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OPERABLE UNIT 3
FINAL FEASIBILITY STUDY

Sunnyside Yard
Queens, New York

Prepared for:

NATIONAL RAILROAD PASSENGER CORPORATION
Washington, D.C. 20002

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ACRONYM AND UNIT DEFINITIONS

AMTRAK	National Railroad Passenger Corporation
API	American Petroleum Institute
Area	Area of Concern
ARARs	Applicable or relevant and appropriate requirements
AWQSGV	Ambient Water Quality Standards and Guidance Values
bls	Below land surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CAMP	Community Air Monitoring Plan
C&D	Construction and Demolition
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CFU/gram	Colony-forming unit per gram
COCs	Compounds of Concern
Conrail	Consolidated Rail Corporation
COPCs	Chemicals of Potential Concern
cPAH	Seven specific PAHs that the NYSDEC considers carcinogenic
CY	Cubic Yards
DER	Division of Environmental Remediation
DRO	Diesel Range Organics
EA	Exposure Assessment
FS	Feasibility Study
GRA	General Response Action
HDPE	High Density Polyethylene
HRO	Heavy Range Organics
HST	High Speed Trainset
HSTF S&I	High Speed Trainset Facility Service & Inspection
IHWDS	Inactive Hazardous Waste Disposal Site
IRM	Interim remedial measures
LIRR	Long Island Rail Road
mg/kg	Milligrams per kilogram, equal to 1,000 µg/kg

ACRONYM AND UNIT DEFINITIONS

μg/kg	Micrograms per kilogram, equal to 0.001 mg/kg
mg/L	Milligrams per liter
μg/L	Micrograms per liter
$\mu g/cm^2$	Micrograms per square centimeters
MNA	Monitored Natural Attenuation
msl	Mean sea level
mV	Millivolt
NAPL	Non-Aqueous Phase Liquid
NCP	National Contingency Plan
NIOSH	National Institute for Occupational Safety & Health
NJTC	New Jersey Transit Corporation
N:P:K	Nitrogen: Phosphorus: Potassium Ratio
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
OOC	Order On Consent
OM&M	Operation, Maintenance and Monitoring
ORP	Oxidation-reduction potential
ORS	Oil Recovery Systems
OU	Operable Unit
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
ppm	Parts per million, equivalent to mg/kg
psi	Pounds per square inch
PVC	Polyvinyl chloride
RAOs	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
Redox	Oxidation-reduction
RI	Remedial Investigation
ROD	Record of Decision
RSCOs	Recommended Soil Cleanup Objectives

ACRONYM AND UNIT DEFINITIONS

SCGs	Standards, Criteria and Guidance
SPH	Separate-Phase Petroleum Hydrocarbon
STARS	Spill Technology and Remediation Series
SVOCs	Semivolatile Organic Compounds
TAGM	Technical and Administrative Guidance Memorandum
TBC	To Be Considered
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substance Control Act
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds
Yard	Sunnyside Yard, Queens, New York

EXECUTIVE SUMMARY

On behalf of the National Railroad Passenger Corporation (Amtrak) and the New Jersey Transit Corporation (NJTC), Roux Associates, Inc. (Roux Associates) and Remedial Engineering, P.C. (Remedial Engineering) have prepared this Feasibility Study (FS) for Operable Unit 3 (OU-3) of the Sunnyside Yard (Yard), Queens, New York (Figure 1).

Site Setting

Sunnyside Yard is located at 39-29 Honeywell Street, Sunnyside, Queens County, New York. The Yard is a railroad maintenance and storage facility that currently encompasses approximately 133 acres. As shown on Figure 1, the East River is located approximately one mile to the west while Newtown Creek, which defines the border between Queens and Kings counties, is located less than 0.5 mile south of the western portion of the Yard. The Yard is bordered by commercial/residential properties, with Northern Boulevard located to the north, 42nd Place located to the east, Thompson Avenue to the west, and Skillman Avenue located to the south.

The Sunnyside Yard is listed as a Class II Site in the New York State Department of Environmental Conservation's (NYSDEC) Registry of Inactive Hazardous Waste Disposal Sites. As a result of the listing for the entire Yard, Amtrak, NJTC, and the NYSDEC entered into an Order on Consent (OOC) Index #W2-0081-87-06, effective September 1989. In accordance with the OOC, the Yard was subdivided into six OUs in 1997, as shown on Figure 2 and described below:

- OU-1: Soil above the water table within the footprint of the HST Facility Service and Inspection (HSTF S&I) Building.
- OU-2: Soil above the water table within the footprint of the HSTF S&I Building ancillary structures (i.e., the access road and utilities route, the parking area, the construction easement area which surrounds the building, and the construction laydown area).
- OU-3: Originally the soil and separate-phase petroleum hydrocarbon (SPH) accumulation (herein referred to as SPH plume) above the water table in the area previously referred to as Area 1 of the Yard; however, it has expanded to include Areas 6 and 7 of the Yard, and saturated and unsaturated soil. The portion of the sewer system that passes through OU-3 and groundwater beneath OU-3 will be addressed under OU-5 and OU-6 RIs, respectively.
- OU-4: Soil above the water table (unsaturated zone) in the remainder of the Yard.

- OU-5: Sewer system (water and sediment) beneath the Yard.
- OU-6: Saturated soil and the groundwater beneath the Yard (delineation of soil to be conducted as appropriate).

At the time of the creation of the OUs, the New York State Department of Environmental Conservation (NYSDEC) identified the three compounds of concern (COCs) for soil at the Yard: polychlorinated biphenyls (PCBs), seven specific polycyclic aromatic hydrocarbons (PAHs) that the NYSDEC considers carcinogenic (cPAHs) and lead. The seven cPAHs that were identified as COCs by the NYSDEC are benzo(a)anthracene, benzo(a)pyrene, benzo(a)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene. The NYSDEC issued the following cleanup levels for these COCs in soil:

- PCBs (total) – 25 milligrams per kilogram (mg/kg);
- cPAHs (total) – 25 mg/kg; and
- Lead – 1,000 mg/kg [1].

OU-3, which is the subject of this document, encompasses approximately eight acres in the north central portion of the Yard. A portion of OU-3 includes property owned by the Long Island Rail Road (LIRR). OU-3 consists of unsaturated and saturated soil and SPH above the water table. There are nine USTs, and subsurface structures located within the OU-3 boundary. The subsurface structures include the former Engine House foundation, exterior Engine House inspection pits, interior Engine House service pits, the former Oil House basement, the former Turntable, the former Metro Shed foundation and inspection pit, and three fuel pump vaults. The partially demolished Oil House is the only aboveground structure currently present in OU-3. The portion of the sewer and groundwater that lies within the OU-3 boundary will be addressed as part of OU-5 and OU-6, respectively at a later date.

[1] Concentrations discussed in the above text have been conformed to the same, standard units (mg/kg), which are also the same units referenced in EPA regulations. For reference, 1 mg/kg is equal to 1,000 µg/kg.

Disposal History

OU-3 is contaminated predominantly with petroleum products and PCBs. Petroleum disposal is likely attributable to leaks over time associated with one or more of the nine USTs located in OU-3; leaks over time from underground piping associated with the nine USTs; or surface spills over time associated with fuel transfer or train maintenance activities. Disposal of PCBs in OU-3 is likely attributable to losses from and maintenance of train-mounted transformers over time. With few minor exceptions, specific locations, dates, or quantities of petroleum or PCB disposal are not known.

The primary objective of this FS will be to determine the most appropriate remedial alternative to address the media of concern. The FS will achieve this objective through the identification, development, and evaluation of alternatives to remediate the various impacted media in OU-3.

Nature and Extent of Contamination

A comprehensive evaluation of the nature and extent of contamination in OU-3 based on the collective results of previous RI investigations was performed and summarized below.

<u>SPH Plume</u>

Contamination in OU-3 included hydrocarbon- impacted soil and a plume of SPH floating on the water table. At its largest, this SPH plume was approximately 3 acres, which was located east of the Engine House and west of a former Turntable. Most or all of the SPH was south of LIRR's tracks and north of the Metro Shed. The SPH plume and some of the soils in OU-3 have contained and continue to contain varying levels of PCBs.

Three previous IRMs have removed and disposed of approximately 11,500 gallons of SPH. Only a small portion of the SPH plume (approx. 0.5 acre) has an apparent product thickness that equals or exceeds 0.5 feet (Plate 2). This SPH "plume core" may also be defined as the extent of mobile SPH. Based on the Brooks–Corey model findings, the extent of mobile SPH in OU-3 lies within the 0.5-foot SPH thickness contour. The migration of the SPH plume is prevented by a variety of conditions in OU-3. Migration of the SPH plume is prevented to the south and west by existing building foundations and is passively captured by the Interceptor Trench installed as part of the third SPH IRM (located at the northern property boundary and northern extent of the plume core) where the SPH is being recovered. In addition, tight (low permeability) soil units are preventing migration to the north and west. Migration of the plume to the east is prevented by the west/northwest groundwater flow direction.

Soil

In total, 122 PCB samples, 54 cPAH samples, and 88 lead samples were collected and analyzed during the various investigations in OU-3. The NYSDEC-recommended soil cleanup levels for at least one of the three COCs (PCBs, cPAHs, and lead) were exceeded in soil samples from seven boring locations: PCBs in 821-E and CS-76; cPAHs in HST-22A and HST-22B; and lead in HST-28, MW-58, and S-62. Approximately 1,625 cubic yards of soils exceeding the site-specific cleanup levels were removed from five locations as part of the three soil IRMs (Figure 4). The remaining two locations will be addressed in this FS..

In addition to the soil contamination described above, an area of approximately 0.5 acres of hydrocarbon-impacted surface soil was delineated visually and the impacts were found to be limited to the unsaturated zone (Plate 2). Based on observations from soil borings completed within this area, the average depth of the hydrocarbon impacts is approximately one foot below land surface (bls).

Subsurface Structures

The subsurface structures within OU-3 include the interior Engine House service pits, the exterior Engine House inspection pits, the Oil House basement, the former UST Areas (and former Fuel Transfer Areas), the former Metro Shed inspection pit, and the former Turntable (Figure 3). Each of these structures has been investigated and determined not to be continuing sources of SPH. Additionally, the investigations of the Oil House basement and former Turntable determined that these structures are no longer areas of concern and require no further remedial action and evaluation in this FS.

Several remedial actions have been implemented at the former Engine House interior service pits. However, continued deterioration caused groundwater to seep into the pit. The interior Engine House pits were subsequently covered with a concrete slab. Sludge and SPH samples collected from the west drop table pit prior to covering with the concrete slab detected PCB concentrations of 512 mg/kg and 517 mg/kg, respectively.

A recent investigation of the UST Areas was performed during the Pre-Design Study to confirm the method of closure for each tank and the potential for these USTs to be acting as a continuing source of SPH contamination to surrounding soil. The USTs were found to be filled with sand and/or water. The observations made during investigation of these tanks indicate that the USTs were emptied of product at their time of closure and are not a continuing source of SPH contamination to surrounding soil.

In August 1989, soil samples from the Metro Shed inspection pit were found to contain petroleum hydrocarbons and PCBs. In 1997, the Metro Shed inspection pit was cleaned and backfilled with sand. During an investigation in 2001, no SPH was observed in the soil sample collected from a boring completed in the western portion of the Metro Shed inspection pit. Based on the field observations, it does not appear that there is residual impacted material within the Metro Shed inspection pit.

Remedial Action Objectives

Remedial Action Objectives (RAOs) are medium-specific objectives developed for the protection of public health and the environment and are expressed with regard to the concentration of COCs and potential exposure routes. As such, the RAOs are based on the results of the fate and transport analysis and the exposure assessment provided in the Final OU-3 RI Report.

The following are the RAOs for the residual SPH and associated hydrocarbon-impacted soil:

- Prevent ingestion of, direct contact with, and/or inhalation of COCs in soil that exceed the site-specific NYSDEC-recommended soil cleanup criteria;
- Prevent the migration of contaminants to groundwater from soil that exceeds the site-specific NYSDEC-recommended soil cleanup criteria for COCs;
- Prevent inhalation of, or exposure to, COCs volatizing from soil;
- Removal of mobile SPH; and

- Reduce the mass of SPH in the subsurface to the action-specific SCGs (SPH performance criteria) and treatment performance goal to the extent practicable.

The RAOs for the subsurface structures include the following:

- Prevent the migration of subsurface structure contents in exceedance of the site-specific NYSDEC-recommended soil cleanup levels and other applicable standards, criteria, and guidance (SCGs) and the potential for impacts to soil and groundwater;
- Prevent direct contact, ingestion, and inhalation of hydrocarbon-impacted materials within the subsurface structures in exceedance of the site-specific NYSDEC-recommended soil cleanup levels and other applicable SCGs.

Evaluation of Remedial Technologies and Alternatives

Potential remedial technologies that may be employed in OU-3 to achieve the RAOs are identified, evaluated, and screened. The evaluated remedial technologies are chosen based on evidence of their success in addressing mobile and residual SPH and associated hydrocarbon-impacted soil, as well as the impacted media associated with the subsurface structures. The remedial technologies retained after the screening evaluation are assembled into remedial action alternatives that will address the mobile and residual SPH and associated hydrocarbon-impacted soil and the subsurface structures and will each fulfill one or more of the RAOs.

The remedial action alternatives developed and evaluated for OU-3 are:

Remedial Alternative I:	No Action
Remedial Alternative II:	Excavation of Mobile SPH/Enhanced In Situ Biodegradation of Residual SPH/In-place Cleaning of Engine House Service Pits/ Removal of USTs, Exterior Engine House Inspections Pits, and Fuel Pump Vaults
Remedial Alternative III:	Excavation/Off-Site Disposal and Removal of All Mobile and Residual SPH and All Hydrocarbon-Impacted Soil/Off-Site Disposal of Subsurface Structures and USTs

Recommended Remedial Action Alternative

The recommended remedial action alternative is Remedial Alternative II. This alternative will address all media of concern in OU-3 and will achieve all of the site-specific cleanup goals and RAOs for residual SPH and subsurface structures.

1.0 INTRODUCTION

On behalf of the National Railroad Passenger Corporation (Amtrak) and the New Jersey Transit Corporation (NJTC), Roux Associates, Inc. (Roux Associates) and Remedial Engineering, P.C. (Remedial Engineering) have prepared this Feasibility Study (FS) for Operable Unit 3 (OU-3) of the Sunnyside Yard (Yard) located at 39-29 Honeywell Street, Queens, New York (Figure 1). The Sunnyside Yard is listed as a Class II Site in the New York State Department of Environmental Conservation's (NYSDEC) Registry of Inactive Hazardous Waste Disposal Sites. As a result of the listing for the entire Yard, Amtrak, NJTC, and the NYSDEC entered into an Order on Consent (OOC) Index #W2-0081-87-06, effective September 1989.

1.1 Enforcement Status

In accordance with the OOC, several investigations have been performed at the Yard including a Phase I Remedial Investigation (RI), Phase II RI and Phase II RI Addendum, OU-3 RI and Supplemental OU-3 RI, as well as a health-based Risk Assessment. Each of these investigations was summarized in the Final OU-3 RI report, submitted to the NYSDEC on May 27, 2005 (Roux Associates, 2005a). As a result of these investigations, several areas of the Yard were identified that required remedial action. Based on the results of Yard inspections, discussions with Amtrak personnel, and previous investigations, initially 16 Areas of Concern (Areas) were identified at the Yard. During the Phase I RI, one additional Area was identified giving a total of 17 Areas for the Yard; three of these Areas (Areas 1, 6, and 7) are located within the boundary of OU-3. A description of the three Areas within OU-3 is given below:

Area		Description
Area 1:	Underground Storage Tank and Fueling Area	Nine abandoned underground storage tanks (USTs), former locomotive fueling station, former Engine House, former Metro Shop.
Area 6:	Drum Storage Area (Oil House)	Drum and equipment storage area; formerly the Yard receiving area.
Area 7:	Storage Area	Reported to be a former empty drum storage area; currently no drums stored there.

To accommodate a rigid construction schedule for Amtrak's High Speed Trainset (HST) program and still address site-wide remedial efforts in a timely and orderly manner, with the

NYSDEC's concurrence, in 1997, the Yard was subdivided into six OUs, as shown on Figure 2 and described below:

- OU-1: Soil above the water table within the footprint of the HST Facility Service and Inspection (HSTF S&I) Building.
- OU-2: Soil above the water table within the footprint of the HSTF S&I Building ancillary structures (i.e., the access road and utilities route, the parking area, the construction easement area which surrounds the building, and the construction laydown area).
- OU-3: Originally the soil and separate-phase petroleum hydrocarbon (SPH) accumulation (herein referred to as SPH plume) above the water table in the area previously referred to as Area 1 of the Yard; however, it has expanded to include Areas 6 and 7 of the Yard, and saturated and unsaturated soil. The portion of the sewer system that passes through OU-3 and groundwater beneath OU-3 will be addressed under OU-5 and OU-6 RIs, respectively.
- OU-4: Soil above the water table (unsaturated zone) in the remainder of the Yard.
- OU-5: Sewer system (water and sediment) beneath the Yard.
- OU-6: Saturated soil and the groundwater beneath the Yard (delineation of soil to be conducted as appropriate).

At the time of the creation of the OUs, the NYSDEC also identified the three compounds of concern (COCs) for soil at the Yard: polychlorinated biphenyls (PCBs), seven specific polycyclic aromatic hydrocarbons (PAHs) that the NYSDEC considers carcinogenic (cPAHs) and lead. The seven cPAHs that were identified as a COC by the NYSDEC are benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene; these are the cPAHs discussed in this report. The NYSDEC issued cleanup levels for each of the three COCs in soil are given below.

- PCBs (total) – 25,000 micrograms per kilogram (µg/kg);
- cPAHs (total) – 25,000 µg/kg; and
- Lead – 1,000 milligrams per kilogram (mg/kg) [1].

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[1] Concentrations discussed in the text are in the units they were provided by the laboratory. Likewise, the table and figures in this report are presented in the units provided by the laboratory for consistency. For reference, 1 mg/kg is equal to 1,000 µg/kg.

With regard to the HST project, portions of what was formerly considered Area 1 have been addressed during the RI/FS process for OU-1 and OU-2 and a Record of Decision (ROD) for each of these units has been issued by the NYSDEC. Additionally, further work was performed in the portion of OU-3 previously addressed in the NYSDEC-approved document titled "Work Plan for the Delineation and Further Characterization of Soil in the HSTF-Related Work Area Located in OU-3" (Roux Associates, Inc., 1997a). The results of the investigation of this portion of OU-3 were submitted to the NYSDEC in the documents titled "Results of Soil Sampling in Selected Work Areas Located in OU-3" (Roux Associates, 1998a) and "Results of Additional Soil Samples Collected in the Subject Area of Operable Unit 3" (Roux Associates, 1998b) and are discussed in this FS report.

1.2 Yard Operating History

The Pennsylvania Tunnel and Terminal Company, a subsidiary of the Pennsylvania Railroad (later known as the Penn Central Transportation Company), originally constructed the Yard in the early 1900s. The Yard officially opened on November 27, 1910. On April 1, 1976, the Consolidated Rail Corporation (Conrail) acquired the Yard, and the same day conveyed it to Amtrak, which has continued to operate it as a storage and maintenance facility for railroad rolling stock. Up until 2002, locomotive fueling was performed in OU-3.

1.3 General Yard Description

The Yard is located in an urban area in northwestern Queens County (Figure 1). The East River is located approximately one mile to the west while Newtown Creek, which defines the border between Queens and Kings counties, is located less than 0.5 mile south of the western portion of the Yard. The Yard consists of a railroad maintenance and storage facility that currently encompasses approximately 133 acres. The Yard functions as a maintenance facility for electric locomotives and railroad cars for Amtrak and a train layover storage yard for NJTC. The land use surrounding the Yard is a combination of commercial, light industrial, and residential areas. The Long Island Rail Road (LIRR) currently owns a portion of the original Yard along the northern boundary (including a portion of OU-3) and maintains rights of way through the Yard.

