July 15, 2011

Mr. Edward Hampston, P.E.
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau D – 12th Floor
625 Broadway
Albany, NY 12233-7013

Re: Former Paragon Oil Terminal and
the 100-120 Apollo Street Property
Texaco Facility #304209
Greenpoint Section – Brooklyn, New York
Soil and Soil Vapor Alternatives Analysis Report

Dear Mr. Hampston:

SAIC Energy, Environment & Infrastructure, LLC (SAIC), on behalf of Texaco Inc. (Texaco), respectfully submits to the New York State Department of Environmental Conservation (NYSDEC) this Soil and Soil Vapor Alternatives Analysis Report. This report identifies and compares remedial alternatives for the soil and soil vapor media of concern at the site. The report also presents the selected remedy for both media. This report has been completed in accordance with the amended Order on Consent Case No. D2-1111-01-09AM between Texaco and NYSDEC dated May 15, 2009.

If you have any questions concerning the information presented in this report, please do not hesitate to contact either Ms. G. M. Harris of Chevron Environmental Management Company on behalf of Texaco at 713-432-2248 or Mr. Peter Cagnetta of SAIC at 717-901-8841.

Sincerely,

SAIC Energy, Environment & Infrastructure, LLC

Peter J. Cagnetta, CPSS
Senior Project Manager/Soil Scientist

PJC:pr

cc: G.M. Harris (Texaco)
    Neil Fletcher (Texaco)
    Stan Luckoski (Texaco)
    Jerry Ross (Pillsbury)
    Sal Geneva (Empire Merchants)
    Elizabeth Knaur (SPR)
    Steve Malinowski (CA Rich)
    Justin Kennedy (Roux)
    Steve Trifiletti (ExxonMobil)
    Nick Onufruk (BP)
    Joe White (NYSDEC)
    Kevin Lumpe (Steel Equities)
    Ivy Marvel (Brooklyn Public Library)
SOIL AND SOIL VAPOR
ALTERNATIVES ANALYSIS REPORT
FOR THE
FORMER PARAGON OIL TERMINAL
AND THE
100-120 APOLLO STREET PROPERTY
GREENPOINT, BROOKLYN, NEW YORK
FACILITY #304209

Prepared for:

Texaco Inc.
4800 Fournace Place
E520A
Bellaire, TX 77401

Prepared by:

SAIC Energy, Environment & Infrastructure, LLC
6310 Allentown Boulevard
Harrisburg, PA 17112

July 15, 2011
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1.0 INTRODUCTION

SAIC Energy, Environment & Infrastructure, LLC (SAIC), on behalf of Texaco Inc. (Texaco), respectfully submits to the New York State Department of Environmental Conservation (NYSDEC) an Alternatives Analysis Report for soil and soil vapor media of concern. The report is for the former Paragon Oil terminal properties located at 16, 42, and 50 Bridgewater Street (Paragon site) and the adjacent 100 and 120 Apollo Street properties (Apollo Street site) in Brooklyn, New York. Paragon Oil and Texaco never owned nor maintained operations on the Apollo Street site. Figure 1-1 presents the regional site setting and identifies the sites.

In May 2009, Texaco signed an Amended Order on Consent for Case No. D2-1111-01-09AM. This Order provides for the implementation of site-wide corrective action on both the Paragon site and the Apollo Street site. This report identifies and compares the remedial alternatives for soil and soil vapor media of concern and evaluates proposed remedies for both media.

Specifically, this report presents the following information:

1. A summary of historical operations for both the Paragon site and Apollo Street site, including former New York City incinerator operations on the Apollo Street site.
2. A summary of the remedial investigation and remedial actions that have been conducted on the site.
3. Identification of remedial goals and remedial action objectives.
4. Presentation of the remedy selection criteria as established by the NYSDEC.
5. Development and evaluation of several remedial alternatives for the soil and soil vapor.
6. Identification of the selected remedy for the soil and soil vapor at the site and details concerning the components and the monitoring program for the selected remedy.
2.0 HISTORICAL SITE OPERATIONS

The Paragon Oil Company operated a petroleum bulk storage terminal on the Paragon site from 1934 to 1958, and Texaco operated a petroleum bulk storage terminal on the Paragon site from 1958 to 1968. Neither the Paragon Oil Company nor Texaco ever owned or maintained operations on the Apollo Street site. The following sections outline historic property operations in more detail. Currently, Empire Merchants operates a wholesale wine and spirits distribution facility out of the warehouses located at both the Paragon site and Apollo Street site.

2.1 Former Paragon Oil Terminal Site

The Paragon site is comprised of the properties located at 16, 42, and 50 Bridgewater Street in Brooklyn, New York. These properties are located north of Bridgewater Street and are adjacent to Newtown Creek to the north, Meeker Avenue to the east, and the Apollo Street site to the west. Approximately 80% of the products stored at the Paragon site in 1954 were lubricating oils and fuel oils (No.’s 2, 4, and 6). In 1958, Texaco purchased the Paragon site and operated a petroleum bulk storage terminal on the properties until 1968. In 1965, approximately 77% of the products stored at the terminal were lubricating oils and fuel oils (No.’s 2, 4, and 6). Lesser amounts of finished products stored on the Paragon site between 1941 and 1968 included kerosene, diesel fuel, and gasoline. Neither Paragon Oil nor Texaco operated a refinery at any of these properties.

Peerless Importers, a wholesale wine and spirits distribution company, purchased the Paragon site in 1969. In 2006, Peerless Importers and Charmer Industries merged to form a new entity, Empire Merchants. Currently, Empire Merchants continues to operate within the warehouses of the Paragon site while Peerless Equities LLC owns the property.

2.2 100-120 Apollo Street Site

The Apollo Street site is comprised of the properties located at 100 and 120 Apollo Street in Brooklyn, New York. These properties are located north of Bridgewater Street and are adjacent to Newtown Creek to the north, the Paragon site to the east, and Apollo Street to the west. Neither Paragon Oil nor Texaco owned or operated on this site, and historical searches have not shown petroleum terminal or refinery operations were ever located on this site. Currently, Empire Merchants operates within the warehouses of the Apollo Street Site. See Table 2-1 for a list of property owners and operators for the Apollo Street site.
2.2.1 New York City Incinerator Operations

The only commercial entity known to have operated on the Apollo Street site prior to 1928 was the D. Cosagliola & Company Ship Yard in 1916. In 1928, the Brooklyn Ash Removal Company owned the Apollo Street site. Aerial photography of the same year shows no visible structures, implying that the property could have been used as a transfer point or disposal facility for ashes.

