill Incidents Database. The site is no longer listed in the New York State Registry of Inactive Hazardous Waste Disposal Sites.

Newtown Creek Remedial Investigation, Laurel Hill Site, Maspeth, New York. Anchor Environmental, L. L. C., 2007

The Laurel Hill site is located across Newtown Creek, directly opposite the Site. Anchor Environmental, L.L.C. implemented remedial investigations both on land and in Newtown Creek adjacent to the Laurel Hill site at the request of Phelps Dodge Refining Corporation. Historically, industrial operations at the Laurel Hill facility included production of sulfuric, muriatic, nitric, and other acids; refining of blister copper; smelting ore concentrates and copper and brass scrap; silver and nickel refining; and tin production. All furnaces were fired by coal until the 1920s when the furnaces were switched to oil stored in two aboveground oil storage tanks. A 1955 plan of the Laurel Hill Facility Uplands indicates a discharge line from the smelting blast furnace into a "slag pond", which eventually discharged into Newtown Creek via an underground sewer pipe. Smelting operations discontinued around 1960. In 1983 copper operations closed at the Laurel Hill Facility Uplands.

Remediation efforts at the facility began in 1987 under NYSDEC supervision. During the uplands RI efforts, more than 100 boreholes and 38 monitoring wells were installed (Anchor, 2007) to characterize the geology and hydrogeology and to investigate soil and groundwater contamination. The RI results indicated the presence of primarily heavy metals in the fill soils at concentrations exceeding the NYSDEC TAGM 4046 recommended soil cleanup objectives. Metals concentrations in ground water were found to exceed the NYSDEC Class GA groundwater standards. PCBs were found at concentrations exceeding applicable NYSDEC cleanup criteria in soils and concrete in some areas of the Laurel Hill Facility Uplands (Anchor, 2007). A remediation at the facility started in 2003 and involved removal of PCB, mercury and petroleum-contaminated soils; capping in some areas and groundwater containment consisting of a steel sheet pile barrier wall and groundwater collection and treatment system.

Anchor Environmental performed a supplemental remedial investigation from 2004 through 2005 which addressed Operable Unit 6 (OU-6), defined as a portion of the site that abuts the Laurel Hill Facility Uplands and includes submerged areas of Newtown and Maspeth Creek. Sediment, surface water, and porewater samples were collected during the investigation. Throughout OU-6 (Newtown Creek and English Kills), a wide range of contaminants have been detected in surface sediments including metals, PCBs, PAHs, SVOCs, VOCs, pesticides, and dioxins exceeding ERM criteria.

A subset of sediment samples collected in Newtown Creek was submitted for PAH and PCB hydrocarbon characterization (Anchor, 2007, Appendix L). The results of the "parent+alkylated" PAH analysis identified four distinct sources or mixture of PAH in Newtown Creek sediments.

Two locations of the sediment samples submitted for PAH forensic analysis were less than 100 ft away from the Site bulkhead, the other three sample locations were positioned both upstream and downstream of the Site extending to the Brooklyn Queens Expressway. Surface sediment samples were collected at all five locations at depth interval from 0 to 10 centimeters bml or 0 to 14 centimeters bml and subsurface sediment forensic samples were collected at two locations to depths of up to 300 centimeters bml. Results of the hydrocarbon characterization were in part summarized as follows "it is unlikely that much of the surface sediment (0-10 centimeters bml) PAHs measured near the Laurel Hill Site, across the Creek, or downstream have a significant contribution from either the tar source or the very high temperature pyrogenic PAH sourcing. Rather, their PAH distributions are more consistent with input from weathered petroleum sources."(Anchor, 2007, Appendix L).

Equity Manufactured Gas Plant Site

AECOM is currently conducting a remedial investigation at the Equity Former MGP site located at 252-254 Maspeth Avenue in Brooklyn, New York at the request of National Grid. The remedial investigation report is not yet available for this review. Information about the Equity site history and conditions were provided in the Remedial Investigation Work Plan (AECOM, 2009). According to the AECOM Work Plan previous investigation activities which were conducted on portions of the Equity site in 2004 and 2005 are discussed as follows.

- **252 Maspeth Avenue Property:**

  A Phase II Environmental Subsurface Investigation (ESI) for the 252 Maspeth Avenue Property was conducted in March 2005 by Gannett Fleming Engineers, P.C. (GFE) on behalf of Cooper Tank and Welding Corp. (Cooper Tank), who was the potential lessee of the property (GFE, 2005). GFE installed four soil borings on the property and collected soil samples which were analyzed for VOCs, SVOCs, PCBs, and 13 Priority Pollutant Metals plus barium. Temporary PVC wells were installed in two of the borings, and groundwater samples were collected and analyzed for the same constituents as the soil samples. In soils, VOCs, SVOCs, and various metals were detected in samples from all four borings. PCBs were detected in only one soil sample. Odors and staining were observed in all four borings. In ground water, VOCs, SVOCs and various metals were detected in samples collected from both temporary wells. PCBs were detected in one groundwater grab sample, but the detection is likely turbidity related given the relative insolubility of PCBs in water.

- **254 Maspeth Avenue Property:**

A Phase II ESI was conducted for the 254 Maspeth Avenue Property in September 2004 by EEA Inc. (EEA) on behalf of Spencer Realty Corporation (the property owner) and Cooper Tank (the potential property buyer) (EEA, 2004). EEA installed six soil borings on the property and collected soil samples which were analyzed for VOCs, SVOCs, and RCRA metals. SVOCs and various metals were detected in all six borings. VOCs were detected in two of the borings. The subsurface geology was characterized to the completion depth of the borings.

Phase I ESA was conducted for the 254 Maspeth Avenue Property in October 2004 by GFE on behalf of Cooper Tank, who was the potential buyer of the property (GFE, 2004). GFE conducted a records search, interviews and site visit. Surficial soil staining was observed on site. A Phase II investigation of potential soil and groundwater impacts was recommended.

- **252 and 254 Maspeth Avenue Properties**

GFE performed geotechnical investigation work on behalf of Cooper Tank in September 2006 (GFE, 2006). GFE installed five soil borings to investigate the geology below these properties. Only a map and boring logs were available for review. The boring locations are shown in Plate 2, the available information for this investigation is provided in Appendix A.

3. Scope of Work

The scope of work presented in this work plan addresses field investigation tasks that will provide a better understanding of the potential presence, nature and extent of soil and groundwater impacts on the Site. The proposed site-wide sampling program includes sampling of ground water, soil vapor, indoor air, surface soil, and subsurface soil. The remedial investigation at the Site is proposed to be conducted in phases to address Areas of Interest in order of priority. As such, all work activities discussed below may not be implemented in each phase. However, they are presented in this document with the intent that this work plan acts as the base document for all work activities; the subsequent work plans will then address sampling type and location based on historical and future findings and refer to this plan for the implementation approach. In addition, investigation activities may be conducted in areas out of sequence to support capital improvement projects. As such, in the following sections that address sampling, the initial text will note if the work is to be performed in Phase 1.

Plate 3 presents proposed sample locations for Phase 1, and Table 2 presents sample description, rationale and analysis by Area of Interest.

The scope of work to be performed in this remedial investigation includes the following tasks:

- Preliminary Site Visit
- Mobilization
- Field Activities:
  - Utility Clearance
  - Surface Soil Sampling
  - Test Pit Excavation and Soil Sampling
  - Soil Borings Advancement and Soil Sampling
  - Monitoring Well Installation
  - Groundwater Sampling
  - NAPL Assessment
  - Soil Vapor Intrusion Investigation
  - Community and Work Zone Air Monitoring
  - Decontamination and Management of Investigation-Derived Waste
  - Survey of Sampling Point Locations
- Step I Fish and Wildlife Impact Analysis (FWIA)
- Qualitative Human Health Risk Assessment
- Quality Assurance/Quality Control and Data Validation
- Groundwater Model

- Data Reduction and Data Summary
- Presentation of Findings.

Descriptions of each proposed work activity are provided separately below.

3.1 Field Investigation Preparation and Mobilization Activities

Upon approval of the Work Plan by NYSDEC and authorization from National Grid, GEI will mobilize to the Site and prepare for the field investigation program. A field operations center will be set up on the Site in a construction trailer. The initial field mobilization will include the following items to be completed at the commencement of the field RI activities:

- Establish a field operations center
- Establish a decontamination area
- Establish a waste storage area
- Identify proposed sample locations
- Identify underground utilities.