1.4 OU-3 Site Description

OU-3 encompasses approximately eight acres in the north central portion of the Yard, and, as mentioned above, includes property owned by the LIRR. There is only one aboveground structure currently present in OU-3, the partially demolished former Oil House. The Oil House, which was used for storage of drummed hydrocarbon products, was taken out of service in 1972. Several additional former structures/features were present in OU-3, but have since been demolished to land surface, removed, closed or rendered inoperable including:

- Engine House (including both interior and exterior pits), which was used for locomotive servicing.
- Engine House Boiler Room, which was used to supply heat to the former Engine House.
- Petroleum tanker car unloading track where fuel was transferred to the USTs from tanker cars.
- UST Areas where nine USTs were used for hydrocarbon storage.
- Locomotive fueling area where fuel was transferred from the USTs to locomotives.
- Metro Shed, which served as the inspection and service facility.
- Turntable, which was used to turn locomotives around.

OU-3 originally included the soil and SPH above the water table in the area previously referred to as Area 1 (now OU-3) at the Yard. During a meeting with the NYSDEC on July 10, 2002, the definition of OU-3 was expanded to include groundwater and saturated soils within OU-3. Subsequent to that meeting, the NYSDEC indicated a further expansion of OU-3 to include former Areas 6 and 7 of the Yard, and later agreed that groundwater for the entire Yard will be addressed during the OU-6 RI. For purposes of this document, OU-3 encompasses Area 1 (including SPH and associated soil, soils [saturated and unsaturated], the nine USTs and the associated subsurface structures and remnants listed above), the Oil House in Area 6, and the storage area for empty drums in Area 7. The portion of the sewer that lies within the extent of the OU-3 boundary will be addressed as part of OU-5. As stated previously, groundwater within OU-3 will be addressed as part of OU-6.

1.4.1 Disposal History

OU-3 is contaminated predominantly with petroleum products and PCBs. Petroleum disposal is likely attributable to leaks over time associated with one or more of the nine USTs located in OU-3; leaks over time from underground piping associated with the nine USTs; or surface spills over time associated with fuel transfer or train maintenance activities. Disposal of PCBs in OU-3 is likely attributable to losses from and maintenance of train-mounted transformers over time. With few minor exceptions, specific locations, dates, or quantities of petroleum or PCB disposal are not known.

1.5 Objective and Organization of the Feasibility Study

The media of concern in OU-3 includes mobile SPH, residual SPH and associated hydrocarbon-impacted soil, visually hydrocarbon-impacted surface soil, and subsurface structures (i.e., former Engine House exterior and interior service pits, UST Areas, Fuel Transfer Area, Turntable, former Oil House basement, and the former Metro Shed inspection pit). The primary objective of this FS will be to determine the most appropriate remedial alternative to address the media of concern. The FS will achieve this objective through the identification, development, and evaluation of alternatives to remediate the various impacted media in OU-3.

The identification and analyses of remedial alternatives in the FS will be performed in accordance with the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) #4030, "Selection of Remedial Actions at Inactive Hazardous Waste Sites; September 13, 1989 (revised May 15, 1990)" (NYSDEC, 1990) and the NYSDEC Division of Environmental Remediation (DER) guidance document titled, "Draft DER-10, Technical Guidance for Site Investigation and Remediation" (NYSDEC, 2002), and the Inactive Hazardous Waste Disposal Site Program regulation (6 NYCRR Part 375-1.10). Additionally, the FS is prepared in accordance with the OOC effective September 1989 and completed in a manner consistent with the procedures for the detailed evaluation of remedial alternatives described by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the National Contingency Plan (NCP), and the United States Environmental Protection Agency (USEPA) guidance document titled, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA", dated October 1988 (USEPA, 1988b).

The OU-3 FS has been divided into the following 11 sections with a brief description of each provided below:

- Section 1.0: Introduction
  This section provides a summary of the operable units at the Yard, the Yard operating history, general Yard description, and the objectives of this report.

- Section 2: Previous Investigations
  This section provides a summary of previous investigations of environmental media and subsurface structures performed in OU-3.

- Section 3: Interim Remedial Measures
  This section provides a summary of soil and SPH Interim Remedial Measures (IRMs) performed and the bioremediation infiltration system installed in OU-3.

- Section 4: Pre-Design Study
  This section provides the results of the pre-design studies that have been performed and a summary of currently ongoing investigations.

- Section 5: Nature and Extent of Contamination
  This section presents a summary of the nature and extent of contamination in OU-3 including the soil and SPH plume.

- Section 6 – Remedial Goals and Remedial Action Objectives
  This section identifies the remedial goals, establishes remedial action objectives and general response actions for addressing the media of concern in OU-3, and discusses the standards, criteria, and guidance (SCGs) for remediation of OU-3.

- Section 7: Identification and Screening of Technologies
  This section discusses potential remedial technologies for the media of concern in OU-3.

- Section 8: Description and Evaluation of Remedial Action Alternatives
  This section develops applicable remedial alternatives for each environmental media in OU-3, and provides a detailed analysis and comparison of the remedial alternatives.

- Section 9: Recommended Remedial Action Alternative
  This section presents the recommended remedial action alternative and provides a summary of the remedial action proposed for each medium of concern in OU-3.

- Section 10: References

2.0 PREVIOUS INVESTIGATIONS

This section provides a listing of the previous investigations of environmental media (i.e., soil, SPH, groundwater) conducted in OU-3, both those performed by Roux Associates and prior to Roux Associates' involvement at the Yard. The details and results of these investigations were provided in the Final OU-3 RI Report (Roux Associates, 2005a), submitted to the NYSDEC on May 27, 2005. Several investigations of the subsurface structures have been performed as well. Background information and previous investigations for the subsurface structures are provided in the following sections.

2.1 Previous Investigations of Environmental Media

The following investigations, for which Amtrak has records (i.e., prior to Roux Associates' involvement), were conducted in Area 1 (OU-3).

- On August 21 and 22, 1985, three soil samples were collected by Atlantic Environmental, Dover, New Jersey, in the area surrounding the former Engine House. All three samples were determined to have PCB concentrations below 50 parts per million (ppm).

- On November 12, 1985, RMC Environmental Services, Pottstown, Pennsylvania, collected two wall scrapings from the former Engine House. The test results indicated both samples had PCB concentrations below 50 ppm.

- On November 21, 22, 23, 25, and 26, 1985, all 49 stationary transformers located in the Yard were analyzed for PCBs by RMC Environmental Services. Of the 49 transformers, 14 were determined to have PCB levels above 50 ppm. Four of these were located in OU-3.

- Geraghty & Miller, Inc., Plainview, New York, was retained by Amtrak in February 1986 to conduct an investigation of the former UST area, the former Engine House, the former Oil House, and the former fuel transfer area to determine if leakage of hydrocarbon compounds had occurred and, if so, to determine the extent of contamination in both soil and groundwater. A June 1986 report, titled "Results of Hydrogeologic Investigation at the Amtrak, Sunnyside, Queens, New York Train Yard" (Geraghty & Miller, Inc., 1986) concluded that a plume of SPH exists in the area east of the Engine House, and that this plume appears to have originated at the underground storage tanks of the former fuel storage area and has migrated beyond Amtrak's northern property boundary. PCB concentrations in the SPH ranged from non-detected to 360 ppm, with the highest concentrations being detected in samples collected immediately east of the Engine House. PCBs were also detected in soil samples, with concentrations ranging from 0.19 to 24 ppm in the 0 to 2 feet below land surface (bls) interval, but no PCBs were detected in groundwater.

Investigations conducted by Roux Associates in OU-3 are listed below with references to the corresponding reports or documentation provided in parentheses. Each of these investigations was discussed in detail in the Final OU-3 RI Report (Roux Associates, 2005a).

- Phase I RI (Roux Associates, 1992);
- Delineation of the Offsite Extent of the Separate-Phase Petroleum Accumulation in Area 1, (documented in the Phase I RI);
- Delineation of the Separate-Phase Petroleum Accumulation in Area 1, (documented in the Phase II RI);
- Phase II RI (Roux Associates, 1995);
- Results of Soil Sampling in Selected Work Areas Located in OU-3, (Roux Associates, 1998c);
- Results of Additional Soil Samples Collected in the Subject Area of OU-3, (Roux Associates, 1998e);
- OU-6 RI Baseline Groundwater Sampling in Area 1 (OU-3) (Roux Associates, 1999c);
- Results of the Additional Delineation of the Separate-Phase Petroleum Accumulation in OU-3, (Roux Associates, 1999e);
- OU-3 RI (Roux Associates, 2001);
- Supplemental OU-3 RI (Roux Associates, 2005a);

For purposes of providing additional information for the evaluation of a potential IRM and preparation of this OU-3 FS, a Pre-Design Study was initiated in April 2004 in accordance with the Pre-Design Study Work Plan (Roux Associates, 2004a), submitted to the NYSDEC on March 4, 2004. The Pre-Design Study included additional investigation of the subsurface structures in OU-3, further definition of the extent of mobile SPH, and a treatability study for treating residual SPH and associated soil. Additionally, a Supplement to the Pre-Design Study Work Plan (Roux Associates, 2004b) was prepared to include the investigation of the Hump Track Foundation.

Preliminary results of the Pre-Design Study were provided in the IRM Conceptual Design Plan (Roux Associates, 2004c), submitted to NYSDEC on July 1, 2004 and a memorandum to the NYSDEC (Roux Associates, 2004d), dated November 12, 2004. The work elements and comprehensive results of the Pre-Design Study are discussed in detail in Section 4.0.

The IRM Conceptual Design Plan also provided a preliminary design for the proposed IRM. However, due to scheduling constraints, the elements proposed in the IRM Conceptual Design Plan will not be performed as an IRM and have been incorporated into this FS evaluation.

The initial findings of the SPH monitoring performed for the Pre-Design Study prompted further field verification of the lateral extent of mobile SPH. The scope of work for the Pre-Delineation Investigation was submitted to the NYSDEC in a letter report dated November 12, 2004 (Roux Associates, 2004e) and the investigation was completed in June 2005. The findings of the Pre-Delineation Investigation were provided to the NYSDEC in a letter report dated July 28, 2005 (Roux Associates, 2005c) and are discussed in Section 6.0.

2.2 Previous Investigations of Subsurface Structures

Subsurface structures within OU-3 include the interior Engine House service pits (e.g., inspection and drop table pits), the exterior Engine House inspection pits, the Oil House basement, the former UST Areas (and former Fuel Transfer Areas), the former Metro Shed inspection pit, and the former Turntable. The following sections provide background information for these structures and discuss the previous investigations that have been performed.

2.2.1 Former Engine House Pits Investigations

The Engine House interior service pits consist of four interconnected concrete pits. Two of the pits are long, shallow inspection pits, (Track Nos. 1 and 2 inspection pits) trending east/west (parallel to the long side of the building) and are approximately 160 feet in length, 4 feet in width, and 2 feet in depth with a concrete thickness up to 1.75 feet. The other two pits are shorter, deeper drop table pits trending north/south (parallel to the short side of the building), as shown on Figure 3. The eastern drop table pit is approximately 13 feet wide, 32 feet long, and 24 feet deep, with a typical concrete thickness of 2 feet. This drop table pit intercepts both the north and south inspection pits (Figure 3). The west drop table pit measures approximately 30 feet in length, 7 feet in width, and 6 feet in depth with a concrete thickness up to 2 feet and has a jack pit (approximately 4 feet by 2 feet) near its intersection with the south inspection that extends 11 feet in depth beyond the bottom of the west drop table pit (a total of 17 feet below the Engine House floor elevation). The thickness of the jack pit concrete is 1.5 feet. These pits have rails passing over them and were designed to provide workers access to the locomotives and other rail equipment from underneath for maintenance and repairs, including heavy repair work at the drop table pits.

Two additional inspection pits (trending east/west) are located to the north and exterior of the former Engine House structure (Track Nos. 3 and 4 inspection pits). The exterior inspection pits measure 91 feet in length, 4 feet in width, and 3 feet in depth. Construction drawings of the two exterior inspection pits were not available. However, the construction of these inspection pits is believed to be similar to the interior Engine House inspection pits. Therefore, the thickness of the concrete walls is approximately 2 feet and the floor of the service pit is estimated to be 9 inches in thickness. One of the exterior inspection pits is temporarily covered with wooden planking, while the other inspection pit remains uncovered and empty. The presence of water or SPH in the south exterior inspection pit could not be determined and quantified.

Sludge samples were collected from the walls and floors of the interior Engine House east drop table pit in February 1985 and submitted for analysis for PCBs. Based on the analytical results, the walls and floor were cleaned with kerosene. All waste was collected and properly disposed offsite. Additional sludge and wipe sampling of the walls and floor was performed in November 1985 and January 1986. The sludge sample contained PCB concentrations of 29.5 mg/kg and the wipe samples were 1.29 micrograms per square centimeter ($\mu g/cm^2$) and 1.74 $\mu g/cm^2$. The Engine House east drop table pit sampling results were provided in the Final OU-3 RI Report.

In April 1986, the National Institute for Occupational Safety and Health (NIOSH) conducted environmental monitoring, including the collection of wipe and bulk samples from the Engine House pits (NIOSH, 1986). An oily substance was still reportedly entering the west drop table pit through small cracks in the walls. Due to the continuous groundwater seepage into the west drop table pit through deterioration cracks, the drop table pit was recleaned (sandblasted) and pressure-grouted to seal cracks in 1986. The walls and floor were then sealed with PCB-resistant epoxy paint. The NIOSH report and supporting analytical data were provided in the Final OU-3 RI Report.

Continued deterioration of the west drop table pit allowed groundwater to again seep into the pit. In December 1993, SPH thickness measurements were taken from the water collected in the west drop table pit and Track No. 1 inspection pit (Roux Associates, 1993). These measurements indicated that the presence of SPH was discontinuous and measured between 0.01 and 0.1 foot of SPH. The SPH was removed using oil sorbent pads. The water was transferred from the west drop table pit to the larger east drop table pit. SPH and sludge samples were collected from the west drop table pit and submitted for analysis for PCBs. The results of the laboratory analyses indicated PCBs were present in both samples. The PCB concentrations detected in these samples were 512 mg/kg and 517 mg/kg in the SPH and sludge samples, respectively. These sampling results were provided in the Final OU-3 RI report.

In 1994, the Engine House building was officially condemned and closed, and the above-grade portion of the building was subsequently demolished in 1996. Prior to commencing demolition, Amtrak contracted Clean Harbors Environmental Services, Inc. (Clean Harbors) to clean and remove all remaining debris from the Engine House building floor.

The interior inspection pit system and concrete floor slab were left in place and capped with a concrete slab, as discussed in the April 1999 letter report titled "Engine House in Operable Unit 3" (Roux Associates, Inc., 1999b). The service pits (i.e., inspection pits and drop table pits) were individually capped prior to the construction of the comprehensive concrete cover. The service pits were capped with metal decking and 1-foot of concrete. The service pit caps extended approximately 2 feet above the surrounding Engine House floor slab. The concrete cover was subsequently constructed and incorporated with the service pit caps to make a comprehensive cover and graded to promote drainage. The concrete cover is approximately 5-inches in thickness with up to 2 feet of compacted fill placed on the Engine House floor and underneath the concrete cover. Since the interior floor was cleaned and clean backfill was placed on the floor prior to capping, the FS evaluation will be limited to the service pits.

In April 2004, as part of the Pre-Design Study, Roux Associates collected SPH thickness measurements through two vent pipes (east end and west end) in the cap over the Track No. 2 inspection pit to evaluate the potential for the interconnected pits to be a continuing source of SPH to the area surrounding the former Engine House. SPH was detected in the pit at a thickness of 0.01 feet. However, the SPH appeared to be much more viscous than the SPH in the plume (having a consistency similar to used motor oil). Based on these visual field observations (i.e., discontinuous SPH layer and minimal SPH thickness), the Engine House interior pits do not present a continuing source of SPH recontamination.

Track No. 3 and Track No. 4 inspection pits, which are located outside the former Engine House, were also inspected in April 2004 by Roux Associates. Based on visual observation, these exterior inspection pits were not found to contain SPH. Therefore, these pits do not present a continuing source of SPH recontamination.

2.2.2 Oil House Basement Investigations

The Oil House basement is located below the platform area located west of the former Oil House, which is no longer in use (Figure 3). In late 1980 into 1981, a 45-foot by 40-foot open basement was found to contain PCB-contaminated liquids by DTK, Incorporated (DTK Inc., 1980). Amtrak authorized the remediation of the basement, which included the following: removal and proper disposal of all contaminated liquid and solid debris; decontamination of the basement and adjacent area using steam; removal and disposal of all residues; backfilling the basement with sand; and capping the area with a six-inch layer of concrete.

In April 2004, as part of the Pre-Design Study, Roux Associates completed two borings (OHB-N and OHB-S) through the concrete cap to evaluate the potential for the basement to be a continuing source of SPH to the area surrounding the Oil House basement. Soil sample OHB-S (8-10) was collected and submitted for PCB analysis. Sample OHB-S contained PCB concentrations of 2,500 µg/kg. No SPH was detected in either boring, confirming that the basement does not present a continuing source of SPH.

2.2.3 Former UST Areas Investigations

The nine USTs are located in the two former UST areas, west (three USTs, Nos. 1, 2, and 3) and east (six USTs, Nos. 4 through 9) and immediately north of the former Metro Shed (Figure 3). The nine USTs reportedly range from 8,200 to 17,600 gallons in capacity. Tank Nos. 1 through 5 reportedly contained No. 2 fuel oil, while Tank Nos. 6 through 9 reportedly contained No. 4 fuel oil. The No. 2 fuel oil tanks were connected by underground pipelines to the Fuel Transfer Area, located northeast of the former Engine House. The No. 4 fuel oil tanks were connected by underground pipelines to a boiler house previously located at the southwestern end of the former Engine House. All but one of the nine USTs were taken out of service between 1961 and the end of 1976. By the end of 1973, it was reported that seven of these USTs were emptied of fuel and filled with either water or sand. By May 1984, all nine USTs had been taken out of service, emptied of fuel, and filled with sand and/or water.

The purpose of the UST investigation for the Pre-Design Study, performed in October 2004, was to evaluate the potential of the USTs to act as a continuing source of SPH to the area surrounding the former UST Areas. Under Roux Associates' supervision, Clean Harbors accessed the UST openings and pumped out the contents of the manways that provide access to the USTs.

The findings of the investigation are consistent with the closure methods reported above. In the west area, UST Nos. 1, 2, and 3 were all found to be filled with both sand and water: UST No. 1 had a small discontinuous layer of SPH floating on the water surface in the tank (approximately 0.1 foot). SPH was not observed in Tank Nos. 2 and 3. In the east area, four of the six USTs were accessed (Nos. 4, 5, 6, and 9). UST No. 4 contained only sand; No. 5 contained sand and water; and Nos. 6 and 9 contained only water. SPH was not observed in any of the USTs in the east area. USTs Nos. 7 and 8 were buried beneath a significant amount of debris and were not accessed, but will be inspected in the future following the procedure described above.

The observations made during investigation of these tanks suggest that the USTs were emptied of product at their time of closure and are not a continuing source of SPH. Based on records of abandonment and observations of the inspected tanks, it is unlikely that Tank Nos. 7 and 8 are continuing sources of SPH.