In 1933, the City of New York Sanitation Department purchased the property and began operations of an incinerator plant. The continued presence of this incinerator was confirmed by 1941 and 1951 Sanborn Fire Insurance maps and 1938, 1954, and 1960 aerial photographs. The 1965 Sanborn Fire Insurance map shows no structures on the property, and a 1966 aerial photograph confirms that there were no buildings on the property at that time. Demolition of the incinerator structure was therefore conducted between 1961 and 1965. Figure 2-1 presents a 1960 aerial photograph of the Apollo Street site.

2.2.2 Current Operations

The warehouses at 100-120 Apollo Street were constructed around 1969 when the Bridge Apollo Company purchased that property. The warehouses were used to house various operations over the years, including the S. & P. Drug Company, J. B. Williams Exp. Company, and SP Ventures, Inc. The property was sold to Apollo Steel, LLC, in 2000. The Apollo Street site is currently leased to Empire Merchants, who also operate the warehouses located on the Paragon site.
3.0 SUMMARY OF REMEDIAL INVESTIGATIONS AND REMEDIAL ACTIONS

Texaco has been conducting investigation and remedial action activities at the Paragon site since June 2005 and the Apollo Street site since May 2009. Investigation activities have included delineating the extent of petroleum-impacted soil, delineating the extent of petroleum-impacted groundwater, delineating and identifying the source of the subsurface PSH in the saturated zone, and implementing an ambient air monitoring program. Since 2005, 13 soil boring and 57 groundwater monitoring wells were completed across the site. From each soil boring and well location, one soil sample was collected and analyzed for regulated petroleum constituents. With respect to groundwater impacts, an annual groundwater sampling and analysis program has been ongoing since 2010.

The ambient air monitoring program at the Paragon site has been ongoing since 2005. From 2005 through 2009, the program was conducted by CA Rich Consultants, Inc., on behalf of Empire Merchants. Currently, the monitoring is being conducted by SAIC, on behalf of Texaco. Both programs have been using essentially consistent air sampling locations, protocols, and analyses. The ambient air monitoring occurs twice per year during the winter heating season and summer cooling season.

Remedial actions completed at the site have included the construction and ongoing operation of a recovery system to stop the former seep of PSH into Newtown Creek and also the implementation of voluntary precautionary vapor intrusion mitigation measures. The stopping of the seep into Newtown Creek was completed using a phased approach which involved the installation of a below grade grout wall, the operation of a total fluids recovery system, the sealing of the seams on the steel bulkhead, and the completion of a creek-side barrier on the timber crib bulkhead on the Apollo Street site. The grout wall was completed in 2006 and is located immediately behind the steel bulkhead on the Paragon site. This grout wall, in combination with sealing the seams in the steel bulkhead creek side using a marine epoxy, has been instrumental in stopping the seep into Newtown Creek. Immediately behind the grout wall on the Paragon site and also extending onto the Apollo Street site are 13 recovery wells used to recover PSH and groundwater along the bulkheaded shoreline. The system has been operating since September 14, 2007, and has successfully reversed the hydraulic gradient landside which was critical to the stopping of the seep. On the face of the wooden timber crib bulkhead on the Apollo Street site, an impermeable barrier was installed in 2009 and has been very effective in stopping the seep through the wooden bulkhead on that site.

The ongoing vapor intrusion mitigation measures include a sub-slab depressurization (SSD) system in the north office space of 50 Bridgewater Street on the Paragon site. This mechanical system is used to extract subsurface air immediately below the office space floor to mitigate potential aboveground risks. The system was made operational in 2010 and continues to operate today. In addition, in the warehouses for both the Paragon site and the Apollo Street site, SAIC has been actively sealing cracks and seams in the warehouse floor since July 2009. This activity
has been ongoing, and it further establishes the concrete warehouse floor as a competent barrier for the elimination of the vapor intrusion pathway.

The following sections provide additional detail concerning remedial investigation and actions at the site.

### 3.1 Soil Conditions

A description of the geomorphology of the site area, including documentation of the development and filling of part of the former Newtown Creek out to the present bulkheads, was provided by SAIC (2006 and 2007). The site was built up to its current grade with fill consisting of sand and gravel intermixed with wood, brick, and other material.

The Paragon site and Apollo Street site are completely developed, with a series of interconnected warehouses, driveways, and paved parking lots at grade. Nearly the entire site is covered with concrete warehouse floors or asphalt pavement. With the bulkhead on the Newtown Creek (north) side and higher ground elevations toward the south, the site soils are contained and not likely to be eroded from their present location.

The depths of interest for this report range from less than 5 feet to over 20 feet in site soils that include fill, sand, and silt. The majority of the unsaturated material beneath the site is fill—some likely from the former Brooklyn Ash Removal Company. There was also other material brought in to fill the former creek channel to the bulkheads in order to reclaim the land for marine industrial uses. This fill consists of ash, bricks, wood, and fine-grained soil and other fill material.

Plate 3-1 shows the distribution of soil samples collected and analyzed during site characterization efforts between 2005 and 2008. Data from these locations are used in the evaluation of soil remediation needs for this report. Table 3-1 summarizes these soil analytical data. These lists represent the results of 97 site soil samples analyzed.

Table 3-1 presents both the New York State Unrestricted Use Soil Cleanup Objectives (SCOs) and also the New York State Restricted Use Industrial SCOs for industrial land use. The site data indicate that several Unrestricted SCOs are exceeded while, to a much lesser extent, only a few Industrial SCOs are exceeded. The site is located in the New York City Planning M3-1 manufacturing zoning district. The M3 districts are designated for areas with heavy industrial use. Figure 3-1 presents the zoning districts. The site also bound by the M3-1 manufacturing zoning district to the east beyond Meeker Avenue, to the west beyond Apollo Street, and to the southeast below Bridgewater Street. The Apollo Street site along the southern boundary of
Bridgewater Street is adjacent to the M1-1 and M1-2 manufacturing zoning districts. This area, although not zoned for heavy industries, still maintains a manufacturing zoning district.