3.1.1 Site Security

The Site is not publicly accessible, secured with a perimeter fence and provided with 24-hour security. The internal LNG tanks and plant are separately secured with and internal fence and will require special accommodation in terms of scheduling and investigation logistics. The site is monitored by cameras and a 24-hour security service.

A temporary fenced "corral" may be constructed to provide additional security for the site trailer, field equipment and the night storage of contactor's heavy machinery.

3.1.2 Establish Decontamination Area

Equipment decontamination will take place on a plastic lined, bermed decontamination area. During the preliminary site visit, the location of the decontamination area will be chosen. For subsequent phases of investigation the decontamination area may be relocated, if necessary. Potable water is not available to certain portions of the Site; consequently potable water for decontamination will need to be staged at the site in close vicinity to the decontamination area(s).

3.1.3 Establish a Waste Storage Area

Investigation derived waste (IDW) including soil cuttings, ground water, and decontamination waters will be collected and stored in 55-gallon U.S. Department of Transportation

(USDOT)/UN drums at the existing waste storage area consisting of a plastic lined, bermed area, roll-off containers or a fractionation tank. The area will be inspected during the preliminary site visit and upgraded as appropriate.

3.1.4 Identify Sample Locations and Underground Utilities

The general position of the proposed RI sample locations will be based on the areas of investigation (Areas 1 through 3 for Phase 1), review of utility plans and input from plant operations staff prior to mobilization, and will be identified during a preliminary site visit. Each proposed boring and subsurface investigation location will be marked with paint or stakes by GEI. The drilling subcontractor will provide the boring locations to New York City and Long Island One Call Center (One Call) to identify potential utility conflicts at the Site boundary and within the street right of ways adjacent to the Site. Each proposed subsurface sample and test pit location will be spotted in such a way as to avoid both active and retired utilities to the extent possible unless the retired utilities are a part of the investigation as potential contaminant sources.

3.2 Field Investigation Activities

This section of the RI Work Plan discusses the proposed field investigation activities for Phase 1 and conceptual approach for Phases 2 and 3 of the Remedial Investigation. Field investigation activities include utility clearance procedures, surface soil sampling, test pit, soil boring, and groundwater monitoring well installation activities as well as soil vapor intrusion assessment, NAPL assessment, and community and work zone air monitoring procedures. Table 2 presents the general rationale and proposed sampling and analysis for the surface samples, test pits, borings, and groundwater monitoring wells. The proposed sample locations and Areas of Interest are shown in Plate 3.

The proposed analyses, analytical methods, and QA/QC samples are discussed under each of the following subsections for surface soil, test pit, soil boring, and monitoring well sampling procedures. Appendix E includes GEI's Field Sampling Plan that will be implemented during the collection of samples for analysis. Subsection 3.6 and the QAPP outlines the laboratory data deliverables and data validation procedures. A NYSDOH Environmental Laboratory Approval Program (ELAP) approved laboratory will perform the analyses.

3.2.1 Utility Clearance

The general location of the proposed Phase 1RI sample locations is shown in Plate 3. For every location a utility mark-out checklist will be completed by GEI and signed by both GEI and National Grid representatives prior to commencement of intrusive activities. Additional

geophysical investigation is proposed if there is an uncertainty about proximity of utilities to the boring or test pit location. It is anticipated that approximately 20 percent of borings and 20 percent of test pits will require geophysical investigation utilizing ground-penetrating radar and/or other means prior to commencement of intrusive activities.

All soil boring and monitoring well locations will be pre-cleared using manual or vacuum extraction methods to a depth of 8 ft bgs. Approximately 20 percent of test pit locations are anticipated to require pre-clearing. Test pits of 10 ft in length or more that require pre-clearing will have at least two pre-cleared locations to attempt to avoid utilities.

CAMP will be implemented at the Site during all intrusive activities (See Section 3.3.11).

3.2.2 Surface Soil Sampling

Surface soil sampling is not planned in Phase 1 of the remedial investigation.

One surface soil sample per acre of the Site will be collected on average in the areas of vegetative cover. The total number of surface soil samples will depend on the size of specific areas addressed during the investigation phases. More frequent surface soil sampling locations may be proposed for the subsequent phases of investigation if contaminants of potential concern (COPCs) are identified in the surface soil at concentrations exceeding the human health standards.

Stainless steel spoons or trowels, or disposable sampling instruments will be used to collect each surface soil sample ftom the upper 2 inches beneath vegetative cover as per DER-10 requirements for assessing human and ecological resource exposure to soil. An approximate area of one square foot will be sampled. The exposed soil will be screened for volatile organic compounds (VOCs) using a photoionization detector (PID). Each surface soil sample will be sampled for the following list of COPCs:

- Semivolatile organic compounds (SVOCs) by USEPA method 8270C
- Target Analyte List (TAL) metals by USEPA method 6000/ 7000 series
- Polychlorinated biphenyls (PCBs) by USEPA method 8082
- Free cyanide by USEPA method 9016
- Hexavalent chromium by USEPA method 3060A/7196
- Total organic carbon (TOC) by Lloyd Kahn method
- Herbicides by USEPA Method 8151A
- Pesticides by USEPA Method 8081A.

The soil will be homogenized in a stainless steel bowl prior to being placed in laboratory-provided sample containers.

Each sampling implement will be decontaminated in accordance with decontamination procedures described in the FSP. QA/QC samples will include blind duplicate soil samples, MS/MSD samples, and equipment rinsate blank samples. The QC samples will be completed at a frequency of 1/20 or once per week of sampling. An approved NYSDOH ELAP laboratory will perform the analyses.

3.2.3 Test Pit Excavation and Soil Sampling

Test pit excavation is planned in Phase 1 of the remedial investigation.

Test pits are proposed to assess the configuration and contents of buried structures which may be present and to assess whether such buried structures, pipes, and utility lines affect potential contaminant distribution. Three test pits (GPEC-TP200) will be installed in Area 1 and Area 2 (see Plate 3).

At the location of some larger structures, test pits may be dug as trenches or additional test pits may be excavated to assess the extent, configuration, and visual contents. Decisions to conduct additional test pits will be made in the field and be dependent upon actual conditions encountered. For example, a single test pit combined with the surface manifestation of the foundation may be enough to assess the size, construction, and contents of a former gas holder. Alternatively, several test pits or a trench may be required to better assess the extent and configuration of buried structures.

Due to the nature of the Site and the large number of active and retired utilities present in the subsurface, up to two locations may be pre-cleared to 8 ft bgs within planned test pits at select locations as described in the Section 3.3.1 above.

Each test pit will be photographed and logged by the field representative during the intrusive utility clearance and excavation. All material removed from the test pit will be placed on 20-mil high-density polyethylene (HDPE) sheeting. Odor-suppressing foam and/or other appropriate means to mitigate odor (e.g. plastic sheeting) will be provided by the contractor to control odor emissions that may result from excavating potentially impacted soils. Test pits will be terminated at the approximate groundwater table, refusal, or a maximum depth of 10 ft bgs. Field screening of soils for total organic vapors will be conducted with a PID from the ground surface during ground-intrusive activities. A minimum of one soil sample will be selected for chemical analysis per 10 lineal ft of each test pit. Samples will be selected from the area

exhibiting the most prominent signs of apparent contamination. If no impacts are observed, a sample will be collected from the bottom of the test pit. Each sample will be analyzed for the following:

- VOCs by the USEPA method 8260B
- SVOCs by USEPA method 8270C
- TAL metals by USEPA method 6000/ 7000 series
- PCBs by USEPA method 8082
- Free cyanide by USEPA method 9016
- Hexavalent chromium by USEPA method 3060A/7196
- Total organic carbon by Lloyd Kahn method.

If NAPL or NAPL-saturated soil is encountered, samples may be collected for hydrocarbon characterization by GC/FID (TPH, DRO) and GC/MS (alkylated PAHs, n-alkanes and isoprenoid hydrocarbons).

After the completion of each test pit, the test pit will be backfilled in reverse sequence in which it was excavated, so that materials removed from the bottom of the test pit are placed back at the bottom and materials removed from the top of the test pit are placed back at the top. The test pits will be backfilled in lifts and compacted using the back-hoe bucket. Excess soils will be containerized in a lined roll-off which will be characterized for reuse or disposal. If test pits are excavated in paved areas, the pavement will be restored.