2.2.4 Former Metro Shed Inspection Pit Investigation

The former Metro Shed was located north of the former Locker Room and the new HSTF S&I Building (Figure 3). The concrete inspection pit, located within the former Metro Shed, was a shallow pit that ran the length of the Metro Shed (approximately 565 feet in length). This inspection pit was approximately 3.5 feet in width and 4 feet in depth and was used for the maintenance of rail cars containing lavatories. The concrete thickness of the inspection pit is approximately 1.5 ft. The measurements for the Metro Shed were based on the Potable and Non-potable Water System and Manifold Toilet Dumping System drawings prepared in September 20, 1983 (Amtrak, 1983) and the Metroliner Servicing and Inspection Facility Plan and Elevation Drawings prepared by Penn Central in April 1970 (Penn Central, 1970).

In July 1997, the former Metro Shed inspection pit was cleaned of all liquid and debris by Amtrak's remedial contractor (Clean Harbors). The above-grade structure and a portion of the Metro Shed foundation were demolished to allow construction of the HSTF S&I Building; the remaining portion was filled with sand. In December 2001, Boring MSF-1 was completed in the western portion of the former Metro Shed. Based on field observations, no SPH was observed in the fill material within the inspection pit.

2.2.5 Former Turntable Investigation

The former Turntable is a large circular concrete structure located in the eastern part of OU-3 that was used to reverse the direction of railroad locomotives (Figure 3). The Turntable structure is approximately 100-feet in diameter and 10-feet in depth with a concrete bottom and drainage to the sewer system. The exterior walls extended approximately 4 feet above surrounding land surface. Reportedly, Turntable operations had ceased prior to 1970, but the structure was left intact. By 1991, proper drainage of the structure had ceased and it had become a mosquito breeding area. The structure was then backfilled to deter this condition and the filled structure provided a roadway for heavy equipment and vehicles to move through this area of the Yard.

In 1998, it was determined that HST construction project parking and access road extended into the Turntable area and, at the NYSDEC's request, an investigation was performed to determine the nature of the material used for backfill. This was accomplished by collecting soil samples for analyses of the COCs from each of four soil borings, one in each of four quadrants, completed to the bottom of the Turntable (Roux Associates, 1998a, 1998b). The results of the investigation (no exceedances of any of the COCs) were presented to the NYSDEC in a letter report (Roux Associates, 1998d). Approximately 80 percent of the aboveground portion of the Turntable was demolished in preparation for HST construction, but the below-ground superstructure was left intact and remains to this day.

3.0 INTERIM REMEDIAL MEASURES

Several IRMs targeting SPH and soil have been implemented to remediate contamination in OU-3. Additionally, a bioremediation infiltration system was installed in the south portion of the historic SPH plume as an IRM to facilitate treatment in this area, if needed, without the disturbance of the HSTF S&I building. A detailed discussion of each of the IRMs is presented in this section.

3.1 SPH IRMs

The historic SPH plume, as delineated by the historic zero-foot contour (Plate 1), was defined by the absence of a visible sheen on the water table based on data collected from several soil borings and monitoring wells. SPH measurements are discussed in terms of apparent SPH thickness (i.e., thickness measurements as observed in monitoring well) throughout this document. As discussed in more detail in Section 5.1.2, apparent SPH thickness measurements are about three times greater than the true or actual thickness of the SPH floating on the water table. IRMs to recover SPH in OU-3 have proceeded in three phases since 1990. The SPH IRM locations are shown on Figure 4, and a discussion of each is provided below.

3.1.1 Phase I – Recovery Trenches

The Phase I SPH IRM implemented in early 1990, consisted of three SPH recovery trenches (RT-1, RT-2, and RT-3) to mitigate the flow of SPH into the inspection pit located in the former Metro Shed and recover SPH in the general Metro Shed area. One of the trenches was located along the southern side and two were located along the northern side of the western end of the Metro Shed (Figure 4). The gravel-filled trenches (RT-1, RT-2, and RT-3) measured approximately 25 feet, 35 feet, and 40 feet in length, respectively, and each contained a recovery sump constructed of four-foot diameter perforated concrete rings installed to a depth of six feet bls. The trenches and sumps straddled the water table allowing SPH (which floats on the water table) to accumulate within them. Each sump was outfitted with an ORS® large-diameter Filter Scavenger™ that pumped recovered SPH into one of two 2,000-gallon capacity aboveground tanks for storage.

3.1.2 Phase II - Recovery Wells

The Phase II SPH IRM was implemented in June 1991 to augment the Phase I SPH IRM (i.e., RT-1, RT-2, and RT-3) and was designed based on additional data on the nature and extent of the historic SPH plume collected during the Phase I RI. The Phase II IRM consisted of the installation of three 4-inch diameter recovery wells (RW-1, RW-2 and RW-3) in the area immediately northeast of the former Engine House where the apparent SPH plume was thickest (Figure 4). Each well was fitted with an ORS® small-diameter Filter Scavenger™ product-only recovery pump to recover SPH. Since groundwater and the SPH were so shallow, the screened intervals began between 0.5 and 2.0 feet bls. The recovered SPH was pumped through underground piping into one of the two 2,000-gallon capacity aboveground storage tanks.

Based on the monitoring data (i.e., water-level and SPH thickness measurements, and SPH sampling and analysis) generated during operation of the Phase II SPH IRM, the following modifications to the Phase I (Recovery Trenches) and Phase II (Recovery Wells) IRMs were implemented in August 1993:

- Discontinued SPH recovery in Recovery Well RW-2 (apparent SPH thickness measured at less than 0.2 foot) and initiated SPH recovery in nearby Monitoring Well MW-16 (apparent SPH thickness measured at over 3-feet) as a replacement to RW-2.
- Continued SPH recovery in Recovery Well RW-1 because it contained recoverable volume of SPH.
- Decommissioned Recovery Trench RT-2 because it no longer contained recoverable SPH.
- Decommissioned Recovery Trench RT-3 because it no longer contained recoverable SPH.

In February 1996, the partial collapse of the wall at the northwest end of the Metro Shed necessitated relocation of the SPH recovery tank and associated equipment. Additionally, due to the decrease in recoverable SPH volume and the damage sustained, Recovery Trench RT-1 was decommissioned, and the sumps in each of the three recovery trenches were backfilled. SPH recovery recommenced at Recovery Wells RW-1, RW-3, and MW-16 in May 1996 and continued recovery until the Phase III IRM was constructed.

3.1.3 Phase III - Interceptor Trench

Construction of the Phase III IRM began in October 1998, and full operation of the system commenced in February 1999. The Phase III SPH IRM consisted of construction of a 340-foot long interceptor trench installed along the northern property boundary and through the thickest part of the SPH plume (Figure 4). The interceptor trench is approximately two feet in width and up to four feet in depth, and was designed to penetrate the full thickness of the SPH plume and remain functional during seasonal water table fluctuations. A 12-inch inside diameter Schedule 40 perforated polyvinyl chloride (PVC) pipe was placed horizontally in the trench on a bed of graded gravel. The remainder of the trench was backfilled with graded gravel to facilitate mobile SPH movement. Two recovery sumps were installed in the trench approximately one third of the way from each end of the trench (Figure 4). Each sump was constructed with four-foot diameter perforated pre-cast concrete rings stacked to a depth of eight feet bls, and the annulus between the rings and surrounding soil was backfilled with graded gravel. A large-diameter ORS Filter Scavenger™ was installed in each recovery sump and the power cables and discharge lines, contained within an underground Schedule 40 PVC conduit, were directed to a new 2,000-gallon SPH recovery tank located on the concrete pad covering the former Engine House foundation. Because Recovery Well RW-3 was situated where the Interceptor Trench was planned, the well was abandoned during construction of the trench.

The Phase III interceptor trench continues to operate and recover SPH. The combined SPH IRM systems have recovered more than 11,500 gallons of SPH to date.

3.2 Soil IRMs

Three soil IRMs have been implemented in OU-3 since 1985. A detailed description of the soil IRMs and analytical results were provided in the Final OU-3 RI Report. The locations of the soil IRMs are shown on Plate 1. A brief summary of each of these IRMs is presented below.

3.2.1 1985/1986

The first soil IRM was implemented between 1985 and 1986 by Amtrak and consisted of excavation of soil saturated with SPH. The excavated area was approximately 50 feet wide by 150 feet long located at the east end of the former Engine House and was dug to a minimum of 0.5 feet bls. An estimated 140 cubic yards (CY) of soil were excavated. A soil sample (821-E) was collected from the excavation (Plate 1) and was found to contain total PCBs at a concentration of 43,400 µg/kg. The excavated soil was disposed offsite in accordance with applicable Federal, State, and local regulations.

3.2.2 1998

The second soil IRM was implemented in 1998, and consisted of the excavation of soils at two locations (near Soil Boring HST-22 [area south of the former Engine House] and Monitoring Well MW-58 [area south of the former Locker Room]), as shown on Plate 1. cPAHs and lead were detected at concentrations exceeding their respective cleanup levels in soil samples collected from Boring HST-22 and the soil boring for Monitoring Well MW-58, respectively. This IRM took place during construction of tracks associated with the HSTF S&I Building. Excavation was completed horizontally and vertically to previously delineated depths (minimum of two feet bls) and locations where the respective concentrations of cPAHs and lead were below site-specific NYSDEC-recommended soil cleanup levels. An estimated 650 CY of soil were excavated. The excavated soil was disposed offsite in accordance with applicable Federal, State, and local regulations.

3.2.3 1999

The third soil IRM was implemented by Amtrak in 1999 and consisted of the removal of approximately 835 CY of contaminated soil encountered during an excavation to locate the source of a water leak. Amtrak personnel uncovered hydrocarbon-impacted soil in OU-4 located adjacent to OU-3. At the NYSDEC's request, Area 7 and consequently a portion of the excavated area were moved into OU-3. The portion of the IRM performed in OU-4 is included in this report for completeness and will not be discussed in the OU-4 RI. Further excavation caused the leaking pipe to break. The water from the pipe came into contact with the hydrocarbon-impacted soil, causing a small quantity of SPH to accumulate on the surface of water that had collected in a utility trench down gradient. Clean Harbors was on-site and collected both the SPH (which they estimated to be less than five gallons) and the water for proper disposal. At Amtrak's request, the SPH was sampled and found to contain total PCBs at concentrations of 2,200 mg/kg (Clean Harbors sample) and 1,067 mg/kg (Roux Associates confirmatory sample) (Roux Associates, 1999d).

An investigation of the area soil consisted of the collection of 27 characterization soil samples from 16 boring locations (SP-1 [OU-4] through SP-11 [OU-4] and SPA-1 [OU-4] through SPA-5 [OU-4]), as shown on Plate 1, and analysis for PCBs. No exceedances of the site-specific NYSDEC-recommended soil cleanup level were found. Following excavation and offsite disposal of hydrocarbon-impacted soil, eight confirmatory samples (CS-1 [OU-4] through CS-8 [OU-4]) were collected at NYSDEC-approved locations and analyzed for PCBs (Plate 1). Again, no exceedances of the PCB soil cleanup level were detected. Remediation was performed to mitigate the unsaturated visually hydrocarbon-impacted soil present in this area of the Yard. Impacted soil did not extend into the water table, further confirming previous data indicating this was an isolated incident and not connected to the OU-3 SPH plume.

3.3 Bioremediation Infiltration System

An infiltration system, consisting of infiltration trenches and a biotreatment solution delivery manifold, was installed in the south portion of the historic SPH plume and located south of the Metro Shed (Figure 4) to facilitate the application of slurry-phase biological amendments to this portion of the historic SPH plume. The objective of installing this infiltration system was to provide future access to this portion of the historic SPH plume, if necessary, following the construction of the HSTF S&I Building and associated tracks. In 1998, the infiltration system was installed in accordance with the document titled "Potential Remedial Alternative Work Plan to Address the Residual Separate-Phase Petroleum Accumulation in a Selected Area Located in Operable Unit 3" (Roux Associates, Inc. 1998d).

The system, as described below, was designed to be a delivery system of biological amendments (i.e., nutrients, oxygen, and/or contaminant-specific microorganisms) in a slurry phase. The liquid would infiltrate from the trench's gravel backfill to the water table approximately one foot below the infiltration piping and make contact with the residual SPH. The addition of biological amendments would enhance the degradation of the SPH.

Approximately 600 feet of perforated 2-inch diameter high-density polyethylene (HDPE) piping was installed at an invert elevation of 16.0 feet above mean sea level (msl), approximately one foot above the actual groundwater elevation of 15.0 feet above msl and approximately 6 to 7 feet below grade. A geotextile membrane was installed around the HDPE piping prior to its placement on 6-inch gravel pipe bedding and backfilled with another 6-inch layer of gravel. The pipe ends were connected aboveground to ball valves before connections were made to a common feeder manifold in the biotreatment solution feed area, located at the southwestern corner of the former Metro Shed foundation.

The completion report titled "Completion Report for the Potential Remedial Alternative Work Plan to Address the Residual Separate-Phase Petroleum Accumulation in a Selected Area Located in Operable Unit 3" (Roux Associates, Inc., 1999a) was submitted to the NYSDEC on August 22, 2001. The bioremediation infiltration system has remained inactive since its installation.

4.0 PRE-DESIGN STUDY

In April 2004, Roux Associates began conducting the elements of the Pre-Design Study in accordance with the Pre-Design Study Work Plan (Roux Associates, 2004a) and the Supplement to the Pre-Design Study Work Plan (Roux Associates, 2004b) in an effort to further define the SPH plume in preparation of developing the Phase IV SPH IRM and OU-3 FS. The Pre-Design Study elements included the following scope of work.

- Installation of Seven Monitoring Wells.
- SPH and Water Level Monitoring.
- Inspection of the former Engine House Inspection Pits.
- Inspection of the Oil House Basement.
- Inspection of the former UST Areas.
- Treatability Study to evaluate the effectiveness of enhanced bioremediation technologies in treating residual SPH.
- Hump Track Investigation (Supplement to the Pre-Design Study Work Plan).
- Evaluation of Backfill for the Excavation of the SPH Plume (Supplement to the Pre-Design Study Work Plan).

Discussion of the inspection of the former Engine House inspection pits, the Oil House Basement, and the former UST Areas was provided in Section 2.0. A discussion of the remaining tasks, listed above, is given in the following subsections. In addition, because the results of some of the Pre-Design Work provided additional information on the nature and extent of the SPH contamination, those results are discussed in that section (Section 5.1).

4.1 Installation of Monitoring Wells

Insufficient monitoring well distribution across OU-3 due to destruction of several monitoring wells and the removal of over 11,500 gallons of SPH through the IRM efforts dictated the need to re-evaluate the current mobile SPH thickness in OU-3. Roux Associates supervised the installation of seven new monitoring wells (MW-71 to MW-77). These seven monitoring wells were installed to provide better definition of the historic SPH plume. The monitoring well locations are provided on Plate 2.

4.2 SPH and Water Level Monitoring

Following installation of the seven new monitoring wells, Roux Associates began routinely collecting SPH thickness and water level measurements from OU-3 monitoring wells containing SPH. The monitoring frequency ranged from weekly to biweekly. A summary of measurements collected during the period from April to August 2004 was provided in the Final OU-3 RI and are shown on Plate 3. Monitoring of these wells has continued on a bi-weekly frequency in 2005. These data were evaluated to describe the current extent of the SPH plume and are discussed in detail in Section 5.0 (Nature and Extent of Contamination).

4.3 Treatability Study

The Pre-Design Study included a treatability study task to assist in the evaluation of potential biological treatment options for the onsite remediation of residual SPH and associated soil. The treatability study task was performed in two phases: baseline characterization sampling and bench scale studies. These tasks are summarized below.

4.3.1 Baseline Characterization Sampling

The objective of the baseline characterization sampling was to characterize the physical, chemical, and biological properties of soil and groundwater within the historic SPH plume. At six locations within the historic SPH plume, two samples were collected for analysis. One sample was collected from the 2-foot interval spanning the oil/water interface and the second sample was collected from the next deeper 2-foot interval of saturated soil. Each sample was submitted for analysis for semivolatile organic compounds (SVOCs), diesel range organics (DRO), nutrients including ammonia, nitrate, nitrite, nitrogen, and phosphorous, total heterotrophic plate count, and total organic carbon (TOC) to evaluate existing biodegradation conditions. Analytical results are provided in Tables 1 to 6.

DRO concentrations ranged from 2,400 to 14,000 mg/kg and total SVOC concentrations ranged from 5,206 µg/kg to 139,370 µg/kg, consisting primarily of PAHs. Nitrate and nitrites were not detected in any samples, indicating a nutrient deficient subsurface environment. High TOC concentrations were observed in the smear zone interval, defined above as the two-foot interval spanning the oil/water interface, which may be attributed to historic marsh sediments in this area of OU-3. Heterotrophic plate counts ranged from non-detect to 760,000 colony-forming units per gram (CFU/gram). These plate counts, though not in the ideal range of 10^6 to 10^8 CFU/gram, are sufficient indicators of biodegradation potential. As expected, microbial counts increased with depth (i.e., in the saturated sample) as TOC decreased with depth. Therefore, based on the testing results and observed correlations, it appears that the slightly low microbial count is attributed to the low nutrient content in the subsurface, resulting in sustained residual DRO concentrations and slowed natural biodegradation.

Groundwater sampling for analysis of geochemical parameters was performed at seven monitoring wells (MW-16, MW-49, MW-50, MW-73, MW-74, MW-75, and MW-77) located within the historic SPH plume. Locations of the monitoring wells that were sampled are provided on Plate 2. The geochemical parameters included in the analysis are ammonia, nitrate, sulfate, sulfide, iron, and manganese. These parameters provide additional information on the nutrient status and oxidation-reduction (redox) conditions in the saturated soil. Analytical results are provided in Tables 7 and 8.

Iron concentrations in the groundwater samples ranged from 13,400 to 68,300 micrograms per liter (µg/L) and manganese concentrations ranged from 331 to 4,570 µg/L. Nitrate concentrations ranged from non-detect to 0.047 milligrams per liter (mg/L), sulfate concentrations ranged from 0.258 to 37.1 mg/L, and sulfide concentrations were non-detect in all samples. Ammonia concentrations ranged from 1.0 to 6.6 mg/L. As seen in the soil sampling results, nitrate and ammonia were not detected or detected at low concentrations.

SPH samples were collected from seven select monitoring wells (MW-16, MW-50, MW-52, MW-72, MW-73, MW-77, and RW-1), as shown on Plate 3, and submitted for PCB analysis. PCB concentrations in SPH ranged from 0.46 mg/kg (MW-77) to 270 mg/kg (MW-73). The analytical results are provided on Table 9.

4.3.2 Bench-Scale Studies

The second phase of the treatability study was the bench-scale testing of biodegradation technologies for treating the residual SPH and associated hydrocarbon-impacted soil. The objective of the bench scale testing was to assist in evaluating the efficacy of treating residual SPH with enhanced biodegradation technologies, probable biodegradation rates, nutrients required for enhancing biodegradation, and the identification of optimum treatment zones. Two bench scale studies were conducted using proprietary products by Adventus Americas: EHC-O®, a slow-release oxygen source injected in a slurry form; and Daramend®, an amendment that integrates controlled release carbon and reduced metals to enhance degradation, in conjunction with Terramend®, a fertilizer comprised of potassium, phosphorus, and nitrogen (in the form of nitrate, ammonium, and urea).

Bench-Scale Baseline Sampling

Four samples (PT-1 through PT-4) were collected from within the residual SPH portion of the SPH plume, between the 0.1-foot contour and the historical zero foot contour and sent to Adventus for bench scale testing. The soil sample locations are shown on Plate 2. PT-2 and PT-3 were collected to the east of the extent of mobile SPH and consisted primarily of sandy soil. PT-1 and PT-4 were collected north of former Hump Track Test Pit No. 1 and 4, respectively. Soil samples from PT-1 and PT-4 consisted mostly of clayey/silty sand. These locations were selected based on the anticipated varying soil types and to evaluate the presence of SPH in both sandy and clayey/silty sand soil types. Soil samples were collected from the 2-foot interval straddling the water table.