The site is also located within a Significant Maritime and Industrial Area (SMIA) as identified by the City of New York in the New York Comprehensive Waterfront Plan (NYC Department of City Planning, 1992) and the New York City New Waterfront Revitalization Program (NYC Department of City Planning, 2002). The site is located in one of six SMIAs throughout the City of New York. These two documents describe SMIAs as areas where the City of New York supports a future use as a functioning industrial waterfront. This M3-1 manufacturing zoning district and the SMIA designation support the use of the site for industrial purposes, which in turn support the relevancy of using the Industrial SCOs for purposes of evaluating remedial alternatives.

### 3.1.1 Petroleum VOCs

Plate 3-2 presents the very limited distribution of petroleum VOC compounds that exceed the Industrial SCOs. The three soil sample locations are located within the distribution of the PSH plume in the saturated zone and are located at depths below grade that correlate with the upper saturated zone where PSH is present. These data indicate that the source of the petroleum VOCs in the subsurface is the PSH in the saturated zone and not the overlying unsaturated zone soils. Compounds that exceed the Industrial SCOs are benzene, total xylenes, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

A total of 65 soil samples were collected for the NYSDEC STARS gasoline list, and only 3 locations exceeded the Industrial SCOs (see Table 3-2). A benzene concentration of 226 mg/kg is present at location CMW-12 and is above the Industrial SCO of 89 mg/kg. At this same location, total xylenes are present at 1,810 mg/kg, which is above the SCO of 1,000 mg/kg. Trimethylbenzene is present at all three locations to include CMW-12, CMW-20, and CMW-60. Petroleum VOC-impacted soil ranges from 10 feet below grade at CMW-60 to 25 feet below at CMW-20.

### 3.1.2 Petroleum SVOCs

The spatial distribution of the polynuclear aromatic hydrocarbon (PAHs) in the soil is presented in Plate 3-3. A total of 14 locations on the Apollo Street site and 17 locations on the Paragon site have PAH concentrations exceeding the Industrial SCOs. Vertical distribution of the soil samples from which PAHs were measured in excess of Industrial SCOs ranges from 5 feet at CMW-44 to 25 feet below grade at CWM-53. All samples with exceedances are present within the fill zone. The concentrations of the PAHs in the soil are not significantly elevated above the Industrial SCOs. The detected PAHs are not volatile and are highly insoluble.
Benzo(b)fluoranthene (CAS 205-99-2) is a five-ring PAH formed during the incomplete burning of fossil fuel, garbage, or organic matter. Two detections of 22 mg/kg and 15 mg/kg exceeded the NYSDEC Industrial SCO of 11 mg/kg.

Benzo(a)anthracene (CAS 56-55-3) is a four-ring PAH formed when fossil fuel, garbage, or other organic material burns. It is usually found in smoke and soot. Three samples had measured concentrations (19, 22, and 29 mg/kg) that exceed the NYSDEC Industrial SCO of 11 mg/kg.

Dibenz(a,h)anthracene (CAS 53-70-3) is a five-ring PAH and was detected at concentrations in excess of Industrial SCOs in seven unique samples. Six were 2.7 mg/kg or below, and the seventh was 31 mg/kg. The NYSDEC Industrial SCO is 1.1 mg/kg.

The analyte most frequently detected at concentrations in excess of the NYSDEC Industrial SCOs was benzo(a)pyrene (CAS 50-32-8), which is a five-ring PAH and was detected in 32 discrete samples. The compound is not manufactured and has no industrial uses. However, it is widespread in the world environment because of its formation during combustion of organic matter. Detections above the NYSDEC Industrial SCO in one sample were not confirmed in either of the duplicate samples collected at the same time. Sample locations where the Industrial SCO is exceeded are included in Table 3-3.

Three of the PAH compounds present in the soil are five-ring structures while the one additional PAH present is a four-ring structure. These large-ring PAHs are primarily pyrogenic in nature or are the result of combustion of fossil fuels. The presence of these four compounds in the soil at concentrations that are only slightly elevated above the industrial SCOs strongly indicate that the source of these PAHs is primarily not the terminal operations from the Paragon site. Paragon only stored and distributed finished petroleum products that did not require on-site combustion. The relatively low concentrations in the soils with the slightly higher density of Industrial SCO exceedances on the Apollo Street site further suggests that the primary sources of the PAHs in the soil is likely a combination of the fill material that was put in place prior to terminal operations on the Paragon site and also the operation of the incinerator on the Apollo Street site. The absence of the two-ring PAHs naphthalene and 2-methylnaphthalene above the Industrial SCOs is also indicative that a finished petroleum release is not the primary source of PAHs in the soil as these two compounds were prevalent in the heavy products stored on the Paragon site.

### 3.2 Ambient Air Monitoring

The ambient air monitoring has been ongoing at the site since 2005. CA Rich Consultants, Inc., on behalf of Empire Merchants, completed this task through 2009. With the amendment of the Texaco Order on Consent in May 2009, SAIC began completing the ambient air monitoring events in the winter of 2010. The current program consists of collecting indoor and outdoor
ambient air data twice each year to include the winter heating season and the summer cooling season. The current sampling program consists of 17 locations that are presented on Plate 3-4. During each event, three ambient air samples are collected from outside the buildings, eight samples are collected from the warehouses, and six samples are collected from within the office spaces. Table 3-3 presents a summary of the ambient air sampling data collected from July 2005 through February 2011. Complete data sets have previously been submitted to NYSDEC in quarterly reports. The data presented in Table 3-3 identify the number of times a compound was analyzed for within each sampling location, the minimum and maximum value for that compound within that sampling location, and then the average concentration collected across all data points.