QA/QC samples will include blind duplicate soil samples, MS/MSD samples, and equipment rinsate blank samples. The quality control samples will be completed at a frequency of 1/20 or once per week of sampling. A NYSDOH ELAP certified laboratory will perform the analyses. One trip blank will be included per shipment of soil samples to the laboratory.

3.2.4 Soil Borings Advancement and Soil Sampling

Soil borings advancement and soil sampling is planned in Phase 1 of the remedial investigation.

Twenty-five borings will be installed during Phase 1 of the RI at sixteen locations (GPEC-SB203 through GPEC-SB217) using resonant sonic (sonic) drilling methods as described below. Borings installed in locations GPEC-SB212 through GPEC-SB217 will be completed as monitoring well clusters (deep, intermediate, shallow). In such a case only the deepest boring will be logged continuously in accordance with the FSP. The monitoring well program is further described in Section 3.3.5. Soil boring and monitoring well locations are shown in Plate 3. Table 2 provides a sample description, rationale, and analysis.

All exploratory soil borings will be advanced to at least El.-60 ft (approximately 70 ft bgs in Areas 1 and 2), which is below the initial zone of NAPL-saturated sediment observed near the bulkhead. One of the monitoring well clusters will be installed in the northwest area of the Site that is approximately 50 ft higher in elevation. The deepest boring in the cluster will be installed to approximately 150 ft bgs to target the formation containing NAPL-saturated soil observed near the bulkhead.

If impacts are observed at the target termination depth of a boring, the boring will be advanced to at least 10 ft below the deepest NAPL-saturated soil observed in the boring, based on field screening described in the FSP. Upon completion, the borings will be tremie grouted to the ground surface using a cement/bentonite slurry mixture.

Up to three soil samples per boring will be selected for chemical analysis at the following depth intervals:

- Within the utility clearance interval, from 0 to 8 ft bgs, from depth interval indicating highest level of impact based on field observations (odors, staining, PID, etc.). If no impacts are observed then soil sample will be collected at 5 ft bgs. Samples will be used to evaluate potential exposure for utility workers as well as to determine whether soil is acceptable for reuse at the Site.
- Below 8 ft bgs, from depth interval indicating highest level of contamination based on field observations (odors, staining, PID, etc.), soil samples will be used to determine the contaminant concentration within potential impacted zones. If no impacts are observed, then a sample will be collected from the depth of the observed groundwater table.
- The boring termination depth.

Samples collected during utility clearance will be collected from the sidewall of the hole using stainless steel spoons, hand auger, or disposable sampling equipment.
Each sample will be analyzed for the following COPCs:

- VOCs by the USEPA method 8260B
- SVOCs by USEPA method 8270C
- TAL metals by USEPA method 6000/ 7000 series;
- PCBs by USEPA method 8082.
- Free cyanide by USEPA method 9016
- Hexavalent chromium by USEPA method 3060A/7196
- Total organic carbon by Lloyd Kahn method.

The 0 to 8 ft bgs soil sample will additionally be analyzed for pesticides by USEPA Method 8081A and herbicides by USEPA Method 8151A for the purpose of human health risk assessment (HHRA) for utility workers.

If NAPL or NAPL-saturated soil is encountered, samples may be collected for hydrocarbon characterization by GC/FID (TPH, DRO) and GC/MS (alkylated PAHs, n-alkanes and isoprenoid hydrocarbons) by the methods listed below. Additional samples may be collected and analyzed to evaluate areal extent of NAPL-saturated soil, and to identify co-mingled or non-MGP related impacts. Up to 40 samples will be selected for hydrocarbon characterization for the RI program, of which up to 10 samples are proposed for Phase 1 of the RI. These samples will be analyzed for the following, consistent with analyses conducted on Newtown Creek sediment samples

- PAHs and alkyl PAHs by USEPA Method 8270C using Selective Ion Monitoring (SIM)
- N-alkanes and isoprenoids including diesel range organics (DRO) and total petroleum hydrocarbon (TPH) ranges by USEPA Method 8100.

Each sampling implement will be decontaminated in accordance with decontamination procedures described in the FSP. QA/QC samples will include blind duplicate soil samples, MS/MSD samples, and equipment rinsate blank samples. The quality control samples will be completed at a frequency of 1/20. An approved NYSDOH ELAP registered laboratory will perform the analyses. One trip blank will be included per shipment of samples to the laboratory.

3.2.5 *Monitoring Well Installation*

Monitoring well installation is planned in Phase 1 of the remedial investigation.

Six clusters of monitoring wells are planned to be completed during Phase 1 of the RI (GPEC-SB212 through GPEC-SB217) to provide input to the groundwater model and to assess groundwater conditions at the Site. Two of these locations (GPEC-SB213 and GPEC-SB217) already have a shallow monitoring well in place. Each cluster will have a shallow (groundwater table depth), intermediate (40-70 ft bgs) and deep monitoring well (100-120 ft bgs, or to intersect the aquitard at approximately El.-90). Additionally, up to 10 boring locations in Areas 1 and 2 may be finished as monitoring wells if NAPL-saturated soil intervals are encountered during the field investigation. The proposed monitoring well locations for Phase 1 are shown on Plate 3, and the descriptions, rationale, and analysis are presented in Table 1.

Groundwater monitoring wells will be installed using sonic drilling techniques. The shallow wells will be screened in the uppermost portion of the water table aquifer and the well screen will extend approximately 3 ft above the existing water table. The screen lengths will be 10 ft

unless NAPL-saturated soil indicates the potential for recoverable product; in such cases, the well screen may be extended as a function of the saturated zone. If DNAPL, or potential DNAPL, is encountered in any of the wells, a 5-ft sump will be added to the well installed on top of any observed confining layer or change in aquifer material grain size that may be retarding the vertical migration of DNAPL. In such a case a NAPL assessment will be conducted as described in Section 3.2.9 below.

3.2.6 Monitoring Well Development

Monitoring well development is planned in Phase 1 of the remedial investigation.
Each newly-installed monitoring well will be developed by alternatively surging and pumping until the turbidity is less than 50 nephelometric turbidity units (NTUs) for a maximum of 1 hour or until a maximum of 10 well volumes of water have been removed. A field turbidity meter will be used to monitor the NTU levels. Well development will be completed in general accordance with the FSP. Purged ground water will be containerized in 55-gallon USDOT drums or fractionation tank and will be disposed of by National Grid at an approved facility.

3.2.7 Groundwater Sampling

Groundwater sampling is planned in Phase 1 of the remedial investigation.

Each of the newly installed monitoring wells will be sampled after a minimum of two weeks following completion of well development. A round of groundwater sampling is also proposed for the existing wells representative of the localized groundwater conditions at the Site. Prior to sampling, two synoptic rounds of groundwater level measurements will be recorded for all on-site monitoring wells (newly-installed and pre-existing) and an established surface water measuring point in the Newtown Creek; ground water will be gauged at both the low tide and high tidal levels. The existing monitoring well locations are shown in Plate 2, the proposed monitoring well locations for Phase 1 are shown on Plate 3, and the descriptions, rationale, and analysis are presented in Table 1.

Monitoring wells will be purged and sampled using low flow groundwater sampling procedures and in accordance with the FSP. Each groundwater sample will be analyzed for the following COPCs:

- VOCs by USEPA method 8260B
- SVOCs by USEPA method 8270C
- TAL metals by USEPA method 6000/7000 series
- PCBs by USEPA method 8082
- Total cyanide by USEPA Method 9012B

- Free cyanide by USEPA method 9016
- Pesticides by USEPA Method 8081A
- Herbicides by USEPA Method 8151A.

If NAPL accumulation is present in any well, then no groundwater sample will be collected for laboratory analysis.

QA/QC procedures are detailed within the QAPP. QA/QC samples include blind duplicate samples, MS/MSD samples, and equipment rinsate blank samples. The quality control samples will be completed on a frequency of 1 per 20 samples. An approved ELAP laboratory will perform the analyses. One trip blank will be included per shipment of samples to the laboratory.

3.2.8 Hydraulic Conductivity Test

Hydraulic conductivity testing is planned in Phase 1 of the remedial investigation.