Baseline treatability study sampling of PT-1 through PT-4 was performed by Adventus. The baseline sampling analysis consisted of particle size distribution, pH, available phosphorus, available potassium, total nitrogen, total inorganic carbon, total organic carbon, PAHs, DRO and heavy range organics (HRO) (collectively total petroleum hydrocarbons [TPH]), water holding capacity, and chemical oxygen demand. The results of the baseline treatability study sampling are provided in Table 10. PT-1 and PT-4 did not exhibit significant detections of PAHs or TPH. The PT-2 and PT-3 results showed very similar particle size distribution, nutrient content, and PAH detections.

Of the four samples, one sample was to be selected for the bench-scale treatability testing. Although PT-2 results indicated a higher concentration of TPH, PT-3 was selected for the treatability testing based on its more moderate TPH levels (expected to be representative of residual SPH). The baseline treatability study sampling results for PAHs and TPH for sample PT-3 were 157 mg/kg and 34,200 mg/kg, respectively.

Bench-Scale Testing of EHC-O

Three microcosms were prepared from the PT-3 soil sample for the testing of three application rates of EHC-O® (i.e., 2% EHC-O, 1% EHC-O, and 0.5% EHC-O) on February 23, 2005. Oxidation-reduction potential (ORP), dissolved oxygen, and pH were monitored every 7 days. Following each progress round after the application of the three treatment protocols, composite samples were collected and analyzed for PAHs and TPH in an effort to develop the biodegradation rate trends and provide the basis for comparison among the three treatment microcosms. The first round of progress samples was collected 14 days after the EHC-O application, on March 9, 2005. The first round results are provided in Table 11.

As demonstrated by the results, marginal decreases in PAH and TPH occurred in the samples treated with 2% EHC-O and 1% EHC-O. The 0.5% EHC application appeared to be ineffective in reducing PAH concentrations. Reductions of 15% and 6% in total PAHs were observed in the 2% EHC-O and 1% EHC-O applications, respectively. The reductions in TPH observed in the 2% EHC-O, 1% EHC-O, 0.5% EHC applications were 6%, 14%, 15% and respectively. In summary, moderate reductions of TPH were observed in each microcosm with moderate reductions in PAH observed in the 2% EHC-O and 1% EHC-O tests only.

The second round of samples was collected on April 12, 2005. Minimal reductions of 2% and 4% for PAH and TPH, respectively, were observed in the 1% EHC-O. The 2% EHC-O and 0.5% EHC tests showed no reductions in either PAH or TPH concentrations. The second round results are provided in Table 11.

Based on the marginal results of the EHC-O testing, it was determined that the EHC-O product was not successful in stimulating the indigenous aerobic microorganisms. As a result, Daramend®/Zeolite and Terramend®, an alternate set of products provided by Adventus, were tested on sample PT-3. In applying these amendments, nitrate would serve as the electron acceptor for the indigenous anaerobic microorganisms.

For this test, four microcosms and one control were tested using blends of Daramend®, Zeolite, and Terramend®. Each microcosm consisted of three jars that were composited when sampled to account for sample variability. Therefore, fifteen jars were prepared from the PT-3 soil sample.

Two of the microcosms were treated with 5% Daramend (D2010) with two different application rates of Terramend®. The other two microcosms were treated with 2% Zeolite (A4000) with two different Terramend® application rates, in an effort to provide additional surface area for the colonization of the microorganisms. The two Terramend® application rates are differentiated by the nitrogen/phosphorus/potassium (N:P:K) ratio applied. The following summarizes the test samples:

Sample	Sample Jars	Amendment	Terramend (N:P:K ratio)
Control	Jars 1-3	NA	NA
Microcosm #1	Jars 4-6	5% Zeolite	19:5:8
Microcosm #2	Jars 7-9	2% Daramend	19:5:8
Microcosm #3	Jars 10-12	5% Zeolite	14:14:14
Microcosm #4	Jars 13-15	2% Daramend	14:14:14

The ORP and pH were routinely monitored throughout the test. The pH was adjusted when necessary with calcium oxide to maintain a pH within the optimal range of 6 to 8 to support the growth of the indigenous microorganisms. The ORP measurements provided an indication of the biogeochemical conditions (i.e., anaerobic) of the test samples

The first round of samples was collected on June 10, 2005, four weeks after the application of Daramend®/Zeolite/Terramend®. The pH was in the optimum range for a week prior to the first round of sampling. The ORP was on a downward trend (less aerobic) from the baseline measurements of 350 to 450 millivolts (mV) to 150 to 260 mV prior to sampling. Significant reductions in PAH concentrations ranging from 16% (Microcosm #4) to 44% (Microcosm #2) were observed in each application, with the exception of Microcosm #3 which showed no PAH concentration reduction. Similarly, significant reductions of TPH ranging from 20% (Microcosm #4) to 39% (Microcosm #3) were observed in each of the applications. The first round of sample results is shown on Table 12.

The Daramend®/Zeolite/Terramend® test continued for an additional 4 weeks. The second round of samples were collected on July 7, 2005, 55 days after the application of Daramend®/Zeolite/Terramend®. Again, significant reductions of TPH concentrations were observed in each application. The pH continued to be in the optimum range for approximately 3 weeks prior to the second sampling round. The ORP slightly increased following the first round but then continued to be in a downward trend and decreased to 79 mV in one jar test. The TPH concentration reductions ranged from 36% (Microcosm #1) to 66% (Microcosm #4). A significant decrease in PAH concentrations in the control sample was observed. This appears to be a result of the variability in PAH analysis. When compared to the control sample, it can be concluded that no PAH reductions were observed in any of the four applications. The second round of sample results is shown on Table 12.

In summary, the Daramend/Zeolite/Terramend testing proved to be a successful bench-scale measure of the anticipated biodegradation rates to be expected for a field application. The testing showed that the biogeochemical conditions were suitable for the anaerobic biodegradation of the TPH and that nitrate was serving as the electron acceptor for the indigenous microorganisms. Additionally, the testing showed that by providing additional nutrients to the subsurface, reduction of SPH would be successful under anaerobic conditions. Due to the inherent wide variability of PAH analysis, measuring the biodegradation rates using PAH analysis as a metric proved to be difficult and inconclusive. However, the TPH sample results proved to be more consistent and a more reliable measure of biodegradation. The concentration reductions observed in the control samples in the two sampling rounds are also attributed to inherent analyses variability. To account for these concentration reductions in the control sample, the biodegradation progress was measured by comparing the test sample to the control sample for the respective sampling round. Consistent reductions of TPH were observed in both rounds of sampling of the test samples. Overall, Microcosm #4 was the most effective test with 66% reduction in TPH concentrations over the 8-week monitoring period.

4.4 Hump Track Investigation to Define SPH North of Amtrak Property Boundary

On October 21, 2004, the Hump Track investigation was conducted in accordance with the Supplement to the Pre-Design Work Plan (Roux Associates, 2004b). The investigation consisted of the excavation of four test pits (TP-1 to TP-4) north of the Amtrak property boundary: two on the south side of the former Hump Track (TP-1 and TP-2) and two on the north side (TP-3 and TP-4), as shown on Plate 2. The purpose of the investigation was to determine if subsurface foundations for the former Hump Track walls were still present, what influence these structures, if any, may have on the mobile SPH, and to provide better definition of the SPH thickness of the plume north of the Amtrak property line. Test pit excavation work was performed by Clean Harbors under the supervision of Roux Associates.

Clean Harbors dug the four test pits to a maximum depth of seven feet and each pit was left open for approximately two hours to allow any SPH potentially present at those locations to enter the pits (Plate 2). Bail down testing, previously conducted in nearby monitoring well MW-50, showed SPH thickness equilibration with the formation in 30 minutes or less. A measurable quantity of SPH was observed only in Test Pit TP-1 (0.02 foot). Small globules were observed floating on the water table in the other three test pits. Unsecured timbers were found in all four test pits and were found running east to west at about 1.5 feet bls. However, because the timbers are above the SPH, they obviously do not affect the potential migration of SPH. No foundations of any kind were found during the investigation that may influence migration of the mobile SPH. Tightly compacted gray clayey silt was found in each test pit beginning at a minimum depth of two feet bls and extending to the bottom (i.e., to a maximum depth of seven feet bls). This clayey silt layer is likely preventing the northerly migration of the SPH. The findings of the Hump Track investigation were provided in a memorandum to NYSDEC dated November 12, 2004 (Roux Associates, 2004d).

4.5 Backfill Tests for Mobile SPH Excavation Evaluation

While evaluating an excavation element for the mobile SPH, there was a concern that residual SPH contamination below the excavated soil in the SPH plume core (greater than 0.5 foot apparent thickness SPH) could possibly be drawn through negative capillary forces up into and re-contaminate the clean backfill. To evaluate this concern, an investigation was conducted using two different sized fill materials. This investigation involved the installation of two, 8-inch diameter PVC casings located approximately 10 feet south of Monitoring Well MW-16 near the thickest parts of the SPH plume core. The casings were installed on April 22, 2004 to a depth of approximately one foot below the SPH/water interface (approximately three feet bls) with the casings extending approximately one foot above land surface. The locations of the test casings are shown on Plate 2. One test casing was filled with clean Morie #00 fine sand and the other was filled with Morie #3 fine gravel. The two grain sizes were used to test whether the capillary force of each material affected the potential rise of SPH in the material differently.

On October 6, 2004 (more than five months later), Roux Associates completed a soil boring within each test casing using a Geoprobe® two-inch Macrocore sampler that was advanced using a hand-operated hammer. Continuous cores were collected from land surface to approximately four feet bls through the backfill and into the undisturbed visually SPH contaminated soil in each casing. The clean fill from each boring was then examined for the presence of visual SPH contamination due to capillary forces. SPH contamination was not observed in either boring, which demonstrates that re-contamination from capillary forces does not occur and would be unlikely to occur following an excavation and subsequent backfilling with approved site soils. The findings of the backfill tests were provided in a memorandum to NYSDEC dated November 12, 2004 (Roux Associates, 2004d).

4.6 Pre-Delineation Investigation

The objective of the Pre-Delineation Investigation was to field verify the lateral extent of the mobile SPH. As presented in the RI report, the Brooks-Corey model predicts SPH mobility at an apparent product thickness of 0.5 foot or greater however a very conservative apparent product thickness of 0.1 foot was used as the threshold criteria for mobile SPH. The investigation was performed in accordance with the Pre-Delineation Work Plan, submitted to the NYSDEC on November 12, 2004 (Roux Associates, 2004e), and as amended by agreement with the NYSDEC during the May 17, 2005 meeting.

The Pre-Delineation Investigation consisted of 25 soil borings completed around the perimeter of the 0.1-foot apparent thickness contour, as depicted in the IRM Conceptual Plan. Additionally, four soil borings were completed peripherally around MW-77 to evaluate the existence of mobile SPH at this location. The 29 soil borings were excavated to a depth of one-foot below the groundwater table or SPH/groundwater interface and examined for physical evidence of hydrocarbon impact (e.g., staining, presence of SPH, odor).

Twenty-six of the 29 soil borings were finished as temporary wells for continued monitoring of SPH using an electronic oil/water interface probe. SPH thickness measurements from the temporary wells were used to determine if the test area contained mobile SPH (i.e., apparent thickness in excess of 0.1 feet).

Based on the observations of SPH in the soil borings, the apparent SPH thickness contours were revised, as shown on Plate 2. The findings of the Pre-Delineation Investigation were submitted to the NYSDEC in the letter report "Results of Pre-Delineation Investigation in Operable Unit 3", dated July 28, 2005 (Roux Associates, 2005c).

4.7 Continuing Pre-Design Studies

A pilot study work plan to test the field application of enhanced bioremediation is currently being developed. The application of Daramend®, an amendment that promotes anaerobic biodegradation, in the bench-scale study showed favorable reductions in SPH. Based on the bench-scale study results, the application of nutrient amendments and nitrate, such as ammonia nitrate, will be tested. During the pre-design study, soil samples were analyzed for ammonia, phosphorus, and nitrate. The results of the pre-design study indicate that there is sufficient phosphorus and ammonia to support degradation and that nitrate was detected at low concentrations limiting the anaerobic biodegradation. The addition of nitrate during the bench-scale study indicated nitrate was used as an electron acceptor and promoted microorganism growth. As a result, the injection of ammonia nitrate in a liquid form in the proposed field pilot study should provide favorable reductions in SPH. The Daramend® product is added as a solid form via soil mixing and is not amenable to liquid injection. Daramend® will be retained for technology screening for potential use in conjunction with mobile SPH excavation.

Additionally, UST Nos. 7 and 8 will be investigated to identify the method of closure that was applied (i.e., filled with sand and/or water). UST Nos. 6 and 9 were filled with water when taken out of service and it is assumed these tanks were closed similarly. The presence of SPH, if any, will be identified during this investigation. The fuel pump vaults will also be investigated to characterize the contents and determine the dimensions of the vaults.

Both of these investigations will be performed prior to the preparation of the Remedial Design.

5.0 NATURE AND EXTENT OF CONTAMINATION

The purpose of this section is to provide a comprehensive evaluation of the nature and extent of contamination in OU-3 based on the collective results of previous RI investigations discussed in detail in the Final OU-3 RI Report and completed and continuing Pre-Design Studies. Specifically, in the sections below, the nature and extent of contamination will be evaluated for the following: the historic SPH plume; the soil (unsaturated and saturated); groundwater; and subsurface structures.

The nature and extent of contamination for sewer sediment, sewer water, and groundwater were provided in the Final OU-3 RI Report for completeness. However, remedial alternatives for sewer sediment and water and groundwater will not be addressed in this OU-3 FS Report but rather in the OU-5 and OU-6 RI/FS documents, respectively. For this reason, the nature and extent of contamination for sewer sediment and water is not provided in the following sections. Groundwater will be addressed in the OU-6 RI/FS documentation but is discussed in this section in relation to potential impacts from soil and SPH in OU-3.

5.1 SPH Plume

Analytical results of SPH samples collected in 1994 indicate that the SPH in the plume consists of degraded No. 2 fuel oil. The SPH plume (including associated contaminated soil) is currently being addressed by the existing OU-3 Phase III IRM system (Interceptor Trench). The SPH plume core is the area of the plume with 0.5 feet or more of apparent thickness of SPH. The SPH plume core may also be defined as the extent of mobile SPH.

The terms residual and mobile SPH characterize the saturation of SPH in the soil matrix within OU-3. The saturation of a fluid (e.g., SPH) at a certain location in the subsurface is defined as the ratio of the volume of that fluid that is present in the soil pore space to the total volume of soil pore space. Capillary pressure is inversely proportional to fluid saturation, thus when capillary pressure is high, the saturation of a particular fluid is low. SPH that is trapped in the soil by capillary pressure is retained as isolated globules within the pore space and is termed residual SPH. Alternately, mobile SPH is present in volumes greater than that retained as a residual phase and the SPH may migrate vertically or horizontally through the soil pores (Higinbotham et al., 2003).

Many models have been developed to evaluate mobility of SPH within the subsurface. The American Petroleum Institute (API) recommends the Brooks-Corey model for calculating SPH distribution. Based on this model, the SPH thickness in a monitoring well determines the vertical distribution of mobile SPH, or SPH saturation, in the vicinity of that monitoring well depending upon field-measured soil and fluid conditions (e.g., air/water surface tension, non-aqueous phase liquid [NAPL]/water interfacial tension, and air/NAPL surface tension). At low SPH thicknesses, (i.e., 0.5 feet or less as observed in monitoring wells) the saturation within the surrounding soil matrix is too minimal for calculation by the Brooks-Corey model, thus the depth of mobile SPH below the water table is considered minimal. Because the volume of SPH below the water table is minimal, the SPH saturation is not sufficient to overcome soil capillary pressure and is considered not mobile. Therefore, based on the Brooks–Corey model findings, the extent of mobile SPH in OU-3 lies within the 0.5-foot SPH thickness contour. A summary report of the Brooks-Corey model findings was provided in the Final OU-3 RI Report.

SPH thickness and water level measurements have been collected in the monitoring well network for many years. The combined action of the three SPH IRMs has resulted in the recovery of more than 11,500 gallons of SPH causing a significant reduction in the mass of the SPH plume (i.e., vertical and horizontal [areal] extent - see below). As discussed in Section 4.0, SPH monitoring was performed to actively delineate the extent of the SPH plume core and 0.1-foot apparent thickness. The current configuration of the SPH plume core is provided on Plate 2.

5.1.1 Horizontal Extent

As provided in the Final OU-3 RI report and the IRM Conceptual Design Plan, the horizontal extent of the SPH plume core (mobile SPH) was depicted by apparent SPH thickness contours as determined by SPH thickness and water level data for the period of April to August 2004. The horizontal extent of the SPH plume core and the 0.1-foot apparent thickness contour were configured using the May 20, 2004 SPH thickness data. Observations of apparent SPH thickness measurements made during subsequent monitoring and the Pre-Delineation Investigation findings on June 2, 2005 have modified the configuration of the SPH plume core, as shown on Plate 2. Due to continued SPH recovery by the Phase III IRM Interceptor Trench and seasonal fluctuations in groundwater levels, the configuration of the SPH plume core may continue to vary slightly. For this reason, the SPH plume core continues to be monitored.

Additionally, there are discontinuous areas of mobile SPH outside of the SPH plume core and within the extent of the historic SPH plume zero apparent thickness contour. For instance, measurable quantities of SPH have been observed at MW-77, which is located approximately 280 feet east of the middle of the plume core, during routine monitoring. SPH was measured at a thickness of 0.32 foot in Monitoring Well MW-77 on May 20, 2004, (Plate 3). The measured thickness at MW-77 on June 2, 2005 was 0.07 foot. The average apparent SPH thickness at MW-77 for a twelve-month duration (June 2004 through June 2005) is 0.3-foot. Pre-Delineation borings CTB-22 through CTB-25 were completed approximately 15 feet radially from MW-77 and did not indicate the presence of any measurable SPH thickness. Therefore, the detection of SPH in this monitoring well is apparently a localized occurrence and lies within the historic zero-foot contour of the SPH plume. The average apparent SPH thickness of 0.33-foot is less than 0.5-foot, indicating the SPH is of residual phase at this location.

Recent apparent SPH thickness measurements collected at MW-75 were recorded as 0.1 feet (June 2, 2005) and the average apparent SPH thickness for twelve-month duration (June 2004 through June 2005) is 0.21 feet. For this reason, the 0.1-foot contour was extended to monitoring well MW-75 (Plate 3).

The historic zero-foot SPH contour, which is very conservatively defined by the absence of a visible sheen on the water table, is shown on Plate 3 and is based on data collected from numerous soil borings and monitoring wells completed to define it. As shown on this plate, a narrow "finger" of the plume extends in a westward direction approximately 55 feet west of the main plume ending just beyond Monitoring Well MW-49. This extension of the SPH plume was discovered in September 1999 during routine monitoring of the Phase III SPH IRM (Interceptor Trench). An investigation into the change in the plume configuration immediately ensued and the results indicated that the narrow finger of the SPH plume had migrated approximately 55 feet in a westerly direction between the outer boundary of Engine House Track 6 and the above grade retaining wall along the northern property boundary. As discussed in detail in the Final OU-3 RI Report, SPH measurements were collected from a new monitoring well (MW-70) and eight other monitoring wells including MW-49, for a period of about six months (October 1999 to April 2000); the monitoring data indicated that the narrow finger of SPH had not migrated any further.

In the event that the narrow finger of the plume does migrate at some point in the future, Monitoring Well MW-70 is strategically positioned to detect it.