The analytical results were not screened against standards, criteria, or guidance (SCG) values because very few exist for petroleum compounds in this medium in New York State. Therefore, as a reference data set for the Greenpoint area, the residential data collected by the NYSDEC during the 2006 and 2007 heating season were generally compared to the data collected for the Paragon site and Apollo Street site. Specifically, the compound benzene was utilized in this comparison. Table 3-4 presents the actual benzene results from samples collected from 50 residences either overlying or just outside the off-site PSH plume where both indoor basement air samples and indoor first-floor air samples were collected. Figures 3-2 through 3-4 present a relative comparison between the residential data set and the Paragon and Apollo Street sites data set. With respect to the residential data set, the New York State Department of Health (NYSDOH) has concluded that petroleum related compounds in the off-site PSH plume area are not expected to harm people’s health via the soil vapor intrusion pathway (NYSDOH, 2009).

Figure 3-2 presents the actual benzene concentrations collected in the three current ambient air sampling locations on the site along with the three historical ambient air sampling locations that are no longer being used. The three previous locations were located on the roof of the warehouses and were discontinued due to safety concerns associated with the collection of these samples, especially during winter months. Site data generally show that the benzene concentrations from the site outdoor air range between 1 and 8 micrograms per cubic meter (µg/m³). Since February 2009, the site data show a downward concentration trend. This trend represents an improvement in the outdoor air quality on the site and possibly adjacent to the site. One contributing activity completed by Texaco was the installation and operation of the total fluids recovery system to stop the seep of PSH into Newtown Creek. By the first quarter of 2009, the seep was reduced significantly and only intermittent sheens were present. This activity may have had an effect on the outdoor air quality at the site. The data points from the 50 residences were all collected at the same season and year. The results are distributed along the X axis on the graph. The data present the range of residential data within the close proximity of the site industrial data. The data indicate that the benzene concentration in the outdoor air at the site is similar to the concentration of benzene in the indoor air of residences in the community. This comparison suggests that the outdoor air on the site is not being adversely affected by the below grade PSH.
Figure 3-3 presents the benzene concentration in the indoor office ambient air for the site. The complete data set from 2005 through February 2011 for each of the six office sampling locations are presented on the graph. The site office concentrations are primarily within 1 to 8 $\mu$g/m$^3$ concentration range but also show a decline since February 2009. This decline could possibly be related to the improvement of outdoor air quality and also the sealing of the cracks and seams in the warehouse floors as there could be some connectivity between the warehouse air and the office air. Presented on this figure are also the NYSDEC residential data from the 50 community residences. This figure includes the indoor basement air concentrations and the indoor first-floor air concentrations. The residential indoor air data set is similar but yet slightly lower than the site benzene data set prior to February 2009. However, since February 2009, the concentration of benzene in the office ambient air has declined to within the residential indoor ambient air range.

Figure 3-4 presents a comparison of the data from the indoor warehouse ambient air samples versus the residential indoor air data for benzene. The declining trend since February 2009 is also evident on this graph as concentrations are generally below 10 $\mu$g/m$^3$ since August 2009. This declining concentration could be a function of the mitigation of the seep, the ongoing sealing of cracks and seams in the warehouse, and also to some extent the operation of the SSD system in the 50 Bridgewater Street rear office space.

The operation of the SSD, the twice-annual ambient air sampling program, and the ongoing pathway elimination program will continue at the site.

### 3.3 Sub-Slab Depressurization System

A voluntary Sub-Slab Depressurization (SSD) system was installed and made operational in August 2010. It is located beneath the concrete floor of the 50 Bridgewater Street rear office space (see Plate 3-4). This area of the property was selected for a voluntary precautionary measure because there is limited opportunity for air exchange in this office space. This system was installed to provide additional protection and reassurance for site workers in rooms where outdoor air exchange was more restricted than the warehouse in general. In addition, the depth to PSH below this office floor is shallowest when compared to the two office spaces on Bridgewater Street. This system was designed to draw sub-slab vapors which could potentially infiltrate occupied first floor areas of the building. Operational parameters of the system, including vacuum and atmosphere discharge after treatment, are monitored weekly. Performance data are presented in Table 3-5. Figures 3-4 and 3-5 present the location and process flow schematic for the SSD.

The most recent three months of SSD performance monitoring are presented in Table 3-5. Currently, the system is operating as designed in order to mitigate any potential vapor intrusion risks. The system was designed to generate a vacuum of 0.01 inches of water column throughout the footprint of the office floor. Based on monitoring, the induced subsurface vacuum in the soil...
immediately below the concrete slab are consistently above 0.01 inches of water column. This distribution of the subgrade vacuum is maintained with flow rates generally in the 10 cubic feet per minute (cfm) range. The off-gases are treated with granular-activated carbon (GAC). The system is currently monitored on a weekly basis to prevent the discharge of any petroleum VOCs to the atmosphere and to maintain a methane gas concentration in the off-gas of <20% of the lower explosive limit (LEL) or <1% methane in the extracted gas. The concentration of methane in the extracted gas is consistently below 0.05%.

3.4 Seep Mitigation Action

SAIC has operated a Total Fluids Recovery (TFR) system along the bulkheads at the location of a former PSH seep through the bulkhead since September 2007. The primary objective of the TFR system was to stop the seepage of PSH and sheens into Newtown Creek by maintaining hydraulic control of the gradients behind the bulkhead. Other actions taken in the past include installing a grout curtain on the landward side of the steel bulkhead (2006) and monitoring PSH and groundwater elevations to evaluate the hydraulic effects of the pumping wells. The current objective of the TFR system is to maintain the permanence of stopping the seep.

The TFR system has been successful at stopping the seep of PSH entirely and reducing the presence of sheens to an infrequent occurrence. Only one observed sheen was recorded within the booms during the fourth quarter of 2010, and two were recorded in 2011 through June 19, 2011. Figure 3-7 presents the decrease in sheens in the boom system through June 19, 2011. The success of the TFR system in stopping the seep has contributed to the improvement of air quality on the site, both indoor and outdoor.
**4.0 REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES**

This section defines the media and constituents of concern and identifies the Remedial Action Objectives (RAOs) for the site.