In-situ hydraulic conductivity tests (slug tests) will be completed at six monitoring well clusters to determine site-specific hydraulic conductivity of the targeted aquifer and different subsurface strata. The slug tests will be completed in accordance with the FSP. Hydraulic conductivity values will be calculated using the Bouwer and Rice Method (1976).

3.2.9 NAPL Assessment

If NAPL is encountered a NAPL assessment is planned in Phase 1 of the remedial investigation.

If potentially free-phase NAPL is observed in any of the borings during the RI, various additional procedures will be implemented. The boring will be sampled to a minimum of ten ft beyond the deepest observed impact. If DNAPL is observed above a stratigraphic change in the formation or potential confining layer in a boring, a 7 or 8-inch outer casing will be advanced to isolate the contaminated zone. The outer casing will be temporarily seated in a 5-ft thick column of bentonite slurry or a minimum of five ft into the confining unit. The bentonite slurry will be used to prevent potential downward migration of contamination along the walls of the casing. The above approach is specific to sonic drilling techniques. If other drilling equipment is used alternative methods will be required.

Once the outer casing has been seated in the bentonite, drilling will continue below the outer casing. After collection of each core, a 6-inch casing will be advanced to case the boring below the bottom of the outer casing. After completing each boring, the 6-inch casing will be removed incrementally as the boring is grouted. If outer isolation casing is used, and the grout has reached the bottom depth of the outer casing, the 6-inch casing will be completely removed.

Grouting will then proceed with incremental removal of the outer casing. Drilling methods and procedures are further described in the FSP.

A monitoring well may also be installed and screened across the DNAPL impacted zone to monitor for accumulating product. If monitoring wells are installed per the above discussion, the wells may be constructed of 4-inch diameter stainless steel with 20 or 30 slot screen and a 5-ft sump. The actual screen slot size will be selected based on the grain size distribution of the formation.

All wells potentially containing NAPL based on boring observations will be gauged using an oil/water interface probe. If measurable NAPL is observed, then the NAPL will be bailed or pumped from the well and the volume of material removed will be recorded. All NAPL removed from a well will be containerized for disposal.

The recovery rate of the NAPL will be assessed through periodic measurements with an oil/water interface probe. Recovered NAPL will be examined and described by the field representative. If present, up to three samples of NAPL will be collected and analyzed for waste characterization purposes, and to determine the density and viscosity of the NAPL.

Up to 7 samples may be collected for hydrocarbon characterization during Phase 1 of the RI to evaluate the origin of the NAPL and NAPL composition by the following methods:

- PAHs and alkyl PAHs by USEPA Method 8270C using Selective Ion Monitoring (SIM)
- N-alkanes and isoprenoids including diesel range organics (DRO) and TPH ranges by USEPA Method 8100.

3.2.10 Soil Vapor Intrusion Investigation

A soil vapor intrusion investigation is not planned in Phase 1 of the remedial investigation.

Screening of soil vapor is proposed for nine buildings (five large and four small) located at the Site based on their occupancy for 8 hours or more during the work week and proximity to potentially contaminated areas. Twenty-eight soil vapor samples, 28 indoor air samples, and 9 outdoor ambient air samples are proposed to be collected. The indoor air samples will be used to assess the potential for soil vapor intrusion into the buildings. The outdoor samples will be used to determine background air quality.

Each soil vapor point will be installed and sampled in general accordance with the NYSDOH *"Guidance for Evaluating Soil Vapor Intrusion in the State of New York"* and National Grid's *"Draft Standard Operating Procedures for Soil Vapor Intrusion Evaluations at National Grid MGP Sites in New York State."*

Soil vapor points will be installed within building interiors as permanent sub-slab soil vapor points. Sub-slab soil vapor points will be installed by drilling a hole through the concrete floor slab and then fitting the point with Teflon or stainless steel tubing secured with stainless steel fittings and cap. Each sub-slab soil sample port will be sealed with non-shrinking grout or beeswax and completed with flush-mount utility covers. Temporary sub-slab soil vapor sample points may be installed instead of permanent ones at some locations.

To ensure that the sampling tube is sealed from the ambient air aboveground, helium will be used as a tracer gas as described in the NYSDOH Soil Vapor Intrusion Guidance document. Each sample will be collected utilizing a SUMMA® canister with a laboratory-calibrated flow controller that is calibrated to an 8-hour period. The regulator flow rate will not exceed 0.2 liters/minute (L/min).

The indoor and outdoor air samples will be collected from the approximate breathing height (3 to 5 ft aboveground). Each indoor air and outdoor air samples will be collected utilizing an individually certified 6-Liter SUMMA® canister with a laboratory-supplied flow controller that is calibrated to an 8-hour period. The regulator flow rate will not exceed 0.2 (L/min). Each SUMMA® canister will be shipped to an approved-NYSDOH ELAP registered laboratory for analysis. The sample will be analyzed for VOCs and naphthalene by the USEPA Method TO-15. The soil vapor sampling will target the winter heating season between November 15 and March 30 in accordance with NYSDOH Soil Vapor Guidance.

QA/QC procedures are detailed in the QAPP. QA/QC samples will include one blind duplicate sample collected for both ambient air and soil vapor. An approved NYSDOH ELAP registered laboratory will perform the analyses.

Building inventory information will also be collected in general accordance with the NYSDOH Center of Environmental Health's Indoor Air Quality Questionnaire and Building Form that is provided as Appendix B of the NYSDOH *"Guidance for Evaluating Soil Vapor Intrusion in the State of New York"* and NGRID's *"Draft Standard Operating Procedure- Soil Vapor Intrusion for MGP Sites in New York"*.

3.2.11 Community and Work Zone Air Monitoring

In accordance with NYSDEC and NYSDOH requirements, a CAMP will be implemented at the Site during each phase of the intrusive field activities. The objective of the CAMP is to provide a measure of protection for the downwind community (i.e., off-site receptors, including residences and businesses and on-site workers) from potential airborne contaminant releases as a direct result of intrusive RI activities. Air monitoring stations will be set up up-wind and downwind of each intrusive work area (i.e., boring and test pit locations). VOCs and respirable particulates (PM-10) will be monitored at the up-wind and downwind stations on a continuous basis. Wind direction will be determined using a wind sock(s) and/or flagging poles installed on site.

GEI will provide the following equipment for work zone monitoring of GEI employees:

- PID with 10.6 eV lamp or equivalent for total VOC monitoring;
- Dust Meter for PM-10 monitoring; and
- Combustible Gas Indicator (CGI)/Oxygen (O2) / H2S / HCN meter.

GEI will monitor and document daily site conditions and operations and inform field staff of results. If action levels are exceeded, GEI's field representative will immediately implement actions outlined in the site-specific HASP and will notify GEI's Project Manager and the site safety officer.

The proposed CAMP is presented in Appendix F.

3.2.12 Decontamination and Management of Investigation-Derived Waste

Prior to commencing intrusive activities, an equipment decontamination area will be selected during a preliminary site visit and a decontamination pad will be constructed. A waste storage pad for IDW is already in place adjacent to GEI's trailer near Varick Street. The pad will be inspected and upgraded as appropriate upon mobilization to the Site.

Drilling equipment will be decontaminated at the established decontamination pad between each boring location in accordance with the FSP. Sampling equipment used for sample collection (e.g., stainless steel split spoons, sample spoons, and hand trowels) will be decontaminated prior to use and reuse.

Soil cuttings and wastewaters produced during decontamination will be collected and contained within 55-gallon USDOT drums, roll-off or fractionation tank. A waste profile sample of soil and fluid IDW will be collected to characterize the wastes to determine the appropriate disposal

options available. Samples will be collected into laboratory-preserved bottles, chilled with ice and submitted to the laboratory under chain of custody as described in the FSP, and QAPP. Each disposal sample media will be sampled for parameters to meet the requirements of the disposal facilities approved by National Grid. National Grid will arrange for the ongoing disposal of the IDW after they have been characterized.

3.2.13 Survey of Sampling Points

Following completion of the soil borings, monitoring wells, and test pits and collection of the surface-soil samples, each of these points will be surveyed by a New York State Licensed Land Surveyor. The vertical and horizontal position of soil sampling locations and monitoring wells will be determined to ±0.02 ft. All locations and elevations will be referenced to the New York State Plane Eastern Zone (3104) North American Datum 1983 (NAD83) and North American Vertical Datum (NAVD88).