5.1.2 Vertical Extent (Plume Thickness)

In June 1994, the thickest apparent measurements of SPH were detected in Monitoring Well MW-50. Apparent SPH thickness has decreased from 4.56 feet on June 14, 1994 to 3.35 feet on May 20, 2004, and then to 2.67 feet on June 2, 2005. These apparent SPH thickness measurements are about three times greater than the true or actual thickness of the SPH floating on the water table. Thus, the apparent SPH thickness is a considerable exaggeration of the actual or true thickness or vertical extent of the SPH plume, and the volume of SPH that remains to be recovered. To appreciate the reduction of mass of the plume, the vertical and horizontal extent of the plume core need to be evaluated together. As mentioned previously, the three SPH IRMs have collectively recovered a total of more than 11,500 gallons of SPH and the plume configuration has decreased considerably reflecting the successful SPH recovery efforts.

5.1.3 Plume Migration

Recent water level and SPH thickness data collected from monitoring wells in OU-3 (April 2004 to June 2005) and knowledge of the layout of OU-3 indicate that significant migration of the SPH plume is prevented in all four directions as follows:

- South and West - building structures /foundations to the south and west.
- North - the Interceptor Trench (the Phase III SPH IRM, which is located at the north property boundary and north extent of the plume core) is passively capturing and recovering SPH, thus preventing the northerly migration of the plume. In addition, the tightly compacted clayey silt found at the four test pit locations near the former Hump Track Wall has helped prevent the northerly migration of the SPH plume prior to the construction of the Interceptor Trench.
- East - migration of the plume to the east is prevented by the west/northwest groundwater flow direction.

5.1.4 Summary

The SPH plume has been fully delineated both horizontally and vertically and is located entirely within the boundaries of OU-3. The outer boundary of the plume (historic zero-foot SPH contour), which is very conservatively defined by the absence of a visible sheen on the water table, occupies an area of approximately three acres in the central part of OU-3 (Plate 3). The core of the plume, as defined by the 0.5-foot SPH apparent thickness contour, currently occupies approximately 0.5 acres (Plate 2). The combined operation of the OU-3 SPH IRMs has resulted in the recovery of more than 11,500 gallons of SPH and has caused a significant reduction of the extent of the SPH plume horizontally and vertically thickness. Significant migration of the SPH plume in all four directions is prevented by a variety of conditions in OU-3.

5.2 Soil

In total, 122 PCB samples, 54 cPAH samples, and 88 lead samples were collected and analyzed during the various investigations in OU-3. The site-specific NYSDEC-recommended soil cleanup levels for any of the three COCs (PCBs, cPAHs, and lead) were exceeded in soil samples from seven boring locations: PCBs in 821-E and CS-76; cPAHs in HST-22A and HST-22B; and lead in HST-28, MW-58, and S-62. The soil at these locations was remediated as part of the soil IRMs discussed in Section 6.0, except for the soil near Borings CS-76 (PCBs) and S-62 (lead).

In addition to the soil contamination detected in soil borings, an area of approximately 0.5 acre of hydrocarbon-impacted surface soil was delineated visually and the impacts were found to be limited to the unsaturated zone (Plate 1). Based on observations from soil borings completed at different times within this 0.5 acre area, the average depth of the hydrocarbon impacts is approximately one foot bls.

5.3 Groundwater

Groundwater in OU-3 is only slightly impacted at concentrations above the NYSDEC Ambient Water Quality Standards and Guidance Values (AWQSGVs) GA standards and guidance values from the Yard-related activities. Groundwater in OU-3 may be impacted by at least one suspected upgradient source of contamination (primarily chlorinated volatile organic compounds [VOCs], benzene, toluene, ethylbenzene, xylenes [BTEX], and metals) and by saltwater intrusion. Further, groundwater at or near the Yard is not used for potable supply. PCBs have been detected in OU-3 groundwater sporadically at concentrations that exceed GA groundwater standards. However, based on the sporadic nature of these detections and the low solubility of PCBs in water, they are more likely the result of the presence of SPH or sediment contained in the sample rather than PCBs dissolved in groundwater.

SVOCs (three cPAHs) were detected in only one former OU-3 monitoring well (MW-59) at concentrations that exceed their respective GA groundwater standards. The second of three sampling rounds from this well had estimated detections of four individual cPAHs that exceeded the standard (during the first and third sampling rounds, these compounds were not detected). It is not likely that the detections are attributable to the SPH plume as this monitoring well was located hydraulically upgradient from the SPH plume and by the sporadic nature of the detections, they are more likely the result of sediment in the sample than cPAHs dissolved in groundwater.

VOCs (BTEX and chlorinated VOCs) have been detected in OU-3 monitoring wells sporadically at concentrations that exceed GA groundwater standards. Detections of these compounds are limited to monitoring wells along the northern property boundary or on LIRR property, all hydraulically downgradient from Standard Motor Products, Inc. Standard Motor Products is listed in the New York State Registry of Inactive Hazardous Waste Disposal Sites as a Class II site with VOCs (BTEX and chlorinated compounds) detected in soil and groundwater to 20 feet bls and with BTEX concentrations up to 3,430 mg/L in groundwater, and likely the source of BTEX and chlorinated compound detections in OU-3. A more detailed discussion of the VOC-impacts associated with Standard Motor Products was provided in the Final OU-3 RI (Roux Associates, 2005a)

Metals have been detected in OU-3 monitoring wells at concentrations that exceed GA groundwater standards including arsenic (one unfiltered Geoprobe® sample), antimony, iron, lead, magnesium, manganese, sodium, thallium, and zinc. Some of these metals are likely attributed to the upgradient Standard Motor Products property, salt-water intrusion of the aquifer contributing to the magnesium concentrations, and anoxic conditions within the aquifer contributing to the iron and manganese concentrations.

Although the groundwater contamination in OU-3 may be attributable to at least one upgradient source (Standard Motor Products), it will nevertheless be addressed during the OU-6 RI.

5.4 Subsurface Structures

The subsurface structures within OU-3 include the former Engine House inspection and drop-table pits, the Oil House basement, the former UST Areas (and former Fuel Transfer Areas), the former Metro Shed inspection pit, and the former Turntable. The following sections discuss the nature and extent of contamination that remains within these structures.

5.4.1 Former Engine House Pits

As discussed in Section 2.2.1, several remedial measures have been performed for the interior Engine House inspection pits and drop table pits. As discussed in Section 2.2.1, PCBs were detected in sludge samples collected from the east drop table pit in 1985. The walls and floor of the east drop table pit were cleaned with kerosene, sandblasted in 1986 when further deterioration of the east drop table pit was observed, and pressure–grouted to seal cracks caused by deterioration. The walls and floor were sealed with PCB-resistant epoxy paint. However, continued deterioration caused the groundwater to again seep into the pit. The interior Engine House pits were subsequently covered with a concrete slab. Sludge and SPH samples collected from the west drop table pit prior to covering with the concrete slab detected PCB concentrations of 512 mg/kg and 517 mg/kg, respectively.

Recent inspection of the Track No. 2 inspection pit during the Pre-Design Study identified SPH at a thickness of 0.01 feet. Based on visual field observations (i.e., comparison of the observed depth to water in nearby monitoring wells and the depth to the observed SPH and minimal SPH thickness), it is apparent that the observed SPH within the interior Engine House pits is not a continuing source to surrounding soil SPH contamination but rather remaining SPH from former maintenance activities prior to closure.

5.4.2 Oil House Basement

The PCB-contaminated liquids that were formerly identified in the Oil House basement were removed in 1980. As discussed in Section 2.2.2, the liquids and solid debris were removed from the basement. The basement was steam cleaned and all residues from cleaning activities were removed. The basement was then backfilled with sand and covered with a 6-inch concrete slab. Recent borings performed during the Pre-Design Study confirmed that the basement was backfilled with sand. No SPH was observed in the borings and the analysis of the samples collected from Borings OHB-S contained PCBs well below the site-specific NYSDEC-recommended soil cleanup levels for PCBs.

The presence of PCB-contaminated liquids in the Oil House resulted from an isolated release and was not a result of continued use of such material. The recent analysis of the soil/fill sample collected from OHB-S indicates that the cleaning performed in 1980 was effective.

5.4.3 Former UST Areas

Recent investigation of the UST Areas was performed during the Pre-Design Study to confirm the method of closure for each tank and the potential for these USTs to be acting as a continuing source of SPH contamination to surrounding soil. The western tank area, consisting of Tank Nos. 1, 2 and 3, were filled with sand and water prior to closure. Tank No. 1 had a small discontinuous layer of SPH floating on the water surface in the tank while no SPH was observed in Tank Nos. 2 and 3. In the eastern tank area, four of the six USTs (Tank Nos. 4, 5, 6 and 9) were investigated. UST No. 4 contained only sand; No. 5 contained sand and water; and Nos. 6 and 9 contained only water. SPH was not observed in any of the USTs in the east area. USTs Nos. 7 and 8 were not accessed, however, it is likely that these tanks were filled with water, similar to Tank Nos. 6 and 9. As discussed in Section 2.2.3, the observations made during investigation of these tanks suggest that the USTs were emptied of product at their time of closure and are not a continuing source of SPH contamination to surrounding soil.

5.4.4 Former Metro Shed Service Pit

Soil samples from the Metro Shed inspection pit were collected by United States Testing Company, Inc in August 1989 and found to contain petroleum hydrocarbons and PCBs (Section 2.2.4). In 1997, the Metro Shed inspection pit was cleaned and backfilled with sand. During an investigation in 2001, no SPH was observed in the soil sample collected from a boring completed in the western portion of the Metro Shed inspection pit. Based on the field observations, it does not appear that there is residual impacted material within the Metro Shed inspection pit.

5.4.5 Former Turntable

The former Turntable was backfilled with sand in 1991 when proper drainage of the structure had ceased to function properly. As discussed in Section 2.2.5, soil samples were collected from the Turntable fill material in 1998 as requested by the NYSDEC and submitted for analysis for the COCs. No exceedances of the site-specific NYSDEC-recommended soil cleanup levels were detected in the samples and it is apparent that the Turntable is not a continuing source of SPH contamination to the surrounding soil. Based on the analytical data for samples collected from the Turntable, this subsurface structure is not an area of concern. For this reason, the Turntable requires no further action and will not be further addressed in this FS.

5.5 Contaminant Fate and Transport Summary

An evaluation of the environmental fate and transport of contaminants in OU-3 was performed to support the RI. This evaluation consisted of the following two elements:

1) Compilation of information regarding physicochemical properties that can influence the fate of contaminants.

2) An evaluation of contaminant transport and degradation processes.

As previously discussed, while groundwater and sewer water and sediment co-exist with soil and SPH in OU-3, the OU-3 RI addresses only soil and SPH in OU-3. These other media, with the NYSDEC's concurrence, will be addressed in OU-5 (sewers) and OU-6 (groundwater). A more detailed discussion of the transport and degradation processes was provided in the Final OU-3 RI Report (Roux Associates, 2005a). The following provides a summary of the Yard-specific fate and transport evaluation with respect to soil.

5.5.1 Soil

Contaminated unsaturated soil in OU-3 is generally not covered with pavement or buildings. Moreover, the shallow depth to groundwater in OU-3 increases the potential for contaminated soil to impact groundwater.

Soil contamination in OU-3 is primarily characterized by PAHs and PCBs of low or zero mobility. These compounds tend to remain tightly bound to soil particles, and do not have significant potential for migration into groundwater relative to lower molecular weight organics and more soluble compounds. However, these compounds are exposed in surface soil. Surface runoff during precipitation may result in the transport of contaminated sediment into the sewer system and subsequently offsite. Detection of PCBs in sediments from the Yard sewer system indicates that this transport pathway is present and the fate and transport will be discussed during the OU-5 RI.

The metals previously detected in soil in OU-3 could also be subjected to migration via either precipitation runoff to the sewer system or leaching from soil to groundwater. Of these metals, four (arsenic, iron, manganese, and sodium) were historically detected in groundwater and their fate and transport will be discussed during the OU-6 RI. The other metals are assumed to be completely immobilized in soil at the Yard. Their mobilization and release from the soil could only occur as a result of a release of strong acid or alkali onto the soil in OU-3 at the Yard.

5.6 Exposure Assessment Summary

An Exposure Assessment (EA) was conducted following the NYSDEC Spill Guidance Manual (NYSDEC, 1995) and the NYSDEC Draft DER-10 guidance to evaluate the potential for exposure to chemicals that remain in soil within OU-3. EAs describe the type and magnitude of exposures to chemicals of potential concern (COPCs) present at a site. The EA for OU-3 was provided in the Final OU-3 RI (Roux Associates, 2005a). Workers in OU-3 engaged in routine work involving soil-moving activities are not expected to experience exposure to unacceptable levels of chemicals in soil in OU-3. Secondary exposure to groundwater or the SPH plume was recognized, but the likelihood of any extensive exposure is considered highly unlikely because of the anticipated use of protective clothing (boots and gloves) and the need to pump out any accumulation of liquids in a construction excavation.

6.0 REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES

This section presents the remedial goals and remedial action objectives (RAOs) that apply to the environmental media (i.e., soil and SPH) and subsurface structures in OU-3. The remedial goals are common for all registered inactive hazardous waste sites, as provided in 6 NYCRR Part 375 and NYSDEC guidance (NYSDEC, 2002). The remedial goals for all registered inactive hazardous waste sites, as outlined in 6 NYCRR Part 375, are:

- Restoration to pre-disposal/pre-release conditions, to the extent feasible and authorized by law; and
- Elimination or mitigation of all significant threats to public health and the environment presented by the contaminants caused by site-related activities through the proper application of scientific and engineering principles.

The remedial goals serve to establish the foundation for developing RAOs specific to the impacted media in OU-3. RAOs are medium-specific objectives developed for the protection of public health and the environment and are expressed with regard to the concentration of COCs and potential exposure routes. As such, the RAOs are based on the results of the fate and transport analysis and the exposure assessment provided in the Final OU-3 RI Report. Summaries of the fate and transport analysis and exposure assessment were provided in Sections 5.5 and 5.6, respectively.

The Inactive Hazardous Waste Disposal Site (IHWDS) program regulation (6 NYCRR Part 375-1.10) requires that activities performed under the IHWDS program must "not be inconsistent with the NCP." The NCP requires the development of RAOs for each environmental medium, specifying the contaminants of concern and the potential exposure pathways. The RAOs were established utilizing NYSDEC guidance provided in NYSDEC TAGM 4030 (NYSDEC, 1990) and the Draft DER-10, Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002).

The media to be evaluated were identified based on the nature and extent of contamination (Section 5) and SCGs. As discussed in Section 5, the media of concern in OU-3 are mobile and residual SPH, visually hydrocarbon-impacted surface soil, and subsurface structures.

General response actions (GRAs) are media-specific measures that can be performed to achieve the RAOs. GRAs include treatment, containment, extraction, excavation and disposal, institutional controls or a combination of these actions. The following sections describe the types of SCGs, present the RAOs and SCGs for each media of concern, and identify media-specific GRAs.

6.1 Definition and Identification of SCGs

Consistent with the NCP and the CERCLA Compliance with Other Laws Manual (USEPA, 1988a), applicable or relevant and appropriate requirements (ARARs) that apply to the environmental media and subsurface structures are established. Applicable requirements are defined in the NCP (40 CFR 300.5) as follows:

> *"Those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable."*

Relevant and appropriate requirements are defined by the NCP (40 CFR 300.5) as follows:

> *"Those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate."*

CERCLA identifies three classifications of ARARs as guidance for identifying and complying with the ARARs. These classifications are the following:

- Chemical (or ambient)–specific requirements:
  Health or risk-based numerical values or methodologies that establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

- Action (or performance)-specific requirements:
  Technology or activity based requirements of limitations on actions taken with respect to hazardous wastes.

- Location-specific requirements:
  Restriction placed on the concentration of hazardous substances or the conduct of activities based solely because they occur in special locations.

In addition to ARARs, the NCP also defines the To Be Considered (TBC) category as advisories, criteria or guidance developed by Federal or State agencies that may be identified, "as appropriate" for the development of CERCLA remedies (40 CFR 300.400[g][3]).

SCGs are promulgated requirements and non-promulgated guidance that govern activities that may affect the environment. Specifically, the standards and criteria are cleanup standards, standards of control and other substantive environmental protection requirements, criteria, or limitations that are generally applicable, consistently applied, and officially promulgated under federal or state law. Guidance are not legal requirements however should be considered based on professional judgment when applicable (NYSDEC, 2002).

SCGs incorporate both CERCLA concepts of ARARs and TBCs. Further, the SCGs include both those of the state and federal, provided that the federal SCG is more stringent than the State SCG (6 NYCRR 375.1.10). Therefore, herein the term SCGs will encompass both SCGs and ARARs.

The Final OU-3 RI Report provided preliminarily identified SCGs. Table 13 presents a comprehensive listing of potential SCGs that may govern remedial actions in OU-3. As discussed above, the SCGs are considered when identifying the nature and extent of the media of concern in OU-3. These SCGs, specific to the media of concern, will be discussed in the following sections relative to the remedial requirements for that media.

6.2 Media of Concern

As discussed in the previous section, the media of concern is selected based on the nature and extent evaluation (Section 5) and the SCGs. The media that will be evaluated in this OU-3 FS include the mobile and residual SPH and associated hydrocarbon-impacted soil, visually hydrocarbon-impacted surface soil, and the subsurface structures. The following sections discuss the remedial requirements, RAOs, and GRAs for each media of concern.

6.2.1 SPH and Hydrocarbon-Impacted Soil

As discussed in Section 5.1, the historic SPH plume consists of the plume core or mobile SPH, defined as the area of the plume with 0.5 feet or more of apparent thickness of SPH that may migrate vertically or horizontally in the soil pores, and the residual SPH, which is SPH that is trapped in the soil by capillary pressure within the pore space. The plume core is approximately 0.48 acres in size. The one remaining exceedance of the site-specific NYSDEC-recommended soil cleanup level for PCBs in OU-3 lies within the mobile SPH limits. PCBs were detected at sample location CS-76 in the 0 to 0.5-foot interval at a concentration of 73,000 µg/kg. This exceedance has been delineated by sample locations TSB-11 through TSB-14 and is limited to approximately 625 sf.

The residual SPH encompasses those areas of measurable apparent thickness less than 0.1-foot apparent thickness and within the historic zero-foot contour or as otherwise defined herein. Select areas of OU-3 have been identified where SPH apparent thickness has been measured consistently in OU-3 wells. These locations are presented on Plate 3. Specifically, apparent SPH thickness measurements have been routinely monitored at MW-77. Recent measurements indicate that the apparent SPH thickness in this area is 0.07 feet (as of June 2, 2005). However, the average apparent SPH thickness for a twelve-month duration (June 2004 through June 2005) at MW-77 is 0.33 feet.

Recent apparent SPH thickness measurements collected at MW-75 were recorded as 0.1 feet. The average apparent SPH thickness for the same twelve-month duration (June 2004 through June 2005) at this location is 0.21-foot.

The extent of visual hydrocarbon-impacted surface soil has been delineated. This area lies to the north, west and east of the former Engine House, within the bounds of the historic SPH plume and partly within the limits of the SPH plume (Figure 5). This area occupies approximately 0.5 acre and is impacted to an average depth of approximately one foot bls. Excluding the portion of the visually impacted surface soil that coincides with the extent of mobile SPH, approximately 450 CY of surface soil are visually impacted. The one remaining exceedance of the site-specific NYSDEC-recommended soil cleanup level of lead was detected in the

0 to 2 foot sampling interval at soil boring location S-62, within the extent of visually hydrocarbon-impacted surface soil.

6.2.1.1 SCGs and TBCs

Chemical-specific SCGs for soil are provided in NYSDEC TAGM 4046 Recommended Soil Cleanup Objectives (RSCOs). Recognizing that restoration to predisposal conditions is not always feasible, the NYSDEC provided recommended soil cleanup levels for the COCs, as discussed in Section 1.0. The site-specific NYSDEC-recommended soil cleanup levels are:

- PCBs (total) – 25,000 µg/kg;
- cPAHs (total) – 25,000 µg/kg; and
- Lead – 1,000 mg/kg.