### 4.1 Media and Constituents of Concern

Petroleum constituents are present in the soil at the site. The constituents consist of petroleum VOCs and PAHs. The petroleum VOCs consist of benzene, xylenes, and trimethylbenzene isomers and are present in a very limited extent on-site. The petroleum VOC concentrations exceed the Industrial SCOs and are associated with the PSH in the saturated zone and not the upper unsaturated zone.

Several PAHs are present in the soil throughout the site. The concentrations only slightly exceed the Industrial SCOs. They are related to pyrogenic activities and may have been present in the soil when it was placed at the site as fill material or could have been associated with the incinerator activities on the Apollo Street site. The alternatives analysis will assess the mitigation of the soil at the site.

Both petroleum and nonpetroleum-related VOCs are present at low concentrations in ambient air samples that have been collected at the site since 2005. The analytical results were not screened against SCG values since very few exist for this media in New York State. As a reference point, the site ambient air data were qualitatively compared to the Greenpoint residential indoor air investigation conducted by the NYSDEC during the winter of 2006-2007. The evaluation of alternatives will also address mitigating any potential risk from vapor intrusion into the site warehouses, site office space, and ambient air outside on the property.

### 4.2 Remedial Action Objectives

RAOs have been developed for the site using guidelines specified in DER-10. The RAOs are medium-specific objectives for the protection of human health and the environment and are developed based on contaminant-specific SGCs. RAOs are considered during the identification of remedial technologies and the formulation of the alternatives and during the evaluation of the remedial alternatives. The evaluation of alternatives will focus on mitigating risk associated with the impacted soil and potential impacts to ambient air. The RAOs developed for the site and as presented in the Site Corrective Action Plan are as follows:

1. Prevent ingestion and direct contact with impacted soil.
2. Prevent inhalation of or exposure from constituents volatilizing from the soil.
3. Prevent migration of constituents that would result in groundwater or surface water impacts.
4. Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at the site.
5.0 REMEDY SELECTION CRITERIA

Chapter 4 of the NYSDEC publication DER-10 “Technical Guidance for Site Investigation and Remediation” provides guidance for developing Remedial Goals and Objectives, criteria to consider, and provides a framework to evaluate and select remediation alternatives using the criteria. The first two selection criteria are “threshold” criteria which must be met for an alternative to be considered for selection. The remaining criteria are intended to help guide the selection through a balanced approach. After the decision document is finalized and any public comments are received, community acceptance (part of the Land Use evaluation) is weighed by the NYSDEC prior to selecting a remedy.

5.1 Overall Protectiveness of the Public Health and the Environment

Overall protectiveness of the public health and the environment is a threshold criterion. It is to evaluate how the alternative controls any existing or potential human exposures or environmental impacts and achievement of each of the RAOs. It draws on the assessments of the other criteria.

5.2 Conformance with Standards, Criteria, and Guidance

Conformance with SCGs is a second threshold criterion which must be met for an alternative to be considered for selection. SCGs are to be identified, and the remedy is evaluated for compliance with each. For SGCs that will not be met, documentation must be submitted to the NYSDEC. Consideration is also to be given to guidance which, through the application of scientific and engineering judgment, is determined to be applicable.

5.3 Long-Term Effectiveness and Permanence

Constituents remaining on-site after the implementation of the selected remedy, including engineering and institutional controls, would be evaluated for human or environmental exposures and impacts. Evaluation of any engineering and/or institutional controls includes description of the mechanisms to assure their continued application and enforcement, as well as possible public costs or financial assurance requirements.
5.4 Reduction of Toxicity, Mobility, or Volume of Constituents

Preference is given to remedies that permanently or significantly reduce toxicity, mobility, or the volume of constituents.

5.5 Short-Term Impact and Effectiveness

The short-term impact and effectiveness criterion reviews the human health and environmental exposures which may occur during implementation of the selected alternative, including measures or controls needed to mitigate these exposures.

5.6 Implementability

The implementability criterion evaluates the feasibility of implementing and monitoring the remedy. This includes expected construction challenges, such as availability of labor and materials, access, permitting, likelihood of success for novel approaches, and the reliability and viability of the controls. Impracticability of implementation for the selected remedy may be a conclusion of this analysis.

5.7 Cost-Effectiveness

Total estimated cost of designing and implementing a solution—including engineering, permitting, construction, operation and maintenance, monitoring and institutional management—is compared to the effectiveness of the solution. This criterion defines its cost-effectiveness.

5.8 Land Use

This evaluation considers the current use and the reasonably anticipated future land use, considering the current use of a fully developed site the best guide for future use. Consistency of proposed use with zoning, comprehensive master plans, and local waterfront revitalization plans as formally adopted by a municipality is considered. This evaluation also considers community concerns including proximity to residential land uses, citizen participation activities, and environmental justice.
6.0 DEVELOPMENT AND EVALUATION OF REMEDIAL ALTERNATIVES

Various remediation alternatives to address documented conditions for the site soil and soil vapor are presented in this section. This chapter also includes the evaluation of the alternatives with respect to the remedy selection criteria.

6.1 Development of Alternatives

Remediation technologies and processes were identified for further evaluation based on the RAOs, general response actions, and treatment technologies available.

While this report is focused on actions to remediate only site soils and site soil vapor, there are additional significant continuing efforts that will be conducted concurrently to address the PSH plume, both on and upgradient of the site, and to prevent PSH from discharging into Newtown Creek. Additional voluntary efforts have been undertaken and are ongoing that provide reassurance to site workers that they are not exposed to potential vapor intrusion of petroleum compounds from the subsurface.

6.1.1 No Action

Consideration of the No Action alternative is required by DER-10. The No Action alternative involves taking no further action to remedy site conditions. This alternative does not include remedial action, institutional or engineering controls, or long-term monitoring.

6.1.2 Monitored Natural Attenuation

No active remediation activities would be undertaken. Instead, natural biological, physical, and chemical processes would be relied upon to reduce the mass, toxicity, mobility, volume, and concentration without active intervention. Such attenuation would be monitored to evaluate when reductions to meet the selected standards are achieved. Monitoring would continue until those standards are achieved.