3.3 Step I Fish and Wildlife Impact Analysis

A Step I Fish and Wildlife Analysis is not planned in Phase 1 of the remedial investigation.

A Step I Fish and Wildlife Analysis (FWIA) will be completed for the Site. The Step I analysis will be conducted in accordance with DER-10 Section 3.10 and the current version of NYSDEC's *Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites* (*FWIA*). The general objectives of the Step I assessment are:

- Identify the fish and wildlife resources, habitats, cover type, wetland and stream classifications at the Site and in the vicinity
- Identify the fauna expected within each cover type and aquatic habitat
- Document observations of stress to the Site soils and vegetation
- Describe the value of habitat to expected fauna
- Describe the value of the fish and wildlife resources to humans
- Determine whether contaminants are present that potentially could affect the expected fish and wildlife resources
- Recommend whether a Step II FWIA is warranted.

The findings of the Step I FWIA will be included in the final RI Report.

3.4 Qualitative Human Health Risk Assessment

A Qualitative Human Health Risk Assessment is not planned in Phase 1 of the remedial investigation.

In accordance with direction provided by the NYSDEC, a qualitative human health risk assessment will be prepared for the Final Remedial Investigation Report. This assessment will follow the guidelines provided in the Appendix 3B to NYSDEC's DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010. The assessment will identify the exposure setting, identify exposure pathways, and will evaluate the fate and transport of the contaminants. The assessment will include text discussions, tables, and graphics depicting the potential exposure pathways. The characterization will include all environmental data gathered pertaining to the RL The qualitative assessment will identify potential risks for specific potential receptors based on complete pathways of exposure to contaminant levels exceeding default "screening criteria," such as the NYSDEC-recommended SCOs and drinking water standards.

3.5 Quality Assurance/Quality Control and Data Validation

Test America, Inc labs will provide New York State Category B data deliverables for the 20% of the samples. The data will be validated in accordance with the *USEPA Region II Functional Guidelines for Evaluating Organic Analyses* (September 2006) and the USEPA Region 2 *Standard Operating Procedure for the Evaluation of Metals for the Contract Laboratory Program,* SOP HW-2, Revision 13 (September 2006), modified as necessary to accommodate the non-Contract Laboratory Program (CLP) methodologies used. Data usability summary reports (DUSRs) will be prepared for all of the samples. The DUSRs will summarize any laboratory quality control non-conformances and their impact on the usability of the data. The data usability report will be used in preparing the RI report, and will be submitted as part of the RI report.

For the 80% of the samples which are not validated, a completeness check will be performed. This review will check only that samples requested on the chains of custody (COCs) were analyzed and if for any reason, the laboratory had to rerun or dilute these samples and submitted several results for one sample, the validator will choose the results to be reported.
No evaluations or reviews are done on the quality control (QC) results for the Category B package samples.

Through the use of standardized sample collection and decontamination procedures, the quality of the samples during field collection can be assured. This will be reviewed in the data validation process through the evaluation of field duplicate pair precision and equipment rinsate and trip blank samples, respectively.

The data validation process will ensure that the data collected and reported by the laboratory are complete and of sufficient quality that management decisions regarding the degree and extent of

potential impacts can be reliably made. The data validation will evaluate whether the required quantitation limits have been achieved for each sample analyzed. Laboratory and field precision will be evaluated through the review of laboratory and field duplicate results and MS/MSD precision. Accuracy will be evaluated through the review of holding times, calibration results, MS/MSD, surrogate, and LCS recoveries, laboratory and field blank results, and internal standard results. Any deviations from the required level of sample quality will be detailed in the DUSR and these deviations will be taken into consideration when using the data to explain Site conditions.

4. RI Report Preparation

GEI will prepare a RI report for submittal to the NYSDEC for the Site. The report will incorporate the findings of the RI activities. The information will be used to describe the nature and extent, and fate and transport of all contaminants associated with the former MGP site. The report will identify specific contaminant concentrations throughout each media (e.g., soil, groundwater, etc.), which is necessary to determine whether any media require remediation or further evaluation. The reports will also incorporate the findings of the Step I FWIA and the Qualitative Human Health Risk Assessment.

Key components of the RI report will include:

- Description of RI activities
- Discussion of Site geology and groundwater flow patterns
- Distribution of analytical compounds in soil and groundwater
- Distribution of NAPL
- Identification of historical structures and associated waste source areas
- Comparison of Site soil and groundwater analytical data to NYSDEC standards
- Identification of areas that exceed the soil and groundwater standards
- Boring logs, test pit logs, and monitoring well construction details
- Data usability reports
- Validated laboratory Form I reports
- Site photographs.

5. Schedule

A tentative project schedule proposed for the RI implementation and RI report preparation is presented below:

- RI Phase 1: 1th quarter of 2012 through 2012
- RI Phase 2: 2012 through 2013
- RI Phase 3: 2013 through 2014
- RI Report Preparation: 2014 through 2015.

A detailed schedule for Phase 1 will be established upon the approval of this work plan and prior to commencing RI field activities. National Grid will notify the NYSDEC five working days prior to the anticipated start date of field activities for the remedial investigation program.

6. Project Team

GEI's key project members and their roles are summarized below.

- **Program Manager.** Mr. David Terry will have ultimate responsibility for successful completion of the work scope, will interface with National Grid as needed, and will be responsible for providing appropriate staff and resources to complete the project.

- **Project Manager.** Mr. Michael Zukauskas, P.E. will have the day-to-day responsibility for project logistics, and coordination with the National Grid and the NYSDEC. He will be responsible for the deliverables and quality control.

- **In-House Consultants.** Mr. John Ripp will serve as GEI's in-house consultants for the project team. He has extensive MGP experience and understanding of MGP historical operations, and the behavior of MGP contaminants in the environment.

- **Lead Engineer.** Under the direction of Mr. Zukauskas, P.E., Ms. Maria Stepanova, P.E. will be primarily responsible for implementation of the field program, managing GEI's subcontractors, interpretation of the investigation findings, and preparation of the RI report.

An organization chart is provided in Appendix G.

7. References

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Tables

Proposed Sample Descriptions, Rationale and Analysis

Table 1
Proposed Sample Descriptions, Rationale and Analysis
Remedial Investigation Work Plan
Greenpoint Energy Center Former Manufactured Gas Plant Site