Additionally, a performance goal for in situ treatment of hydrocarbon-impacted soils associated with residual SPH, as measured by total SVOCs, was provided by the NYSDEC. The NYSDEC recommended performance goal is:

- SVOCs (total) – 500 mg/kg.

The site-specific NYSDEC-recommended soil cleanup levels are considered applicable TBCs. Previous investigations have identified two locations that exceed the NYSDEC-recommended soil cleanup levels for lead (S-62) and PCBs (CS-76).

In addition to chemical-specific SCGs and TBCs, action-specific standards that apply to the development of remedial action objectives for mobile and residual SPH and hydrocarbon-impacted soil include 6 NYCRR Parts 370 through 373 and 375 and Article 12 of the NYS Navigation Law (New York Oil Spill, Control, and Compensation Act). 6 NYCRR Parts 370 through 373 and 375 pertain to the identification and management of solid and hazardous wastes. The New York State requirements for SPH removal are described in Article 12 of the New York State Navigation Law. Article 12 requires containment of any discharge of petroleum with removal efforts as a possible additional task, "giving first priority to minimizing environmental damage." Article 12 also requires cleanup and removal effort to be implemented in accordance with the NCP (USEPA, 1990). 40 CFR 300.310(b) of the NCP states, "As appropriate, actions shall be taken to recover the oil or mitigate its effects. Of the numerous chemical or physical methods that may be used, the chosen methods shall be the most consistent with protecting public health and welfare and the environment."

The performance criterion for mobile SPH is removal of the mass of mobile SPH in the subsurface to the extent practicable. The performance criterion for residual SPH in OU-3 is reduction of SPH to less than 0.01-foot apparent SPH thickness (the lowest accurate measurement using standard meters) as observed in monitoring wells.

6.2.1.2 Remedial Action Objectives

The RAOs for mobile SPH, residual SPH, and associated hydrocarbon-impacted soil were developed based on the SCGs and TBCs discussed above and the exposure assessment (Section 12 of the Final OU-3 RI). The following are the RAOs for the mobile SPH, residual SPH, and associated hydrocarbon-impacted soil:

- Prevent ingestion, direct contact, and/or inhalation of soil that exceeds the site-specific NYSDEC-recommended soil cleanup criteria for the COCs;
- Prevent the migration of contaminants in exceedance of the site-specific NYSDEC-recommended soil cleanup criteria for the COCs to the groundwater;
- Prevent inhalation of or exposure from COCs volatilizing from soil;
- Removal of mobile SPH; and
- Reduce the mass of SPH in the subsurface to the action-specific SCGs (SPH performance criteria) and treatment performance goal to the extent practicable.

6.2.1.3 General Response Actions

As discussed above, there are two exceedances of the site-specific NYSDEC-recommended soil cleanup levels within OU-3. Areas of measured SPH thickness have been identified on Plate 3. The applicable GRAs for the mobile SPH, residual SPH, and associated hydrocarbon-impacted soil include:

- *In Situ* Treatment/Extraction
- Excavation/Disposal

6.2.2 Subsurface Structures

The subsurface structures to be addressed consist of the former Engine House interior service pits (i.e., inspection Pits No. 1 and 2 and drop table pits) and exterior inspection pits, the former Metro Shed inspection pit, the former UST areas, and the fuel pump vaults in the Fuel Transfer Area.

Former Engine House Service Pits

As discussed in Section 5.4.1, the former Engine House interior service pits consists of four interconnected concrete pits (inspection pits and drop table pits). Upon inspection for the Pre-Design Study in April 2004, SPH measurements were collected through two vent pipes in the cap over the Track No. 2 inspection pit. The measured SPH thickness in this inspection pit was 0.01 feet. The observed SPH in the inspection pit system is a result of remaining SPH from former maintenance activities prior to covering the pits with a concrete cover in 1996. Samples collected from the sludge and SPH from the west drop table in December 1993 contained PCB concentrations of 512 mg/kg and 517 mg/kg, respectively.

Historically, portions of the west drop table pit walls had deteriorated and allowed groundwater to seep into the pit. As the west drop table pit filled with water, the remaining pits filled with water to the level of the surrounding groundwater. The east drop table pit intersects both the Track No. 2 inspection pit and the Track No. 1 inspection pit. The Track No. 1 inspection pit intersects the west drop table pit (Figure 3). Based on this configuration and the measurement of water in the Track No. 2 inspection pit, it is assumed that the other pits contain water as well. Due to the presence of the concrete cover, it is not possible to quantify the amount of water present in the inspection pit system. For estimating purposes of this FS, it has been assumed that 80 percent of the service pits' available volume is filled with water. Therefore, approximately 87,000 gallons of water estimated to be present.

It is estimated that the concrete interior service pits and original concrete slab are composed of approximately 930 CY of concrete. The measurements of the inspection and drop table pits were based on the Inspection Building Contract Drawings drafted in August 1909 and the Temporary Containment Cap and Engine House Demolition Drawings prepared in June 1995.

Two additional inspection pits (trending east/west) are located to the north and exterior of the former Engine House structure (Track Nos. 3 and 4 inspection pits). The pits measure 91 feet in length, 4 feet in width, and 3 feet in depth. The construction of these inspection pits is believed to be similar to the interior inspection pits. Therefore, the thickness of the concrete walls is approximately 2 feet and the floor of the service pit is estimated to be 9 inches in thickness. One of the exterior inspection pits is covered with wood planking, while the other inspection pit remains uncovered and empty. It is estimated that the concrete exterior inspection pits are composed of approximately 100 CY of concrete. The presence of water or SPH in the south inspection pit could not be determined.

Metro Shed Inspection Pit

Since the construction of the former Metro Shed inspection pit in the early 1970s, separate-phase petroleum entered through the inspection pit walls. The inspection pit was ultimately cleaned and filled with soil. It is estimated that the inspection pit is comprised of approximately 1,160 CY of concrete and is filled with 1,200 CY of soil.

UST Areas

Nine USTs with capacities ranging from 8,200 to 17,600 gallons are located north of the former Metro Shed. The observations from the Pre-Design investigation verified that the USTs were closed in place and filled with sand and/or water, as discussed in Section 2.2.3. SPH was not observed in the USTs, with the exception of a small discontinuous layer of SPH on the water surface within UST No. 1.

Fuel Transfer Area

Three fuel pump vaults are located to the northwest of the UST Areas. As stated in Section 4.6, these concrete subsurface structures would be investigated to determine the contents and dimensions of the vaults. For estimation purposes, it is assumed that the pump vaults are approximately 6 feet in depth. Two of the pump vaults measure approximately 22 feet in length and 7 feet in width and appear to be filled with soil/fill. It is unknown if equipment still exists inside the vaults. Based on these assumptions, it is estimated that the three pump vaults are composed of approximately 20 CY of concrete and the two filled vaults each contain approximately 35 CY of soil (70 CY total).

6.2.2.1 SCGs and TBCs

The SCGs and TBCs for the subsurface structures pertain to the contents of the structures and their potential to be released to the surrounding environment. The chemical-specific SCGs and TBCs relevant for soil/fill and sludge in the subsurface structures are the site-specific NYSDEC-recommended soil cleanup levels for the COCs and Toxic Substance Control Act (TSCA) standards for PCBs in environmental media (40 CFR 761). The site-specific NYSDEC-recommended soil cleanup levels are considered applicable TBCs and the TSCA PCB remediation waste standard is a promulgated standard. PCBs were detected in sludge and SPH samples collected from the interior Engine House inspection pits in exceedance of the TSCA PCB remediation waste standard.

TSCA defines PCB remediation waste as environmental media "containing PCBs as a result of a spill, release, or other unauthorized disposal, at the following concentrations:

- Materials disposed prior to April 18, 1978, that are currently at concentrations ≥50 ppm PCBs, regardless of the concentration of the original spill;
- Materials which are currently at any volume or concentration where the original source was ≥500 ppm PCBs beginning on April 18, 1978, or ≥50 ppm PCBs beginning on July 2, 1979; and
- Materials which are currently at any concentration if the PCBs are spilled or released from a source not authorized for use under 40 CFR 761."

PCB remediation waste includes soil and gravel, as well as structures (such as concrete floors, wood floors, or walls contaminated from a leaking PCB or PCB-contaminated transformer). The cleanup requirements for PCB remediation waste are provided in 40 CFR 761.1(a)(4) and are dependent on PCB concentrations and potential exposure relevant to occupancy usage (high and low occupancy).

The NYS regulations for identification and handling of hazardous waste, 6 NYCRR Part 370 through 373 and Part 375, pertain to the contents of the Engine House inspection pit system. 6 NYCRR Part 371.4(e) states solid wastes containing 50 mg/kg or greater of PCBs are listed hazardous wastes. Petroleum oil or other liquid containing 500 ppm or greater of PCBs in the subsurface structures would be classified as New York State B003 listed PCB hazardous waste. The SPH and sludge samples collected from the Engine House inspection pit contained PCB concentrations of 512 mg/kg and 517 mg/kg, respectively.

The NYS Petroleum Bulk Storage Regulations (6 NYCRR Part 613) regulates the permanent closure or removal of all tanks installed prior to December 27, 1987. This regulation provides requirements for the proper in-place closure or removal of a UST including the removal of all product from the tank and associated piping, the capping or removal of all connecting lines and filling the tank with an inert material or removal. These regulations are applicable to the nine USTs located in the UST Area.

6.2.2.2 Remedial Action Objectives

The RAOs for the subsurface structures were developed based on the SCGs discussed above and include the following:

- Prevent the migration of subsurface structure contents in exceedance of the site-specific NYSDEC-recommended soil cleanup levels and other applicable SCGs and the potential for impacts to soil and groundwater;
- Prevent direct contact, ingestion, and inhalation of hydrocarbon-impacted materials within the subsurface structures in exceedance of the site-specific NYSDEC-recommended soil cleanup levels and other applicable SCGs.

6.2.2.3 General Response Actions

With the exception of the interior Engine House service pits, there are no exceedances of the site-specific NYSDEC-recommended soil cleanup levels for the COCs in the contents of the subsurface structures. Elevated concentrations of PCBs were detected in the SPH and sludge sampling performed in the interior Engine House inspection pit system prior to closing. The applicable GRAs for the subsurface structures include:

- No Action;
- Institutional Controls/Monitoring;
- Containment; and
- Removal/Disposal Actions.

7.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section develops the GRAs discussed in the previous section into potential remedial technologies by identifying, evaluating, and screening applicable remedial technologies that may be employed in OU-3 to achieve the RAOs. The remedial technologies to be evaluated in this section have been chosen based on evidence of their success in addressing mobile and residual SPH and associated hydrocarbon-impacted soil, visually hydrocarbon-impacted surface soil, as well as the impacted media associated with the subsurface structures. For the purpose of this screening, the remedial technologies are grouped by media of concern to which they would be applied.

The objective of screening the technologies is to narrow the field of available technologies, eliminating those with implementability concerns, those that are not deemed sufficiently protective of human health and the environment, or those associated with a high cost accompanied by no substantial increase in performance relative to the other technologies.

The technology screening process considers whether technologies and process options can by themselves or in combination, address the impacted media in OU-3, and meet the RAOs. During the screening of the technologies, the demonstrated ability of the technology to prevent potential impacts to human health and the environment and proven reliability of the technology under similar site conditions is evaluated.

The technology types and associated process options in this section have been identified through a review of NYSDEC and USEPA information and guidance, relevant literature, experience with similar types of environmental conditions, and engineering judgment. The selected remedial technologies will be evaluated on the basis of:

- Effectiveness – The effectiveness criterion evaluates the extent to which the technology meets the established RAOs and considers the short-term effectiveness, long-term effectiveness, and potential impacts to human health and the environment. Short-term effectiveness refers to the effects during construction and/or implementation of the technology. Long-term effectiveness refers to the period after the remedial action is in place and effective.

- Implementability – The implementability criterion focuses on both technical and administrative feasibility of constructing and operating a remedial action. Institutional aspects of the remedial technologies with factors such as institutional constraints, time schedules, and the availability of services, equipment, and trained personnel, compliance with applicable rules and regulations being considered as part of the evaluation. Due to the presence of widespread underground utilities in OU-3, consideration of this constraint will be evaluated for any remedial technology or process option.

The evaluation of technology effectiveness and implementability for technology screening purposes incorporates elements from TAGM 4030 (NYSDEC, 1990) and the draft DER-10 (NYSDEC, 2002) and the USEPA document, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA, 1988b).

After screening, the remaining technologies for each media will be combined in Section 9.0 to evaluate remedial alternatives and ultimately develop a recommended remedial alternative for OU-3.

7.1 Technology Screening for SPH and Hydrocarbon-impacted Soil

Five technologies have been identified to be potentially applicable in addressing the mobile SPH, residual SPH and associated hydrocarbon-impacted soil, and visually hydrocarbon-impacted surface soil. The technologies selected for screening include:

Institutional Control/Containment

- Monitored Natural Attenuation

In Situ Treatment

- Enhanced Biodegradation
- Chemical Oxidation

Ex Situ Treatment

- Excavation/ On-Site Solid-Phase Bioremediation
- Excavation/Off-Site Disposal

The following sections provide a brief description of the above technologies and present the evaluation of the technology's effectiveness and implementability. Based on this preliminary screening, the technology will either be carried forward and considered in the remedial alternative analysis or will be eliminated from further evaluation.

7.1.1 Monitored Natural Attenuation

Monitored Natural Attenuation (MNA) is the process of relying on natural attenuation processes within a controlled and monitored cleanup approach to reduce contaminants in the subsurface and achieve remedial objectives. The natural attenuation processes that may occur in the subsurface include biodegradation, volatilization, dilution, and adsorption. The natural attenuation process of focus for mobile and residual SPH is biodegradation since this process results in the reduction of mass of contaminants in the subsurface (USEPA, 2004).

The key component of MNA is contaminant modeling for demonstrating that degradation would result in SPH reduction within a reasonable timeframe and prohibiting SPH migration via potential exposure pathways. Regular monitoring is performed to verify that SPH reduction is occurring consistent with the RAOs. Monitoring would not only measure SPH reduction, but also detect any changes in the subsurface (e.g., microbial and geochemical changes) and identify any potential migration caused by the breakdown of residual SPH. Monitoring typically continues for 1 to 2 years after the RAOs are achieved for performance monitoring purposes.

EVALUATION

Effectiveness	Implementability
• This technology is well suited for addressing residual SPH where mobile SPH has been addressed by a more aggressive technology. • This process would reduce the mass of the residual SPH, resulting in long-term effectiveness. • Contingent on the existing microbial population in the subsurface and available nutrients, which may result in slowed or limited success. • Very few short-term effects. This process would not pose exposure risks to workers. Migration to exposure pathways would be routinely monitored.	• Existing monitoring well network may be utilized for routine monitoring. Well installation for expanding the current monitoring well network is a common practice and easily implementable. • Long-term operation, maintenance, and monitoring (OM&M) may be needed following the remediation period. • Reasonable level of effort and time required for preparation of monitoring and sampling plans, SPH modeling, and NYSDEC approval. • MNA success within a reasonable timeframe is unpredictable. This process may take years to reach the RAOs.

This technology would be effective in reducing the mass of residual SPH in the subsurface at those areas of residual SPH that exhibit minimal apparent SPH thickness observed in monitoring wells and do not require an aggressive means of SPH reduction. MNA performance would be measured by routine gauging of the existing monitoring well network and any additional monitoring wells installed to expand the existing network.

The duration of MNA remediation is highly unpredictable and there is no guarantee that reduction in the SPH mass would occur within a reasonable timeframe, in comparison with other available technologies. Based on a review of gauging data at MW-77 for the past twelve months, apparent SPH thickness measurements have basically remained consistent. Therefore, it is likely that the MNA processes may require several years before any success can be observed.

At the same time, MNA is often incorporated into remedial actions to follow up more aggressive technologies (USEPA, 2004). MNA would be an applicable follow-up technology and can be combined with a more aggressive treatment implemented to address the mobile SPH.

The baseline characterization sampling performed for the Pre-Design Study including heterotrophic plate counts (microbial counts) and available nutrients in the subsurface indicated that although slightly below the optimal range, sufficient potential for biodegradation exists within the residual SPH areas (Section 4.3.1). Additional baseline sampling in the areas to be treated would be required and incorporated in the contaminant modeling, as well as the existing gauging and analytical data.

An on-going OM&M plan would be needed to outline the routine monitoring and sampling schedule. Routine monitoring would likely occur quarterly until consistent degradation is exhibited (i.e., SPH observed in monitoring wells is consistently less than 0.01-foot [lowest accurate measurement of standard meters]). Monitoring would likely be decreased to semi-annually or annually thereafter for a period of one to two years.

This technology would fulfill the RAOs associated with the prevention of direct contact and other exposure pathways, prevention of migration into the groundwater, and reduction of the mass of residual SPH. However this technology would not be as effective in addressing the mobile SPH and hydrocarbon-impacted surface soil. Based on this information, MNA will be carried forward for the development and evaluation of remedial alternatives for residual SPH.

7.1.2 Enhanced In Situ Biodegradation

Enhanced in situ biodegradation, similar to MNA, utilizes microorganisms to degrade SPH in the subsurface, however, accelerates this process through the addition of oxygen and/or nutrient amendments (e.g., nitrogen, phosphate) or through the inoculation of microorganisms. During aerobic biodegradation, microorganisms use oxygen as an electron acceptor. Anaerobic biodegradation typically occurs in oxygen deficient environments where microorganisms utilize alternate electron acceptors such as nitrate. Both forms of biodegradation can lead to the complete mineralization of organic compounds in SPH to carbon dioxide, water and microbial cell mass. Enhancing natural biodegradation processes through the addition of oxygen and/or nutrients has been demonstrated to increase the rate of biodegradation by an order of magnitude or greater (USEPA, 2004).

For biodegradation, oxygen or nutrients are delivered to the subsurface typically in the form of oxygen releasing compounds or sodium nitrate in either a solid or slurry form. Common modes of injection include direct placement in excavations or boreholes, injecting through direct-push borings, and directly mixing with soil (USEPA, 2004).

Several soil parameters drive the success of enhanced biodegradation. These parameters include the SPH concentrations, soil type, organic content, water holding capacity, moisture content, nutrient content, redox potential, the presence of contaminants that may be toxic to microorganisms, and the presence of other electron acceptors (USEPA, 2005). Typically, bench-scale and field pilot testing is performed to measure the efficacy of the technology and determine the required application rates. Monitoring performed at the bench and pilot scale testing stages establish the anticipated biodegradation rates. Depending on subsurface conditions, treatment may require months to years.

Monitoring of soil pH, nutrient balance, oxygen content, and moisture content would be required with adjustments made as necessary.

EVALUATION

Effectiveness	Implementability
• Decreased efficiency in the presence of mobile SPH. The rate of degradation would be decreased by the slowed rate of SPH dissolving in groundwater. • Demonstrated effectiveness in treating surface soils. However, the degree of petroleum hydrocarbon saturation within the surface soil may result in decreased effectiveness and extended treatment duration. • Minimal short-term effects to workers. Treatment areas are not located immediately near potential receptors. • Biodegradation results in reduction of SPH mass, resulting in long-term effectiveness. • Preferential pathways in the subsurface may preclude oxygen/nutrients from reaching entire treatment area, limiting treatment success.	• Requires minimal construction of treatment equipment. Bioremediation products are readily available. • Permits and approvals would be required for injection of oxygen releasing compounds and/or nutrients. • Reasonable level of effort and time required for preparation of monitoring and sampling plans, SPH modeling, and NYSDEC approval. • The presence of underground utilities may interfere with soil mixing technique required for treating hydrocarbon-impacted surface soil. • Treatment may require months to years. Bench scale and/or pilot scale testing can estimate biodegradation rates.