6.1.3 Pathway Elimination and Institutional Controls

The pathway elimination and institutional controls alternative combines a series of risk mitigation activities. The institutional control is the use of the Industrial SCOs within the M3-1 manufacturing zoning district where the site is located. The pathway elimination is an ongoing program to maintain the competency of the floor throughout the series of warehouses on the site.
in order to prevent the vapor intrusion. This ongoing activity began in July 2009 where cracks in
the floors are sealed with a high-strength epoxy while expansion seams in the floor are sealed
with a durable caulking material. There has been an ongoing ambient air monitoring program at
the site where outdoor ambient air, warehouse ambient air, and office space ambient air are
monitored twice a year during both the heating season and the cooling season. This program has
been ongoing since 2005 and will continue as part of this alternative.

Another component of this alternative involves additional voluntary precautionary measures
taken at the three office locations on-site. The three locations are presented on Plate 3-4. The
alternative includes the continued operation of the SSD system in the rear office space of 50
Bridgewater Street. This alternative also includes precautionary vapor intrusion soil vapor
extraction (SVE) wells installed by ExxonMobil adjacent to the two office spaces along
Bridgewater Street. At the front office location of 50 Bridgewater Street, well SVE-13 is
located. At the office space for 16 Bridgewater Street, extraction wells SVE-11 and SVE-12 are
located. These wells are currently not operational but are being held in reserve if ambient air
data in the future suggest operation of these wells is necessary.

### 6.1.4 Soil Vapor Extraction

This method uses vapor phase vacuum pumps to exchange the interstitial air in the soils. Natural
partitioning of chemicals of concern into the interstitial air and continued replacement of that air
may eventually reduce the mass, toxicity, mobility, volume, or concentration of these chemicals.
This technology is suitable for removing volatile compounds and not suitable to remove semi-
volatile compounds.

The conceptual design for an SVE system would involve the installation of approximately 50 to
100 SVE wells within the series of warehouses on the site. The actual number would be refined
and based on several pilot tests prior to the design and installation of a full-scale system.
However, an extensive uniformly spaced well field would be necessary to capture petroleum
vapors emanating from the PSH in the saturated zone. The wells would be manifolde through a
series of laterals in manifolds located both below and above grade in the warehouses. It is
estimated that several thousand feet of piping would be required to construct such a system.
Each well would be equipped with individual devices to monitor vacuum, flow rate, and
petroleum VOC concentrations. All wells would be manifolde to one or more vacuum blower
units with off-gas anticipated to be treated through an oxidation process. Long-term monitoring
would be conducted at a minimum of once per week in order to maintain optimal performance of
such a large-scale system.

### 6.1.5 Soil Excavation

The soil excavation approach involves the physical removal of the impacted soil from the site
which would reduce the mass of contaminants at the site. All excavation activities would be
conducted within the series of warehouses. This approach would require shutting down individual warehouses while excavation activities are ongoing in order to ensure the protection of on-site employees. In addition, structural supports for the building would be required as the buildings are currently supported by underlying wooden pilings. Based on the extent of soil contaminant PAH concentrations, it is possible that the Apollo Street building would need to be razed prior to excavation activities. Preliminary calculations estimate that approximately 110,000 cubic yards of soil would require excavation with off-site transportation for disposal, treatment, or beneficial reuse.

6.2 Evaluation of Alternatives

The detailed analysis of alternatives consists of the analysis and presentation of the relevant information needed to select a site remedy. Each proposed alternative is assessed by the evaluation criteria prescribed by NYSDEC and summarized in Chapter 5.0 of this report. The results of this assessment will provide sufficient information to compare the alternatives and to document the methodical selection of an appropriate remediation for the site soils and soil vapors. Table 6-1 presents a summary of the comparison of remedial alternatives.

6.2.1 No Action

The No Action alternative at this site will not remove or contain the constituents in the site soils and soil vapor. Thus, it cannot achieve the RAOs. This option is not compliant with the remediation goals and objectives which include reduction in the mass, toxicity, mobility, volume, or concentration of compounds of concern. Since these two evaluation criteria are NYSDEC-mandated threshold criteria, the No Action alternative is not considered for selection.

6.2.2 Monitored Natural Attenuation

Monitored natural attenuation relies on existing natural biological, physical, and chemical processes to reduce the mass, toxicity, mobility, volume, or concentration of the constituents of concern. Using this approach, no attempt is made to introduce amendments to the subsurface to accelerate the removal process.

This alternative may not be completely protective of the public health and the environment because even though the compounds under the warehouse slab and outside pavement are currently isolated, vapor could potentially migrate through the barriers if they are not maintained in the future. Because the vapor pathway is not completely eliminated, this alternative is not selected.
6.2.3 Pathway Elimination and Institutional Controls

The pathway elimination and institutional controls alternative combines a series of risk mitigation activities. It includes an ongoing program to maintain the competency of the floor throughout the warehouses to prevent vapor intrusion. This activity began in July 2009 where cracks in the floors are sealed with a high-strength epoxy while expansion seams in the floor are sealed with a durable caulking material. Operation of the SSD system in the rear office space of 50 Bridgewater Street (since 2010), in conjunction with the ambient air monitoring program (since 2005), is another part of this alternative. Monitoring has shown that these activities are effective.

The mass of the constituents is expected to decline with time as current on-site PSH and groundwater removal systems continue to reduce mass in the subsurface. In addition, a site-wide alternatives analysis for groundwater and PSH is being developed, and once that remedy is implemented, the mass reduction in the saturated zone will accelerate.

This alternative also includes soil vapor extraction (SVE) wells (precautionary vapor intrusion wells) installed by ExxonMobil adjacent to the two office spaces along Bridgewater Street. At the front office location of 50 Bridgewater Street, well SVE-13 is located. At the office space for 16 Bridgewater Street, extraction wells SVE-11 and SVE-12 are located. These wells are currently not operational but are being held in reserve if ambient air data in the future suggest operation of these wells is necessary.

The institutional controls for this alternative include the use of the Industrial SCOs within the M3-1 manufacturing zoning district where the site is located. Continuation of the SSD system and ambient air monitoring program is planned.