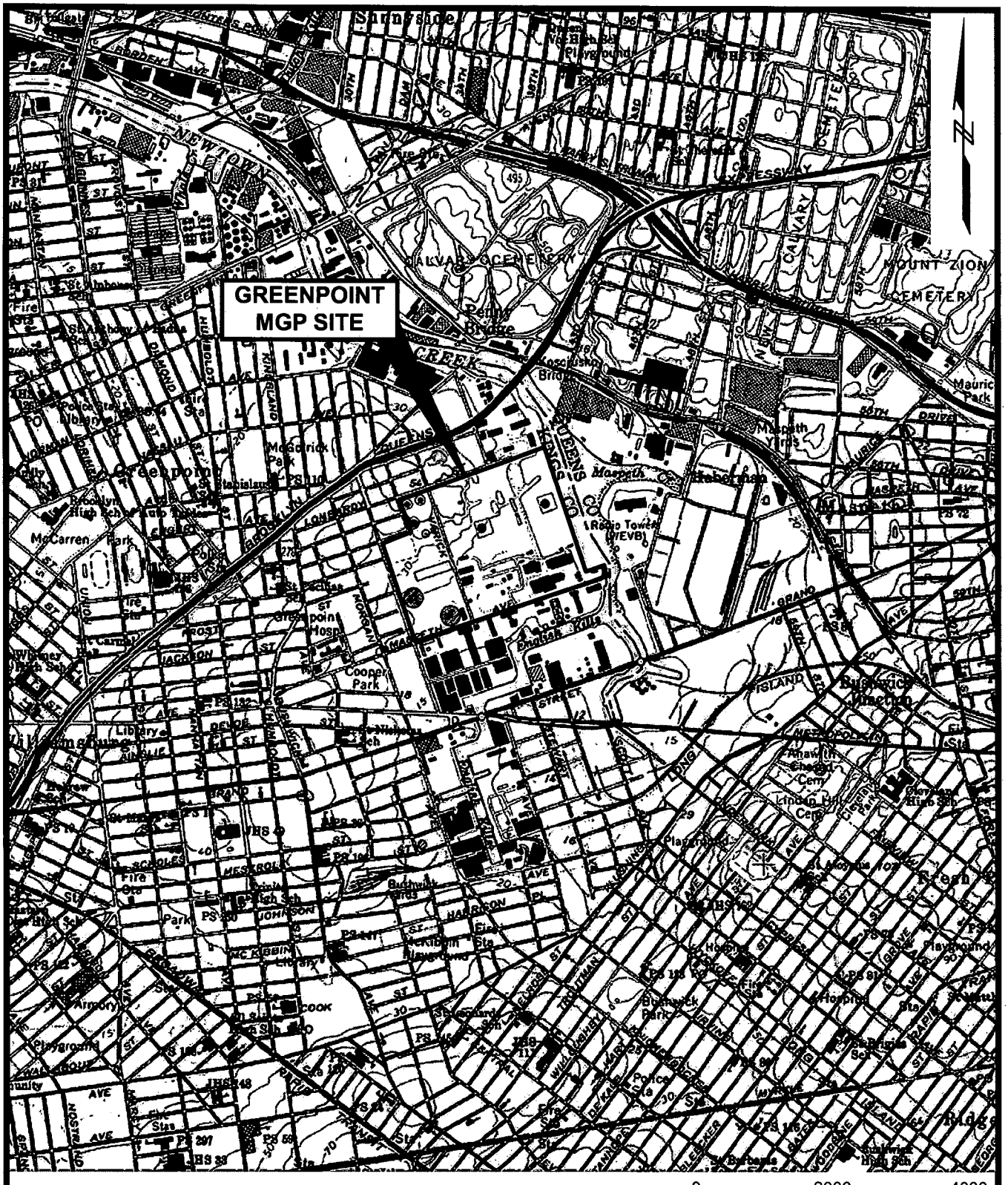
Sample I.D.	Sample Area	Sample Location	Sample Rationale	Number of Samples		VOCs (EPA 8260)	SVOCs (EPA 8270)	TAL Metals (6000/7000)	Cyanide[1]	PCBs (EPA 8082)	Herbicides (EPA 8151A)	Pesticides (EPA 8081A)	Hexavalent Chromium (EPA	Total Organic Carbon (Lloyd Kahn)
				Soil	Ground water									
GPEC-SB-203	Area 1	MW-1 area of the GPEC	Soil boring to approximately 70 ft bgs (El.-60) to evaluate potential DNAPL presence near monitoring well MW-1. Monitoring well to be installed if it is determined that DNAPL recovery is possible.	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-204	Area 1	MW-1 area of the GPEC	Soil boring to approximately 70 ft bgs (El.-60) to evaluate potential DNAPL presence near monitoring well MW-1. Monitoring well to be installed if it is determined that DNAPL recovery is possible.	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-205	Area 1	MW-1 area of the GPEC	Soil boring to approximately 70 ft bgs (El.-60) to evaluate potential DNAPL presence near monitoring well MW-1. Monitoring well to be installed if it is determined that DNAPL recovery is possible.	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-206	Area 1	MW-1 area of the GPEC	Soil boring to approximately 70 ft bgs (El.-60) to evaluate potential DNAPL presence near monitoring well MW-1. Monitoring well to be installed if it is determined that DNAPL recovery is possible.	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-207	Area 2	Bulkhead area of the GPEC.	Soil boring to approximately 70 ft bgs (El.-60) to evaluate subsurface soil conditions along the bulkhead. Monitoring well to be installed if it is determined that DNAPL recovery is possible.	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-208	Area 2	Bulkhead area of the GPEC.	Soil boring to approximately 70 ft bgs (El.-60) to evaluate subsurface soil conditions along the bulkhead. Monitoring well to be installed if it is determined that DNAPL recovery is possible.	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-209	Area 2	Bulkhead area of the GPEC.	Soil boring to approximately 70 ft bgs (El.-60) to evaluate subsurface soil conditions along the bulkhead. Monitoring well to be installed if it is determined that DNAPL recovery is possible.	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-210	Area 2	Bulkhead area of the GPEC.	Soil boring to approximately 70 ft bgs (El.-60) to evaluate subsurface soil conditions along the bulkhead. Monitoring well to be installed if it is determined that DNAPL recovery is possible.	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-211	Area 2	Bulkhead area of the GPEC.	Soil boring to approximately 70 ft bgs (El.-60) to evaluate subsurface soil conditions along the bulkhead. Monitoring well to be installed if it is determined that DNAPL recovery is possible.	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-212 /GPEC-MW	LNG Area	North-East part of the Site near LNG Plant, vicinity of former Lagoon	Soil boring to evaluate the subsurface soil conditions near potential area of concern. Cluster of monitoring wells to provide input to the groundwater model and to assess groundwater conditions at the Site (see Notes).	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]

Table 1
Proposed Sample Descriptions, Rationale and Analysis
Remedial Investigation Work Plan
Greenpoint Energy Center Former Manufactured Gas Plant Site

Sample I.D.	Sample Area	Sample Location	Sample Rationale	Number of Samples		VOCs (EPA 8260)	SVOCs (EPA 8270)	TAL Metals (6000/7000)	Cyanide[1]	PCBs (EPA 8082)	Herbicides (EPA 8151A)	Pesticides (EPA 8081A)	Hexavalent Chromium (EPA	Total Organic Carbon (Lloyd Kahn)
				Soil	Ground water									
GPEC-SB-213 /GPEC-MW	MW-13 area	Near former 400,000-gal Tar Tank, north of the Site, to the right of Varick Avenue	Soil boring to evaluate the subsurface soil conditions near potential area of concern. Cluster of monitoring wells to provide input to the groundwater model and to assess groundwater conditions at the Site (see Notes).	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-214 /GPEC-MW	Tank Field	South of Tank Field, near corner of Division Pl and Porter Avenue	Soil boring to evaluate the subsurface soil conditions near potential area of concern. Cluster of monitoring wells to provide input to the groundwater model and to assess groundwater conditions at the Site (see Notes).	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-215 /GPEC-MW	Demolished Maspeth Holders	Demolished Holder 2 area, near Vandervoort Avenue	Soil boring to evaluate the subsurface soil conditions near potential area of concern. Cluster of monitoring wells to provide input to the groundwater model and to assess groundwater conditions at the Site (see Notes).	Up to 3	3	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-216 /GPEC-MW	Demolished Maspeth Holders	Demolished Holder 1 area, near Maspeth Avenue	Soil boring to evaluate the subsurface soil conditions near potential area of concern. Cluster of monitoring wells to provide input to the groundwater model and to assess groundwater conditions at the Site (see Notes).	Up to 3	3	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-SB-217 /GPEC-MW	Near Storage Building	North of Storage building, to the right of Varick Ave	Soil boring to evaluate the subsurface soil conditions near potential area of concern. Cluster of monitoring wells to provide input to the groundwater model and to assess groundwater conditions at the Site (see Notes).	Up to 3	1	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-TP-200	East of Stores building	Underground utilities	Test pit to determine location of underground historical MGP utilities.	1	NA	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-TP-201	LNG Area	Underground utilities	Test pit to determine location of underground historical MGP utilities.	1	NA	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]
GPEC-TP-202	LNG Area	Underground utilities	Test pit to determine location of underground historical MGP utilities.	1	NA	X	X	X	X	X	X[2]	X[2]	X[3]	X[3]

Notes:
Additional investigation locations to be installed on as-needed basis.
If impacts are observed at the target termination depth of a boring, the boring will be advanced to at least 10 ft below the deepest MGP-related contaminant observed in the boring.
Each cluster will have a shallow (groundwater table depth), intermediate (40-70 ft bgs) and deep monitoring well (100-120 ft bgs, or to intersect the aquitard at approximately El.-90).
Chemical analysis test methods specified are from U.S. EPA SW-846 test methods
EPA - Environmental Protection Agency
GPEC - Greenpoint Energy Center
MGP - Manufactured Gas Plant
PCB - Polychlorinated Biphenyls
SVOCs - Semivolitile Organic Compounds
TAL - Target Analyte List
VOCs - Volatile Organic Compounds
[1]-Soils will be analyzed for Free Cyanide (EPA Method 9016) and water will be analyzed for both Free Cyanide (EPA Method 9016) and Total Cyanide (EPA Method 9012)
[2]-Soil samples from 0 to 8 ft bgs interval and all groundwater samples will be analyzed for these parameters
[3]-Only soil samples will be analysed for these parameters

Figures



SOURCE: Map created with TOPO! ® ©2001 National Geographic (www.nationalgeographic.com/topo)

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GREENPOINT ENERGY CENTER
BROOKLYN, NEW YORK

nationalgrid

GEI Consultants

SITE LOCATION MAP

PROJECT 093260

November 2011 Figure 1

J:\Projects\National Grid\Greenpoint\Greenpoint Site Location Map-updated July 2011.ppt

SOURCES:

1. AERIAL PHOTOGRAPH BING MAPS © 2008 MICROSOFT CORP.
2. PARCEL BOUNDARY AND LAND USE FROM BYTES OF THE BIG APPLE MAPPLUTO. NYC DEPARTMENT OF CITY PLANNING. UPDATED NOV 2009.
3. NYC DEPT. OF CITY PLANNING SELECTED FACILITIES AND PROGRAM SITES DATABASE.