Bench-scale testing of aerobic and anaerobic biodegradation was performed as part of the Pre-Design Study to determine the efficacy of this technology for residual SPH in OU-3. As discussed in Section 4.3.1, baseline characterization sampling performed for the Pre-Design Study indicated that although existing microorganisms and nutrients are present at lower than optimal levels, the levels found in the subsurface are indicative of biodegradation potential. The bench-scale testing of anaerobic biodegradation has showed optimistic SPH reduction with up to 66% reduction of TPH concentrations observed.

This technology would be effective in achieving the RAOs of preventing direct contact and other exposure risk to workers, preventing migration of SPH to the groundwater, and reducing the mass of residual SPH. The potential locations of treatment near MW-77, MW-75, and the area adjacent to the North Runner Track are each located in areas that are not immediately adjacent to potential receptors. Application of this technology would provide flexibility to take action in residual SPH areas, such as MW-75 and the North Runner Track, if future monitoring warrants.

The presence of mobile SPH may inhibit the reproduction and metabolism of microorganisms, resulting in significantly reduced biodegradation rates, increased treatment durations, and multiple applications.

The technology has demonstrated effectiveness in addressing unsaturated surface soils when applied using a soil mixing technique. However, petroleum hydrocarbon saturation in the surface soil may decrease the effectiveness of this technology, similar to the anticipated results in addressing mobile SPH. Furthermore, the presence of underground utilities and active tracks would preclude the use of a soil mixing technique.

This technology could be applied in conjunction with a more aggressive technology such as limited soil excavation (e.g., excavation of the mobile SPH plume), whereas slurry-phase biological amendments would be applied to the excavation sidewalls to enhance biodegradation of residual hydrocarbon-impacted soil remaining in place.

The depth to water in OU-3 is fairly shallow in the treatment areas. Due to the shallow water table, ambient temperatures may influence soil and groundwater temperatures. The optimum soil temperature for successful implementation of enhanced biodegradation is between 59°F and 113°F. Temperatures lower than this range may affect microbial activity and therefore slow biodegradation rates during winter months.

Based on the above information and success observed in the current bench scale testing, this technology will be retained for further evaluation and development of remedial alternatives for mobile and residual SPH.

7.1.3 *In Situ* Chemical Oxidation

In situ chemical oxidation is the injection of oxidizing agents that are capable of chemically converting SPH into carbon dioxide and water. Various oxidizing agents and application techniques are available. The most commonly used oxidizing agents for treating SPH in the subsurface are hydrogen peroxide (Fenton's Reagent) and ozone. Of these two oxidizing agents, ozone is the stronger oxidant with an oxidation potential about 1.2 times greater than hydrogen peroxide and observed reductions in SPH in weeks to months (USEPA, 2004). For this reason, ozone has been selected for evaluation in this screening process.

The hydrogeologic conditions strongly influence the chemical oxidant from contacting the SPH, thus chemical oxidation is more applicable for coarse-grained soils. Chemical oxidation is best applied in areas of residual SPH or smaller source areas. The presence of mobile SPH increases the risk of explosion or generation of explosive gases. Similarly, explosion is a risk if applied in the presence of underground utilities. Pilot testing of this technology is typically performed to measure the efficacy of the technology with regard to subsurface conditions in the treatment areas.

The ozone gas is generated on-site and delivered through sparge wells. The ozone dissolves in the groundwater and either reacts with SPH compounds and decomposes to oxygen or forms hydroxyl radicals, also strong oxidants, which also react with SPH compounds. A vapor collection system (e.g., soil vapor extraction system) would likely be required to collect any potential off-gases that could be generated and impact nearby utilities. The system may consist of vertical collection wells or horizontal perforated piping/galleries. Monitoring stations may be required at grade to monitor any fugitive ozone.

Ozone would also effectively deliver oxygen to the groundwater, which would enhance natural biodegradation. Since the ozone is highly soluble and decomposes quickly into oxygen, the groundwater becomes oxygen rich. Literature for this technology reports that approximately one-half of dissolved ozone degrades to oxygen within 20 minutes (USEPA, 2004).

EVALUATION

Effectiveness	Implementability
• Decreased efficiency in the presence of mobile SPH. Additionally, the presence of mobile SPH increases the chance of explosion or generation of explosive gases. • The heterogeneity of the soil/fill and presence of ballast and subsurface utilities may hinder the delivery of oxidizing agent to the treatment area. The presence of subsurface utilities also poses a risk for explosion. • Increased health and safety concerns associated with handling of chemical oxidants and on-site storage. Added precautions would be required. • Chemical oxidation irreversibly reduces the mass of SPH in the subsurface, providing long-term effectiveness.	• Injection points with standard construction would be employed. Direct-push well points have been demonstrated to be effective. Vapor collection systems are of standard construction using readily available equipment and materials. • Shallow groundwater elevations pose an increased risk of uncontrollable emissions. • This technology is not suitable for treating unsaturated surface soil. • Increased level of effort and time required for acquiring the appropriate permits, preparation of work plans, pilot testing, and NYSDEC approval. Vapor collection systems would require detailed design and monitoring plans. • Treatment would require weeks to months. Pilot scale testing can estimate reduction rates.

The heterogeneous nature of soil/fill in OU-3 may hinder the delivery of the oxidizing agent throughout the treatment area. Low permeable soils prevent contact of the oxidizing agent with the SPH. The soil in the area of MW-77 primarily consists of sand or gravelly sand, which would be optimal for chemical oxidation. However, the soil near MW-75 or near the North Runner Track consist of lower permeable soils and may exhibit limited success in the event these areas require treatment. This technology would not be applicable for unsaturated surface soil.

An on-going OM&M plan would be needed to outline the routine monitoring and sampling schedule. Routine monitoring would likely occur bi-weekly until SPH reduction is exhibited (i.e., SPH observed in monitoring wells is consistently less than 0.01-foot [lowest accurate measurement of standard meters]). Monitoring would likely be decreased to semi-annually or annually thereafter for a period of one to two years.

Chemical oxidation is not typically applied in treatment areas with shallow groundwater (less than 5 feet bls), as seen in OU-3, due to the risk of uncontrollable emissions. The presence of unmapped and unidentified utilities in OU-3 poses a significant safety hazard with regard to heat, steam, and pressure generated from the use of ozone. The risk of explosion and corrosion is a real concern, especially in an active portion of the Yard. Chemical storage is also a significant concern in this portion of the Yard. Although this technology would be effective in achieving the RAO of reducing the mass of SPH in the subsurface and ultimately preventing exposure risks to the SPH, this technology poses too many short-term effects. For these reasons, this technology will not be retained for evaluation and development of remedial alternatives.

7.1.4 Excavation/Off-Site Disposal

Soil would be excavated using readily available mechanical excavation equipment. The soil would be temporarily stockpiled on-site or directly loaded into trucks. All free liquids would be removed prior to transportation off-site. The recovered liquids would require disposal. The soil would likely be disposed as non-hazardous petroleum-impacted waste. Waste characterization sampling would be performed to confirm the waste classification. The analysis would be determined by the disposal facility and may include PCBs, total lead, Toxicity Characteristic Leaching Procedure (TCLP) for VOCs, SVOCs, and metals and Resource Conservation and Recovery Act (RCRA) characteristics analysis.

EVALUATION

Effectiveness	Implementability
• Short-term effects include significant health and safety concerns with respect to worker exposure to excavated material and increased truck traffic in the surrounding neighborhood. Proper engineering controls and health and safety monitoring can reduce this risk. • Mobile SPH, residual SPH, and hydrocarbon-impacted surface and subsurface soil are permanently removed from OU-3. Long-term potential for exposure is permanently eliminated from OU-3. • OM&M may be required to monitor surrounding residual SPH migration and any SPH recharge to excavated area.	• Proven remedial technology with experienced contractors, transportation and excavation equipment, and disposal facilities are readily available. • Reasonable level of effort and time required for acquiring the appropriate permits, preparation of work plans, and NYSDEC approval.

This technology would be effective for addressing mobile SPH, residual SPH, and visually hydrocarbon-impacted surface soil. Implementability of this technology is estimated to take weeks to months, depending on the size of the excavation. This estimated duration includes mobilization, site preparation, excavation and soil screening, backfill of the excavation and demobilization from OU-3.

During excavation activities, this technology may present dermal contact, inhalation, and ingestion exposure risks to workers associated with the physical removal of the hydrocarbon-impacted soil. However, with the proper engineering controls and health and safety monitoring, this risk could be reduced.

This technology would fulfill each of the RAOs for mobile and residual SPH in OU-3. For this reason, this technology will be retained for further evaluation and development of the remedial alternatives.

7.1.5 Excavation/Solid Phase Bioremediation

Solid phase bioremediation, also referred to as biopile treatment, consists of piling the excavated soils over an impermeable liner and stimulating aerobic biodegradation through aeration and adding nutrients and moisture. The induced aeration promotes microbial activity, resulting in reducing SPH concentrations. The aeration would be induced by using an aeration system consisting of perforated piping throughout the biopile. Alternatively, the biopile may be aerated by manually tilling.

The biopile system can be placed in any open and flat area of OU-3. An impermeable liner is used to minimize contaminants from leaching from the impacted soil to the underlying uncontaminated soil. The aeration system would consist of perforated piping and a blower to supply the oxygen to the soil. Additional piping may be installed to supply a liquid bio-blend throughout the soil. The liquid bio-blend consists of a microbial/nutrient mixture combined with water that stimulates the biodegradation process. The biopile would be covered with an additional impermeable liner in order to minimize infiltration of precipitation onto the biopile, as well as control runoff and promote heating of the biopile via solar heat. The cover would also be used to reduce any vapor emissions from the biopile.

The hydrocarbon-impacted soil would be excavated as described in Section 7.1.4. Any overlying unsaturated fill material would be excavated and stockpiled for later reuse as backfill. The 2-foot interval of hydrocarbon-impacted soil straddling the water table would be excavated and treated in the biopile. Prior to treatment, any debris present in the soil would be removed.

The biopile system would be routinely monitored for pH, nutrient balance, oxygen content, and moisture content. Adjustments to these parameters would be made as necessary during the treatment duration. If leachate were generated, leachate collection would be performed by sloping the liner to a low point where the leachate could be collected. During the treatment duration, this leachate may be re-introduced to the soil pile or properly disposed.

EVALUATION

Effectiveness	Implementability
• Similar decreased efficiency as in situ biodegradation in the presence of mobile SPH.	• Requires moderate construction effort. Equipment and vendors for nutrient amendments are readily available.
• Biodegradation results in reduction of SPH mass, resulting in long-term effectiveness.	• Requires a dedicated work area for the biopile and associated equipment for extended duration.
• Increased short-term effects to workers during excavation, piling of soil, and operation of the biopile. Engineering controls would be used to minimize exposure risk.	• Treatment would only require weeks to months. Bench scale testing can estimate reduction rates.

Bench-scale testing of aerobic and anaerobic biodegradation has been performed as part of the Pre-Design Study to determine the efficacy of biodegradation for residual SPH in OU-3. As discussed in Section 4.3.1, baseline characterization sampling performed for the Pre-Design Study indicated that although existing microorganisms and nutrients are present at lower than optimal levels, the levels found in the subsurface are indicative of biodegradation potential. The bench-scale testing of anaerobic biodegradation using Daramend®/Terramend® has showed promising SPH reduction with up to 66% reduction of TPH concentrations observed.

Biopiles are relatively simple systems to design, construct, operate, monitor, and maintain. The services of solid phase bioremediation vendors are available to aid in the design, construction, and operation of these types of units. An OM&M plan for monitoring the performance of the biopile, nutrient, and moisture needs, and runoff of liquids would be required. The nutrient content, microbial population, pH, and moisture content would be routinely monitored.

The required work area is a significant implementability concern, especially in this portion of the Yard. Approximately 25 cubic yards of soil would be treated in the biopile. Typically, biopiles range from 3 to 10 feet in height. Assuming that the average height of the biopile was five feet, a 140 square foot area would be required for treatment. OU-3 is an active portion of the Yard where workers using the only access road through the Yard or working in the HSTF S&I

building would be in proximity to the biopile. For this reason, adequate workspace may not be available for constructing the biopile. Further, moving the hydrocarbon-impacted soil to a portion of the Yard that may accommodate the required workspace would require additional handling of the hydrocarbon-impacted soil and possibly transportation through the surrounding neighborhood to reach other portions of the Yard due to the inability of crossing on-site tracks with haul trucks. This measure would increase the short-term impacts to workers and the surrounding neighborhood.

Although this technology would fulfill the RAOs of reducing the mass of SPH and preventing the risk of migration of SPH to groundwater, this technology would not prevent exposure risk to workers. Depending on the results from on-going treatability studies for biodegradation, the long-term effectiveness may offset the temporary increase in short-term effects to workers. However, the implementability concern of available workspace and increased soil handling to transport the soil to available workspaces decreases the practicality of applying this technology. For this reason, this technology will not be retained for further evaluation and development of remedial alternatives.

7.1.6 Applicable Technologies for the SPH and Hydrocarbon-Impacted Soil

Three remedial technologies have been carried forward for remedial alternative development in Section 9.0. These technologies are:

Institutional Control/Containment

- Monitored Natural Attenuation

In Situ Treatment

- Enhanced Biodegradation

Ex Situ Treatment

- Excavation/Off-Site Disposal

7.2 Technology Screening for the Subsurface Structures

Four technologies have been identified to be potentially applicable in addressing the subsurface structures including the former Engine House interior service pits and exterior inspection pits, the former Metro Shed inspection pit, the Oil House basement, the fuel pump vaults, and the UST areas. The technologies selected for screening include:

Institutional Control/Containment

- Institutional/Engineering Controls and Monitoring

In Situ Treatment

- In-place Cleaning
- Permanent UST Closure in Place

Ex Situ Treatment

- Removal/Off-Site Disposal

The following sections provide a brief description of the above technologies and present the evaluation of the technology's effectiveness, implementability, and ability to fulfill the RAOs. Based on this preliminary screening, the technology will either be carried forward for further evaluation and development of remedial alternatives or the technology will be eliminated.

7.2.1 Institutional/Engineering Controls and Monitoring

Institutional controls are non-physical mechanisms that restrict usage of a designated portion of a site in an effort to limit exposure. Implementation of institutional controls would consist of applying an environmental easement to the portions of OU-3 in which the former Engine House service pits, Metro Shed inspection pit, fuel pump vaults, Oil House basement, and nine USTs vaults are located. An environmental easement would limit all future use of these areas of OU-3. Institutional and engineering controls are typically grouped with other remedial technologies.

EVALUATION

Effectiveness	Implementability
• Typically combined with other remedial technologies to improve level of protection of human health and the environment. • Minimal short-term effects to workers. • Current controls have afforded protection from exposure. Continued maintenance of the existing engineering controls may provide long-term effectiveness.	• Minimal construction required. • Annual inspections would be required to certify continued effectiveness of the institutional/engineering control. The inspection would evaluate if the control should remain in place and it remains effective (NYSDEC, 2002). • The USTs were previously closed by filling with sand and/or water. The use of closure using a liquid is not in accordance with 6 NYCRR Part 613.9. • Average administrative implementability concerns. However, this would likely not be applied as a stand-alone technology.

Each of the subsurface structures would remain in its present condition. Any existing engineering controls such as the steel plating covering some of the USTs, metal grating over the fuel pump vaults, the concrete cover over the Engine House interior service pits and Oil House basement, and the soil/fill cover over the Metro Shed inspection pit would remain in place. The USTs were previously taken out of service by filling with sand and/or water. The use of filling USTs with a liquid for permanent closure is not permitted per NYSDEC regulation (6 NYCRR Part 613.9) but rather an inert material is required.

The environmental easement would be applied to the areas of OU-3 where the subsurface structures are located. This environmental easement would apply for the duration these structures are present in OU-3. The environmental easement is not anticipated to impede the continued usage as a train maintenance facility unless construction by Amtrak of this area is intended.

The institutional and engineering controls would achieve the RAOs of preventing exposure to the hydrocarbon-impacted materials within the structures. This technology would not be effective in preventing the migration of the subsurface structure contents. Currently, there is no direct impact to groundwater occurring due to the associated subsurface structures, and institutional controls would not eliminate or reduce the potential for impacts. However, as stated earlier, this technology is typically coupled with another remedial technology. Routine groundwater monitoring at downgradient monitoring wells would be performed to identify any impacts to surrounding groundwater and soil.

Based on the above discussion, this technology will be carried forward for further evaluation and development of remedial alternatives with respect to the fuel pump vaults, Oil House basement, former Engine House interior service pits, exterior Engine House inspection pits, and Metro Shed inspection pit. Since application of this technology would not be compliant with NYSDEC regulation, this technology will not be carried forward for the UST area.

7.2.2 In-place Cleaning

The interior service pits in the Engine House have been capped with metal decking and a slab of concrete measuring up to two-feet in thickness. In order to access the service pits, a portion of the concrete cap would be removed. Once the former Engine House service pits are accessed, the service pits would be cleaned in-place. It is anticipated that the four service pits have been filled with groundwater that has infiltrated through cracks in the deeper drop table pit, which in turn has filled the shallow, interconnecting pits to the surrounding groundwater elevation. Any water and SPH found in the pits would be pumped from the service pits, containerized, and sampled for off-site disposal waste characterization purposes. Debris, including former equipment and machinery, and soil/sludge found within the service pits would also be removed and disposed off-site. Service pit surfaces would be cleaned to remove surface accumulation of sludge/SPH.

Cleaning would be accomplished by pressure washing the concrete walls and floor of the service pits. Pressure washing utilizes high-pressure water combined with a commercial detergent to remove accumulated dirt, residue, and surface contaminants on concrete surfaces. These materials are removed through application of water sprayed at an average pressure of 3,000 pounds per square inch (psi). The resulting wash water generated from pressure washing would be collected using a vacuum truck and containerized for proper disposal. Water generation is estimated at approximately 0.5 gallons per square foot cleaned. Pressure washing can effectively remove contaminates from floor and wall surfaces. Pressure washing generates large quantities of water requiring treatment/permitted discharge to the on site sewer or off-site disposal.

The former Metro Shed inspection pit was cleaned prior to being filled with soil/fill in 1997. The Oil House basement was also cleaned prior to being filled with soil/fill. Therefore, in-place cleaning of the Metro Shed inspection pit and Oil House basement would not be required. Similarly, this technology would not be applicable in addressing UST areas and fuel pump vaults. Groundwater monitoring would be performed at downgradient monitoring wells at these locations to identify any impacts to groundwater.

EVALUATION

Effectiveness	Implementability
• Pressure washing is effective in removing surface contamination. • Increased short-term effects to workers during cleaning. Engineering controls and proper PPE would be required to reduce potential risks to workers.	• Pressure washing equipment is readily available and easily implemented. • Wash water would require off-site disposal. Disposal facilities are available to accept this waste. • No long-term OM&M associated with this technology. • Minimal administrative implementability concerns.

Following the cleaning activities, the Engine House interior service pits would be backfilled with soil/fill from either onsite sources within OU-4 or off-site certified sources.

This technology would fulfill the RAO of preventing migration of subsurface structure contents to the surrounding environment and reducing the risk of impacts to groundwater by effectively removing the contents, cleaning any residue on the structures, and filling with clean soil/fill. This technology would not prevent exposure risks to workers during implementation. However, proper engineering controls and PPE would greatly reduce exposure risks. Although this technology is not applicable for addressing the UST areas and cleaning would not be required at the former Metro Shed, and Oil House Basement, this technology would likely be combined with a groundwater monitoring program. For this reason, this technology will be retained for consideration in the development of remedial alternatives for addressing the interior service pits for the former Engine House.