The pathway elimination and institutional controls alternative removes all possible pathways including inhalation, incidental ingestion, and incidental contact with soil and soil vapors. This alternative achieves all RAOs, and with the long-term monitoring and maintenance program, the long-term effective and permanence is rated as high. With the pathway elimination, the potential for toxicity and mobility is removed.

The implementability of this alternative within the very active warehouses is rated highly effective and desirable, as there is very minimal disruption to the current site business operations.

Although the implementability of the current activities and the planned activities is rated as high, the coordination and the actual completion of the activities are still required to be completed during off-hours such as weekends or between work shifts. This type of scheduling has been required in the past and will continue to avoid the physical hazards associated with the extensive forklift traffic in the warehouse and the minor nuisance odors that are created when monitoring.
wells are opened up for gauging and sampling events. This type of off-hour scheduling also removes warehouse workers from potential vapor exposure.

With this alternative, the continued collection and evaluation of the ambient air data will be used to determine if additional mitigation measures are warranted.

Other site conditions contribute to the reduction of completed pathways and site worker risk. This includes factors that contribute to the exchange of air within the series of warehouses and include garage bays and ventilation fans associated with Empire Merchants operations. These features are presented on Plate 3-4. In 2009, six large ventilation fans were installed in the Apollo Street site, and an additional six fans were installed in the 50 Bridgewater Street warehouse. Each fan is 4.5 feet by 4.5 feet in size and was installed to decrease humidity buildup within the warehouses and to maintain more comfortable working conditions for the employees in the warehouses. These fans contribute to the air exchanges in the 42 Bridgewater Street warehouse and to an extent the 16 Bridgewater warehouse because all four warehouses are connected. The fans operate primarily from the late spring to early fall. Operation of the ventilation system is on an intermittent basis. On the north side of the 16 Bridgewater Street warehouse, there are a total of 30 garage bays, each 8 feet wide by 9 feet high, and at the south end of 50 Bridgewater Street are three large garage bays. These bays are part of the facility operations and are used to load outgoing trucks and offload incoming trucks. The daily use of these garage bays further contributes to air exchanges in the warehouses.

Actions being taken on-site and in the off-site areas contribute to lessening the total amount of PSH present in the subsurface, thus reducing the source for subsurface vapor creation. Finally, because most of the soil concentrations are already within approximately one order of magnitude of the Industrial SCOs, given time, the toxicity, mobility, or volume of compounds of concern is expected to diminish to below the NYSDEC Industrial SCOs.

6.2.4 Soil Vapor Extraction

SVE would require the installation of numerous vacuum recovery wells throughout the active warehouses. In addition to the construction of the wells, pipe runs to a centralized location where the vacuum blowers and off-gas control systems would be maintained. If constructed in the floor or suspended overhead, the construction impacts of these pipe runs will be significant to the operations of the ongoing business in the warehouse, and they will represent an open exposure pathway to site workers during construction. With the wide layout of the well field, the pipe runs will also be extensive. Maintenance of the repaired slab will likewise be extensive. If the utility runs are placed overhead or along walls, there will be a continuing risk of a complete exposure pathway to site workers if a pipe is damaged or requires maintenance.
Implementability is a serious weakness of this remediation approach. Construction of the systems would certainly require relocation or disruption to the existing ongoing warehouse business. Maintenance activities may also require the occupant to make adjustments to owner operations.

The long-term performance of an SVE system is contingent upon the quality of the operations, maintenance, and monitoring (OM&M) program to ensure optimal performance. A system of this size, with approximately 50 to 100 extraction wells, would require at a minimum weekly OM&M. Maintenance and monitoring of the well field inside the warehouse would require that this task be completed during off-hours such as in between warehouse work shifts or weekends. This is how currently ongoing activities such as monitoring well gauging, groundwater sampling, and other activities are completed inside the warehouses.

The complicated coordination and scheduling required in completing the work during off-hours does not lend itself to the optimal operation of the system, as maintenance activities are often needed to be completed in response to the actual operating conditions of the system. Significant downtime for an SVE system may allow petroleum vapors to accumulate in the extraction piping or to accumulate closer to the underside of the concrete floor. Since the PSH is a source of the vapors, any type of SVE well construction would inherently pull vapors upward toward an extraction point, which brings them closer to the slab. With this type of removal scenario, in order to be successful, it is critical that the system maintain a very high operational uptime. A monitoring program based on off-hours and weekend schedules is not conducive to maintaining an optimal operational uptime.

6.2.5 Soil Excavation

Remediation of the site soils and soil vapors by excavation was considered and found not feasible for a number of key reasons. The size of the excavation required and the resources needed to implement it would simply not be commensurate with the impacts observed. Complete disruption of the operations of the owner’s business would not be a reasonable response to the site conditions presented.

In addition to these primary concerns, there are serious logistical concerns with any excavation, and even more with one in the city. Demolition of the warehouses to implement the option would increase resource requirements and employment disruption. Even if demolition is not required, structural stability of the building would be of great concern as the buildings are supported by below grade wooden pilings and the steel bulkhead is supported by below grade cable tie backs. Removal of soil adjacent to the pilings and tiebacks could cause failure of the structures.
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The volume of soil, estimated at 200,000 tons, would need to be transported to an offsite facility for disposal, treatment, or recycling. Then a large source of clean backfill is required. Depending on the size of the transport trucks, approximately 1,000 trucks may be needed for each way of soil hauling. This tremendous volume of truck traffic in the Greenpoint community and beyond will create safety hazards with respect to potential accidents with other vehicles and pedestrians. The truck exhausts and the potential generation of dust through the community would also create additional risks to public. Safety concerns would also arise for onsite workers with the potential for direct exposure to soil vapors during the excavation. Excavation is not a practical option.

6.3 Selected Remedy and Remedy Components

This section presents a discussion of the selected remedy and the primary components of the remedy. The remedy selection was based primarily on the RAOs and the criteria presented in DER-10, as previously discussed. Based on the evaluation of alternatives, the recommended remedy is one identified as pathway elimination and institutional controls. This alternative was selected because it satisfies the threshold criteria and provides the best balance of criteria previously described. The six primary components of this remedy are described in the following subsections.