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SCALE, FEET

REMEDIAL INVESTIGATION WORKPLAN
GREENPOINT ENERGY CENTER
BROOKLYN, NEW YORK

nationalgrid

GEI Consultants

SENSITIVE AREAS WITHIN 1/2 MILE OF GREENPOINT ENERGY CENTER

Proj 093260-2-1201 | November 2011 | Figure 2

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Plates

1. Site Plan with Historical Operations Features

2. Previous Site Investigation Locations

3. Phase 1 Proposed Remedial Investigation Locations

LEGEND:

- CURRENT BUILDING/STRUCTURE
- POTENTIAL SOURCE AREAS
- APPROXIMATE SITE BOUNDARY
- 1924 SHORELINE
- 1888 CHANNEL

SOURCES:

1. SANBORN FIRE INSURANCE MAPS 1933, 1951, 1965, 1968, 1977.
2. 1954 AERIAL PHOTOGRAPH OBTAINED FROM ENVIRONMENTAL DATA RESOURCES, INC.
3. 2002 AERIAL PHOTOGRAPH OBTAINED FROM WWW.GLOBEXPORER.COM.
4. *DRAWING NO. 10 A 76 - GREENPOINT PLANT PROPERTY PLAN* PREPARED BY BROOKLYN UNION PROJECT/CONSTRUCTION ENGINEERING DEPT., SCALE 1"=80', DATED DEC. 21, 1989, REVISED 3/22/96.

BEADEL STREET
PORTER AVENUE
DIVISION PLACE
SKILLMAN AVE
VANDERVOORT AVENUE
MASPETH AVENUE
GARDNER AVE.
NEWTOWN CREEK
MUSSEL ISLAND (1924)
HISTORICAL MUD FLATS
OFF SITE
LITTLE LEAGUE BASEBALL FIELD
CONTRACTOR TRAILER PARK
METER OPERATIONS BUILDING
PURIFIERS
HOLDER No. 2 HOLDER NO. 2 4300
MASPETH STATION AREA
SOFTBALL FIELD
RETIRED HOLDER NO. 1 HOLDER No. 1 4200
L.N.G. PROCESS AREA 1100
L.N.G. TRUCK LOADING AREA 1700
L.N.G. TANK NO. 2 1300
L.N.G. TANK NO. 1 1400
POND AREA
LAGOON
DRY TAR STORAGE
WET TAR TANKS
TAR TANK
TAR SEPARATOR
SEPARATOR IN PIT
CONDENSERS
SCRUBBERS
TAR EXTRACTORS
TAR TANKS
GAS GENERATORS
RELIEF HOLDER
EQUIPMENT MAINTENANCE & WELDING SHOP
STORAGE & SERVICE OFFICE BUILDING
BOILER HOUSE
PRODUCER HOUSE
PRODUCER GAS HOLDER
GASOLINE TANKS
NAPHTHA PAD
OIL/WATER SEPARATOR
SNG PLANT
CRG UNIT
UTILITY UNIT
HYDROGEN UNIT
UNDERGROUND OIL TANKS
SERVICE BUILDING 3100
STORES BUILDING 3200
GREENPOINT SERVICE CENTER AREA
TRANSPORTATION BUILDING
BY-PRODUCTS BUILDING
TAR TANKS
LIQUOR STORAGE TANK
OIL STORAGE TANK
WASTE LIQUOR
WASH OIL STILL
GAS WASHERS
RECTIFIERS
EMPLOYEE PARKING
OIL SCREENING TANK
OIL SCRUBBER
ACCOM. BLDG.
PUMP HOUSE
WASTE CATALYST
ABANDONED TANK FIELD
400,000-GALLON TAR TANK
CRUDE OIL SOLVENT TANK
RESIDUAL DISTILLATE TANK
BENZOL TANK
1,000,000-GALLON OIL TANK
OIL FROM HOLDER SEALS
0 120 240
SCALE, FEET

REMEDIAL INVESTIGATION WORK PLAN GREENPOINT ENERGY CENTER FORMER MANUFACTURED GAS PLANT SITE BROOKLYN, NEW YORK	**SITE PLAN WITH HISTORICAL OPERATIONS FEATURES**
nationalgrid	
PROJECT 093260-2-1201	Nobember 2011 — Plate 1

GEI Consultants
1 GREENWOOD AVENUE
SUITE 210
MONTCLAIR, NEW JERSEY 07042

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ID	Source	Source Description	Year	Type of Investigation	Area
11	Geraghty and Miller, Inc	Underground Accumulation of Hydrocarbons	1979	SB, MW	GPEC
12	Brooklyn Union Gas	Borings in SNG Naphtha Tank Farm Area	1979	SB, MW	GPEC
13	Roux	Groundwater Contingency Plan	1990	SB, MW	GPEC
15	Lexicon Environmental	Greenpoint UST Site Investigation	1993	SB	GPEC
16	Fanning, Phillips, & Molnar	Underground Storage Tank GW Investigation	1995	SB, MW	GPEC
17	Groundwater Technology	Greenpoint UST Abandonment	1994-1995	SB, MW	GPEC
18	PS&S	Maspeth Holder Demo	2004	Surf Soil	GPEC
19	Vanasse Hangen Brustlin	Maspeth Holder Demo sampling (pre,-post-demolition)	2001	Surf Soil	GPEC
20	Miller Environmental	Holder Soil Samples - Lead Sampling	2002	Surf Soil	GPEC
21	Miller Environmental	Greenpoint Subsurface Investigation	2003	SB	GPEC
22	NYSDEC	Cooper Tank & Welding Corp	2003	Pump Well	GPEC
23	PS&S	LNG area investigation	2004-2005	SB	GPEC
24	EEA,Inc.	254 Maspeth Ave	2004	SB	EQ
25, 26	PS&S	LNG area investigation	2004	SB, MW, SV	GPEC
27	Anchor Environmental	Laurel Hill Sediment Sampling	2004-2005	SED	LH
28	Gannett Fleming, Inc.	252 Maspeth Ave (Equity)	2005	SB, MW	EQ
30	PS&S	LNG area investigation	2006	SB	GPEC
31	Gannett Fleming, Inc.	252-254 Maspeth Ave.(Equity)	2006	SB, MW	GPEC
32	PS&S	LNG area investigation	2007	SB	GPEC
33	GEI Consultants	Bulkhead Soil Investigation-South Fireboad Manifold	2008	SB	GPEC
34	GEI Consultants	Pre-Design Investigation	2009	SB, MW, TP	GPEC
35	GEI Consultants	Stormwater Infiltration Study	2009	PZ	GPEC
36	GEI Consultants	Pre-Design Investigation-Barrier Wall	2009	SB, MW	GPEC
37	GEI Consultants	Pre-Design Investigation Test Pits	2010	TP	GPEC
38	GEI Consultants	Ballfield Investigation	2010	Surf Soil	GPEC
39	GEI Consultants	Supplemental Pre-Design Investigation, 287 Maspeth Ave.	2010	SB, MW, CPT	GPEC
40	GEI Consultants	Supplemental Pre-Design Investigation, Newtown Creek	2010	Sed	GPEC
41, 42	GEI Consultants	Maspeth Regulator Station Investigation	2010-2011	SB	GPEC
43	Malcolm Pirnie	BCF Oil Site - Ditmas, Maspeth Ave	Unkn	SB, MW	BCF
44	Malcolm Pirnie	BCF Oil Site - BCF Oil, Maspeth Ave	Unkn	SB, MW	BCF
45	AECOM	Equity Site, 252 Maspeth Ave	2009	SB, MW	EQ
46	Miller Environmental	Surface Soil Investigation along Maspeth Ave	2010	Surf Soil	GPEC
47	AECOM	Equity Works Remedial Investigation	2010	SB	GPEC
48	GEI Consultants	Operations Support/ Remedial Investigation	2011	SB, MW	GPEC

Notes
Area:
GPEC - Greenpoint Energy Center
LH - Laurel Hill
EQ - Equity Site
BCF - BCF Oil
Type of Investigation:
SB - Soil Boring
MW - Monitoring Well
Surf Soil - Surface Soil Sample
Sed - Sediment Sample
SV - Soil Vapor Sample
TP - Test Pit
CPT - Cone Penetrometer Test

PHASE 1
PHASE 2
PHASE 3
AREA 1
AREA 2
AREA 3
AREA 4
AREA 5

ANTHONY ST
LOMBARDY ST
DIVISION PL
RICHARDSON ST
FROST ST
WITHERS ST
JACKSON ST
SKILLMAN AV
UNNAMED ST
MASPETH AV
MORGAN AV
VANDERVOORT AV
PORTER AV
STEWART AV
GARDNER AV
SCOTT AV
NEWTOWN CREEK

LEGEND
CURRENT STRUCTURES
HISTORICAL STRUCTURES
SITE BOUNDARY
ACTIVE MONITORING WELL
INACTIVE MONITORING WELL

PREVIOUS INVESTIGATIONS
11
12
13
15
16
17
18
19
20, 46 MILLER ENVIRONMENTAL GROUP
24
23, 25, 26, 30, 32 PS&S
27
28, 31 GANNETT AND FLEMING, INC.
33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 48 GEI CONSULTANTS, INC.
43, 44
45, 47 AECOM

SOURCES:
1. FIGURE BASED ON PLAN TITLED "PROPOSED SOIL BORINGS/TEST PIT, MONITORING WELL AND SOIL GAS SAMPLE LOCATION SITE PLAN," BY PAULUS SOKOLOWSKI AND SARTOR ENGINEERING, PC DATED OCT 2004.
2. SURVEY OF EXISTING MONITORING WELLS CONDUCTED BY GEI ON 6-16-09.
3. AERIAL PHOTOGRAPH BING MAPS © 2008 MICROSOFT CORP.
4. STREETS, NYC DEPARTMENT OF CITY PLANNING, BYTES OF THE BIG APPLE

0 50 100 200
SCALE, FEET

REMEDIAL INVESTIGATION WORKPLAN
GREENPOINT ENERGY CENTER
FORMER MANUFACTURED GAS PLANT SITE
BROOKLYN, NEW YORK

nationalgrid

PROJECT 093260-2-1201

GEI Consultants
455 WINDING BROOK DRIVE
SUITE 201
GLASTONBURY, CONNECTICUT 06033

PREVIOUS SITE INVESTIGATION LOCATIONS

November 2011 Plate 2

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ID	Source	Source Description	Year	Type of Investigation	Area
11	Geraghty and Miller, Inc	Underground Accumulation of Hydrocarbons	1979	SB, MW	GPEC
12	Brooklyn Union Gas	Borings in SNG Naphtha Tank Farm Area	1979	SB, MW	GPEC
13	Roux	Groundwater Contingency Plan	1990	SB, MW	GPEC
15	Lexicon Environmental	Greenpoint UST Site Investigation	1993	SB	GPEC
16	Fanning, Phillps, & Molnar	Underground Storage Tank GW Investigation	1995	SB, MW	GPEC
17	Groundwater Technology	Greenpoint UST Abandonment	1994-1995	SB, MW	GPEC
18	PS&S	Maspeth Holder Demo	2004	Surf Soil	GPEC
19	Vanasse Hangen Brustlin	Maspeth Holder Demo sampling (pre-,post-demolition)	2001	Surf Soil	GPEC
20	Miller Environmental	Holder Soil Samples - Lead Sampling	2002	Surf Soil	GPEC
21	Miller Environmental	Greenpoint Subsurface Investigation	2003	SB	GPEC
22	NYSDEC	Cooper Tank & Welding Corp	2003	Pump Well	GPEC
23	PS&S	LNG area investigation	2004-2005	SB	GPEC
24	EEA,Inc.	254 Maspeth Ave	2004	SB	EQ
25, 26	PS&S	LNG area investigation	2004	SB, MW, SV	GPEC
27	Anchor Environmental	Laurel Hill Sediment Sampling	2004-2005	SED	LH
28	Gannett Fleming, Inc.	252 Maspeth Ave (Equity)	2005	SB, MW	EQ
30	PS&S	LNG area investigation	2006	SB	GPEC
31	Gannett Fleming, Inc.	252-254 Maspeth Ave (Equity)	2006	SB, MW	GPEC
32	PS&S	LNG area investigation	2007	SB	GPEC
33	GEI Consultants	Bulkhead Soil Investigation-South Fireboad Manifold	2008	SB	GPEC
34	GEI Consultants	Pre-Design Investigation	2009	SB, MW, TP	GPEC
35	GEI Consultants	Stormwater Infiltration Study	2009	PZ	GPEC
36	GEI Consultants	Pre-Design Investigation-Barrier Wall	2009	SB, MW	GPEC
37	GEI Consultants	Pre-Design Investigation Test Pits	2010	TP	GPEC
38	GEI Consultants	Ballfield Investigation	2010	Surf Soil	GPEC
39	GEI Consultants	Supplemental Pre-Design Investigation, 287 Maspeth Ave.	2010	SB, MW, CPT	GPEC
40	GEI Consultants	Supplemental Pre-Design Investigation, Newtown Creek	2010	Sed	GPEC
41, 42	GEI Consultants	Maspeth Regulator Station Investigation	2010-2011	SB	GPEC
43	Malcolm Pirnie	BCF Oil Site - Dimas, Maspeth Ave	Unkn	SB, MW	BCF
44	Malcolm Pirnie	BCF Oil Site - BCF Oil, Maspeth Ave	Unkn	SB, MW	BCF
45	AECOM	Equity Site, 252 Maspeth Ave	2009	SB, MW	EQ
46	Miller Environmental	Surface Soil Investigation along Maspeth Ave	2010	Surf Soil	GPEC
47	AECOM	Equity Works Remedial Investigation	2010	SB	GPEC
48	GEI Consultants	Operations Support/ Remedial Investigation	2011	SB, MW	GPEC

Notes
Area:
GPEC - Greenpoint Energy Center
LH - Laurel Hill
EQ - Equity Site
BCF - BCF Oil
Type of Investigation:
SB - Soil Boring
MW - Monitoring Well
Surf Soil - Surface Soil Sample
Sed - Sediment Sample
SV - Soil Vapor Sample
TP - Test Pit
CPT - Cone Penetrometer Test

SOURCES:
1. FIGURE BASED ON PLAN TITLED "PROPOSED SOIL BORINGS/TEST PIT, MONITORING WELL AND SOIL GAS SAMPLE LOCATION SITE PLAN," BY PAULIUS SOKOLOWSKI AND SARTOR ENGINEERING, PC DATED OCT 2004.
2. SURVEY OF EXISTING MONITORING WELLS CONDUCTED BY GEI ON 6-16-09.
3. AERIAL PHOTOGRAPH BING MAPS © 2008 MICROSOFT CORP.
4. STREETS, NYC DEPARTMENT OF CITY PLANNING, BYTES OF THE BIG APPLE

LEGEND
- CURRENT STRUCTURES
- HISTORICAL STRUCTURES
- SITE BOUNDARY
- PHASE 1 INVESTIGATION
- 1988 NEWTOWN CREEK
- HISTORICAL DRAINAGE AREA
- ACTIVE MONITORING WELL
- INACTIVE MONITORING WELL
- PROPOSED SOIL BORING LOCATION
- PROPOSED MONITORING WELL CLUSTER
- PROPOSED TEST PIT
- MONITORING WELL WITH DNAPL
- EXISTING BORING LOCATION

0 50 100 200
SCALE, FEET

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PHASE 1 PROPOSED REMEDIAL INVESTIGATION LOCATIONS

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