6.3.1 Institutional Controls

The institutional controls will be based on the designated land use. Currently, the site has an M3-1 manufacturing zoning district. These districts are designated for areas with heavy industries within New York City. Adjacent properties are also within the manufacturing zoning districts. In addition, the site is located within a Significant Maritime Industrial Area as designated by New York City. Within this area, manufacturing and industrial activities are promoted and encouraged by New York City. Because of these two institutional controls, the long-term land use is not expected to change. Based on historical information, this site has been used for nonresidential purposes since the late 1800s. Based on these land designations, the Industrial SCOs have been used to evaluate conditions in the soil.

The existing Administrative Order on Consent between Texaco and the NYSDEC is another institutional control mechanism that ensures continued risk mitigation and remediation.

6.3.2 Pathway Elimination Program

The continued elimination of the vapor migration pathway is a component of the selected remedy. The site surface is covered by concrete in the warehouses and office space and covered by asphalt outside of the buildings. Since July of 2009, a total of 578 cracks and/or seams have been sealed in the warehouses, which equates to approximately 5,884 linear feet of potential
pathways that have been sealed. The cracks and seams in the warehouse have been sealed using a two-party epoxy on the cracks, caulking on the seams, and then also a concrete sealant along seams where floor slabs adjoin vertical block walls. A hydraulic type cement that expands as it sets will be used to fill cracks. The resulting seal has strong bonding qualities and after seven days the compression strength is 8,000 psi. Common masonry techniques in accordance with manufacturer specifications will be followed when applying the hydraulic cement.

Most of the seam and crack sealing work was completed in July 2009 and July 2010. Another inspection and maintenance event is planned for July 2011. These events correspond to a two-week period of July when the warehouse is shut down for vacation. It is at this time that forklift traffic and operations cease and extensive work can be completed in the warehouses. During each event, particular attention has been and will continue to be paid on high-traffic areas where cracks may be more prevalent and seams in adjoining concrete slabs may be deteriorating due to the forklift traffic. In addition to the annual maintenance events, there have been periodic events where sealing and maintenance have been completed by Empire Merchants and Texaco.

During the planned July 2011 maintenance event, potential pathways will again be identified and sealed. Two areas of note are where the 42 Bridgewater Street warehouse floor adjoins the 50 Bridgewater Street interior wall and where structural I-beams protrude through the slab. All seals will be inspected to ensure they sufficiently mitigate these potential pathways. Concrete and/or epoxy will be applied as needed. In addition, any other utilities that protrude through the floor, such as roof drains, will be inspected at the base for preferential migration pathways. Future maintenance events will be scheduled annually and periodically as needed.

### 6.3.3 Ambient Air Monitoring

The ambient air monitoring program will continue on a semiannual basis, with one event completed during the winter heating season and one event completed during the summer cooling season. Each event will include 18 sampling locations. Seventeen other locations are presented on Plate 3-4, and one additional location will be added. In the northeast corner of 16 Bridgewater Street, an additional Summa canister will be set up in the dispatch area by the entrance to the building. Each sampling event will consist of using Summa canisters to collect ambient air samples over a 24-hour period. Canisters are typically set up on Saturday morning and picked up on Sunday morning. During these sampling events, both the offices and warehouses are closed. All samples will continue to be analyzed by Method TO-15.
6.3.4 Sub-Slab Depressurization System

The SSD system will continue to operate in the rear office space of 50 Bridgewater Street. The system was voluntarily installed by Texaco as another preventive measure to further minimize the risk for vapor intrusion in that office space. Monitoring of the system will continue on a weekly basis.

6.3.5 Bridgewater Street Precautionary Vapor Intrusion Wells

ExxonMobil installed three precautionary vacuum extraction wells on Bridgewater Street. The purpose of these three wells was to add an additional measure of protection to the two office spaces located on Bridgewater Street. Well SVE-13 is located by the front office of 50 Bridgewater Street, while two additional wells, SVE-11 and SVE-12, are located by the office space at 16 Bridgewater Street. Each of the three wells is currently connected to ExxonMobil’s existing SVE system. These wells are currently not operating but could be activated in a relatively short period of time in response to any data that are collected that suggest these wells need to be activated. These three wells, in conjunction with the SSD system mentioned above, provide an additional measure of protection for the office spaces. These additional active precautions are needed for the office spaces as they are inherently less well ventilated than the much larger warehouse spaces with the ventilation fans and garage base.

6.3.6 Reporting

All activities will be implemented in conjunction with the selected remedy and will be reported to NYSDEC in the current quarterly reporting program within the consent order. All components of this selected remedy will be evaluated in detail on an annual basis in order to ensure the protection of site employees. With each annual review, qualifications to the selected remedy through either upgrades or downgrades will be presented to the NYSDEC.
7.0 CONCLUSIONS

Based on the results of the soil and soil vapor alternatives analysis, the following conclusions are drawn concerning the Paragon site and the Apollo Street site.

1. The only petroleum VOCs that exceed the Industrial SCOs are benzene, xylenes, and trimethylbenzenes, and their distribution is limited to three sample locations.
2. The petroleum VOCs that exceed the Industrial SCOs are associated with the PSH in the upper saturated zone.
3. Four PAHs exceed the Industrial SCOs. The PAHs are the large four- and five-ring PAHs that are non-volatile and highly insoluble.
4. The soils at the site are capped by both concrete and asphalt and are not exposed to erosional forces.
5. The ongoing ambient air monitoring program at the site indicates that no indoor air hazards associated with the underground petroleum exist.
6. The selected remedy for the soil and soil vapor includes pathway elimination and institutional controls.
7. The primary components of the selected remedy are the M3-1 Industrial Zoning District and the Significant Maritime and Industrial Area classification for the site and surrounding properties.
8. Additional components of the remedy include the continuation of the ambient air monitoring program, the continuation of the pathway elimination program by continuing the maintenance of the warehouse floor slabs, the continued operation of the SSD system, and the presence of the ExxonMobil SVE wells that are on Bridgewater Streets for the front offices.
8.0 REFERENCES


New York State Department of Environmental Conservation Division of Environmental Remediation, 2010. Technical Guidance for Site Investigation and Remediation (DER-10).