7.2.3 Permanent In-Place UST Closure

Decontamination of the subsurface structures associated with the former fueling area would include draining and decommissioning of all piping. Due to limited available information regarding the location of all piping associated with the nine USTs, the pipes would need to be located by tracing the pipes from the tanks. In the event that the piping was not decommissioned during the initial closure of the USTs, the pipes would require draining and proper closure according to 6 NYCRR Part 613.9. Once the connecting lines are located, the lines would be disconnected, drained, and capped.

As discussed in Section 5.3.3, the nine USTs were previously taken out of service, emptied of fuel, and filled with sand and/or water. In the west area, UST Nos. 1, 2, and 3 were found to be filled with both sand and water. In the east area, only four of the six USTs (Nos. 4, 5, 6 and 9) were accessed. UST No. 4 contained only sand; UST No. 5 contained sand and water; and Nos. 6 and 9 contained only water. Continued investigation of the remaining two USTs (Nos. 7 and 8) is currently planned. Based on visual observations, it is presumed that UST Nos. 7 and 8 were closed in a similar manner as Nos. 6 and 9. The water in those USTs that contain sand and water or water only would be pumped and disposed off-site. These tanks would then be filled with an inert material, such as sand, and sealed, in accordance with 6 NYCRR Part 613.9.

Routine monitoring of soil and groundwater surrounding the USTs would be performed to detect any impacts due to the USTs.

EVALUATION

Effectiveness	**Implementability**
• This technology would permanently remove any remaining fuel oil associated with the USTs and associated piping, providing long-term effectiveness. • Moderate short-term effects to workers during closure activities. Engineering controls and proper PPE are available to reduce potential risks to workers.	• This technology is commonly applied and contractors are readily available to perform closure activities. • Locating all the piping may be slightly difficult due to the level of activity in the area, the location of existing tracks (both active and inactive). The tracing of the pipes would need to be performed systematically to ensure that all pipes are located and decommissioned • Routine OM&M associated with this technology. • Increased administrative implementability concerns regarding permitting, work plans, and agency approvals.

Following closure activities, the UST areas would be sealed to prevent access. Groundwater monitoring would be performed routinely for a specified duration to monitor any impacts to surrounding soil and groundwater.

Permanent in-place closure of the nine USTs and associated piping would be effective in achieving the RAOs. Additionally, the level of contamination in OU-3 would be reduced and the potential for future impacts would be minimized since all residual fuel oil in the pipes would be removed. Although inspection of the USTs has demonstrated that the USTs are not a continuing source of contamination, these USTs or associated piping may have leaked in the past. Therefore, closure in-place would not comply with the SCGs, specifically the Petroleum Bulk Storage Regulations. Based on the above reasons, this technology will not be carried forward for further consideration in the development of remedial alternatives.

7.2.4 Removal and Off-Site Disposal

The nine USTs and all associated piping would be removed under this technology option. Based on available information regarding the USTs, each of the USTs has been filled with sand and/or water. As indicated above, information regarding the closure of the USTs is limited and it is not known if the USTs were cleaned prior to filling with sand. Similarly, it is unknown if the piping had been drained. Therefore, the piping would be drained, if necessary, and removed prior to the removal of the USTs.

During the excavation, the sand within the tanks would be removed, stockpiled, and sampled for disposal purposes. Water would be pumped from the USTs, containerized, and sampled for disposal purposes. Following the removal of the USTs, the tanks and associated piping would be triple washed in accordance with applicable regulations and inspected for visual indications of leakage and corrosion. Wash water would be contained for disposal at a permitted oil/water recycling facility or permitted discharge to the on site sewer.

The USTs would be cut into manageable sized pieces and loaded into trucks for disposal. All scrap metal associated with these tanks would be properly disposed according to NYSDEC regulations.

Removal of the former Engine House and Metro Shed pits would consist of accessing the pits as discussed in Section 7.2.2. The concrete cover over the Engine House interior service pits would be removed in its entirety, the wood cover over the exterior Engine House inspection pit would be removed, and the soil cover over the Metro Shed inspection pit would be excavated. Liquid contained in the former Engine House would be removed. Similarly, any soil/fill contents in the former Oil House basement and fuel pump vaults would be excavated. Once the contents of each of the concrete structures were removed, the structures would be dismantled using concrete saws and demolition equipment, including jackhammers and backhoes. All removed concrete would be broken up into manageable sized pieces, sampled for waste characterization, and transported off-site for proper disposal. Both areas would be backfilled and compacted with soil/fill from on-site sources within OU-4.

EVALUATION	
Effectiveness	**Implementability**
• This technology would permanently remove each of the subsurface structures in their entirety, providing long-term effectiveness. • Long-term exposure risks would be prevented, the level of contamination within OU-3 would be reduced, and the potential for future impacts to surrounding soil and groundwater would be eliminated. • Moderate short-term effects to workers during excavation activities. Disposal trucks would transport waste, increasing short-term risks to the surrounding neighborhood. Engineering controls and proper PPE are available to reduce potential risks to workers.	• This technology is commonly applied and excavation equipment and disposal facilities are readily available. The excavations would require large work areas and disturbance of routine railroad operations. • Information regarding the construction of the USTs is limited and complications with the removal of the USTs are probable. However, contractors skilled in tank removal are readily available. • Locating all the piping may be difficult due to the level of activity in the area, the location of existing tracks (both active and inactive). The tracing of the pipes would need to be performed systematically to ensure that all pipes are located and removed. • No OM&M associated with this technology. • Increased administrative implementability concerns regarding permitting, work plans, and agency approvals.

As identified above, limited information is available regarding the construction and current disposition of the USTs. Based on the age of the USTs, it is probable that the integrity of the USTs may be weakened and complications may arise during excavation. Experience contractors are available to complete this work.

Excavation of the structures would require large work areas and would likely disturb railroad operations performed in OU-3 and at the HSTF S&I building, and access to the sole access road in the northern portion of the Yard.

During the transportation of the excavated materials to the off-site disposal facility, the risk of exposure to the contaminated material may be increased in the event that the disposal trucks travel through residential, retail, or commercial areas. Contingency measures, such as covering the disposal vehicles and using leak-proof vehicles, would minimize the risk of exposure.

The removal of the subsurface structures associated with the UST areas, the fuel pump vaults, the former Engine House, the Oil House, and former Metro Shed would be effective in achieving all the RAOs established for OU-3 and would provide a permanent remedy. Since all the contaminated media would be removed with this alternative, the potential for future development of this area would be unconstrained. This technology will be retained for further evaluation and development of remedial alternatives.

7.2.5 Applicable Technologies for the Subsurface Structures

As evidenced in the technology screening, limited technologies are available for addressing the subsurface structures. The screened technologies are proven technologies and would fulfill the RAOs for some or all of the subsurface structures. For this reason, each of the evaluated technologies has been carried forward for alternative development in Section 9.0. In summary, four remedial technologies are carried forward for further consideration in development of remedial alternatives.

Institutional Controls/Containment

- Institutional/Engineering Controls and Monitoring

In Situ Treatment

- In-place Cleaning (former interior Engine House service pits)
- Closure in Place

Ex Situ Treatment

- Removal/Off-Site Disposal

8.0 DESCRIPTION AND EVALUATION OF REMEDIAL ALTERNATIVES

This section assembles the remedial technologies retained after the screening evaluation in Section 8.0 into remedial action alternatives that will address the mobile and residual SPH and associated hydrocarbon-impacted soil, visually hydrocarbon-impacted surface soil, and the subsurface structures. The retained technologies each fulfill one or more of the RAOs identified in Section 7.0. The remedial alternative evaluation combines the retained technologies in an effort to expand the potential of meeting all of the RAOs. The following technologies were retained:

SPH and Hydrocarbon-impacted Soil	*Subsurface Structures*
• Monitored Natural Attenuation • Enhanced Biodegradation • Excavation/Off-Site Disposal	• Institutional/Engineering Controls and Monitoring • In-place Cleaning (former Engine House service pits) • Removal/Off-Site Disposal

The remedial action alternatives for the mobile SPH, residual SPH, hydrocarbon-impacted soil, and subsurface structures include:

Remedial Alternative I: No Action

Remedial Alternative II: Excavation of Mobile SPH/Enhanced In Situ Biodegradation of Residual SPH/In-place Cleaning of Engine House Service Pits/Removal of USTs, Exterior Engine House Inspections Pits, and Fuel Pump Vaults

Remedial Alternative III: Excavation/Off-Site Disposal and Removal of All Mobile and Residual SPH and All Hydrocarbon-Impacted Soil/Off-Site Disposal of Subsurface Structures and USTs

Each of the above alternatives is evaluated based on seven specific criteria. The results of this assessment are used to comparatively evaluate the alternatives to determine which is most appropriate for implementation. The seven criteria are provided in NYSDEC TAGM 4030 (NYSDEC, 1990), the NCP (40 CFR Part 300.430), Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988b), and Draft DER-10, Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002). The seven evaluation criteria are the following:

- Overall protection of public health and the environment
- Compliance with SCGs
- Long-term effectiveness and permanence
- Reduction of Toxicity, Mobility or Volume
- Short-term effectiveness
- Implementability
- Cost

Overall protection of public health and the environment and compliance with SCGs are termed threshold criteria, whereas the remedial alternative must meet these requirements in order to be eligible for selection. The next five criteria are termed primary balancing criteria and are used as the primary basis of comparison in selecting the recommended remedial alternative.

8.1 Remedial Action Alternatives

The following sections provide a description of the three remedial alternatives that were developed to address the mobile and residual SPH and associated hydrocarbon-impacted soil, visually hydrocarbon-impacted soil, and the subsurface structures and evaluate the alternatives based on the above seven evaluation criteria.

8.1.1 Remedial Alternative I: No Further Action

The following sections provide a description of Remedial Alternative I: No Further Action and an evaluation of this alternative with respect to the seven evaluation criteria.

8.1.1.1 Description

In accordance with the NCP and the draft DER-10, a no action alternative is evaluated to provide a baseline for comparison of potential risks posed if no remedial action were performed. For this remedial alternative, all residual SPH and hydrocarbon -impacted soil would remain in place. Additionally, the engineering controls currently in place for the subsurface structures would not be maintained.

8.1.1.2 Evaluation

The following sections provide a detailed evaluation of Remedial Alternative I based on the seven specific evaluation criteria.

8.1.1.2.1 Overall Protection of Human Health and the Environment

Remedial Alternative I would not be protective to human health and the environment. The presence of mobile and residual SPH and visually hydrocarbon-impacted surface soil would continue to pose an exposure risk to on-site workers. Although contained under the concrete cover, the contents of the Engine House service pits have been identified as a B003 hazardous waste. Under this alternative, the existing cover over the Engine House service pits and the integrity of the service pit structure would not be maintained. The existing steel plates covering the east UST area would not be maintained and in time would not prevent infiltration of stormwater into the UST accessways and could possibly mobilize any residue within the UST piping into surrounding soil. The Oil House basement and the former Metro Shed inspection pit were cleaned prior to being filled with soil/fill and do not appear to pose a risk to human health and the environment.

8.1.1.2.2 Compliance with SCGs

A summary of the applicable SCGs is presented on Table 13. Since no remedial actions would be conducted under this alternative, many of the action-specific SCGs would not be relevant to this alternative. This alternative would not comply with the applicable chemical and action specific SCGs. Specifically, this remedial alternative would not comply with:

- The chemical-specific SCGs for soil (i.e., NYSDEC recommended soil cleanup levels, TSCA, Article 12);
- The performance criterion for residual SPH reduction to less than 0.01-foot apparent SPH thickness as observed in monitoring wells and the treatment performance goal measured by total SVOCs;
- The 6 NYCRR 375 goals to restore the site to pre-disposal conditions to the extent feasible and authorized by law and to eliminate or mitigate all significant threats to public health and the environment;
- The 6 NYCRR Part 613.9 requirements for permanent closure of out-of-service tanks.

8.1.1.2.3 Long-Term Effectiveness and Permanence

Alternative I provides neither long-term effectiveness nor permanence since the volume of mobile and residual SPH, hydrocarbon-impacted soil, and subsurface structure contents would remain the same. This evaluation criterion is based on the amount of residual risk of contamination that remains after the remedial action alternative is implemented. If Alternative I is implemented, the current level of risk to workers would remain, and the alternative would not be protective of human health and the environment.

8.1.1.2.4 Reduction of Toxicity, Mobility, or Volume

This alternative would not be effective in reducing the toxicity, mobility, or volume of impacted soil or subsurface structure contents from OU-3. The toxicity and volume of the NYS B003 listed PCB hazardous waste present in the interior Engine House service pits water and sludge would not be reduced. Currently, the impacted water is contained, however, this alternative would not provide a means to ensure the mobility of this waste continues to be prevented. Limited natural biodegradation of the mobile and residual SPH and hydrocarbon-impacted soil may be expected; however this process would be slow and inefficient as a reliable means of reducing the mobility or volume of SPH in the subsurface.

8.1.1.2.5 Short-Term Effectiveness

Since there are no actions proposed for this alternative, there is no associated construction and implementation period, and therefore no associated short-term effects to human health and the environment.

8.1.1.2.6 Implementability

Implementability concerns posed by this alternative do not exist since there would not be any actions performed. Therefore, this alternative would be readily implementable.

8.1.1.2.7 Cost

Since there are no remedial actions for this alternative, there are no capital costs associated with Remedial Alternative I.

8.1.2 Remedial Alternative II: Excavation of Mobile SPH/Enhanced In Situ Biodegradation of Residual SPH/In-place Cleaning of Engine House Service Pits/ Removal of USTs, Exterior Engine House Inspections Pits, and Fuel Pump Vaults

The following sections provide a description of the Remedial Alternative II elements and discuss how each of the medium of concern is addressed. An evaluation based on the seven specific evaluation criteria is also presented below.

8.1.2.1 Description

Remedial Alternative II includes the excavation of mobile SPH and visually hydrocarbon-impacted surface soil, in situ enhanced biodegradation treatment of residual SPH and hydrocarbon-impacted soil, the cleaning of the interior Engine House service pits, the removal of the nine USTs, fuel pump vaults and exterior Engine House pits, and monitoring of remaining subsurface structures.

Enhanced biodegradation of the residual SPH would accelerate the natural process of the breakdown of SPH by microorganisms through the addition of oxygen and/or nutrient amendments or through the inoculation of SPH-degrading microorganisms. Bench-scale testing of enhanced aerobic and anaerobic biodegradation has been performed. As discussed in Section 4.3.2, initial results of the aerobic testing showed poor biodegradation rates, due in part to soil parameters including high pH and SPH content. The bench-scale testing of anaerobic biodegradation using Daramend®/Terramend® has showed favorable SPH reduction with up to 66% reduction of TPH concentrations observed.

Recent measurements at MW-77 have indicated that the apparent SPH thickness in this area is 0.07 feet (as of June 2, 2005). However, the average apparent SPH thickness for a twelve-month duration (June 2004 through June 2005) at MW-77 is 0.33 feet and SPH thickness is expected to fluctuate slightly. This area would be addressed by enhanced biodegradation, to the extent practicable, to achieve the residual SPH reduction performance criterion.

Similarly, recent apparent SPH thickness measurements collected at MW-75 were recorded as 0.1 feet. MW-75 is located at the limit of the mobile SPH and would be included in the excavation. However, the average apparent SPH thickness for the same twelve-month duration (June 2004 through June 2005) is 0.21 feet. For this reason, the area outboard of the excavation at MW-75 would be monitored for apparent SPH thickness measurements greater than 0.1-foot. In the event measurements exceed 0.1-foot, this area would be addressed by enhanced biodegradation to the extent practicable, to achieve the SPH reduction performance criterion.

Another area that would be monitored for potential treatment is the tract of soil under the North Runner Track (approximately 1,700 sf). Although the soil under the North Runner Track is within the 0.1-foot apparent SPH thickness contour, this track would not be taken out of service or removed during the excavation of mobile SPH. Removal and temporary relocation of the North Runner Track would be too costly and disruptive to daily railroad operations. In the event SPH persists at apparent thickness measurements greater than 0.1-foot, this area would also be addressed by enhanced biodegradation, to the extent practicable, to achieve the SPH reduction performance criterion.

The southern portion of the historic SPH plume, where a bioinfiltration system was previously installed, would also be monitored for persistent apparent SPH thickness measurements greater than 0.1-foot. Monitoring wells were removed from this area due to the construction of the HSTF S&I building. A monitoring well would be re-installed in this area and incorporated into the current routine monitoring program to develop information regarding the current extent of SPH in this portion of the SPH plume. Enhanced biodegradation would be applied using the existing bioinfiltration system should the apparent SPH thickness measurements exceed 0.1-foot.

As discussed in Section 7.2.2, the Engine House interior service pit system is the only subsurface structure that would require in-place cleaning. The Oil House basement and the Metro Shed inspection pit were cleaned prior to being filled with soil/fill. Sludge and water samples collected from the Engine House interior service pits exhibited PCB concentrations in excess of 500 ppm, qualifying the sludge and water as a B003 listed hazardous waste. The nine USTs, exterior Engine House inspection pits, and fuel pump vaults would be removed and disposed off-site.

Figure 5 shows the areas to be addressed and the technologies proposed for this alternative. Remedial Alternative II includes the following remedial elements:

- Excavation of Mobile SPH

- Excavation of Visually-Impacted Surface Soil
- Removal of Fuel Pump Vaults and Exterior Engine House Inspection Pits
- In Situ Biodegradation Baseline Testing
- Injection of Amendments/Microorganisms
- Cleaning of Interior Engine House Service Pits
- Removal of the USTs
- Performance Monitoring
- Ambient Air Monitoring
- Transportation and Off-Site Disposal
- Site Management Plan
- Environmental Easements

It is estimated that this alternative would require 6 to 8 months to complete. The enhanced biodegradation duration may be extended and a more refined estimate would be available when the pilot-scale testing is completed. These tasks would begin upon NYSDEC approval of the Remedial Design for this alternative. Groundwater monitoring would be conducted beyond this timeframe.

8.1.2.1.1 Excavation of Mobile SPH

Excavation of the mobile SPH and associated soil consists of the removal of soil and SPH with apparent SPH thickness measurements of 0.1-foot or greater, as measured in monitoring wells. The excavation would extend beyond the lateral extent of mobile SPH (i.e., within the 0.5-foot SPH thickness contour) to the extent of the 0.1-foot SPH thickness contour and to a depth of one-foot below the water table (ranging from 2 to 4.5 feet bls). In total, approximately 3,600 CY of soil would be excavated and disposed off-site. The North Runner Track, which is integral to Amtrak's operation of the rail yard, divides the mobile SPH excavation. As Figure 5 shows, the main part of the excavation is located south of the North Runner Track. The smaller excavation is located north of the North Runner Track and is north of the Amtrak/LIRR property boundary.

The presence of mobile SPH at the excavation boundaries would be monitored throughout the excavation. During the excavation, as groundwater is exposed, visible floating (mobile) SPH on the groundwater table would be removed by vacuum truck or pumping to a storage tank and disposed properly. The north excavation would be performed first and would remain open during the south excavation activities (south of the North Runner Track) allowing mobile SPH under the North Runner Track to continue to seep on both sides of the track and be vacuum extracted. The south excavation would begin by excavating a narrow trench (approximately 2 to 3 feet wide) along the east and south portions of the 0.1-foot apparent thickness contour. The excavation would then commence in the northwest corner, adjacent to the North Runner Track, and proceed in a southeasterly direction towards the excavated trenches. This sequencing would allow the eastern and southern excavation sidewalls to remain open for the entire duration of the excavation and thereby allow observation of any conditions that would prompt additional excavation. Further excavation may be required should the presence of significant quantities of SPH be discovered at the sidewalls.

The excavation sidewalls would be treated with slurry-phase biological amendments to enhance biodegradation. The biological amendments may contain an oxygen-releasing compound or other nutrients, such as Daramend®, needed to provide optimum conditions for promoting biodegradation and would be based on the results of the bench-scale testing and on-going pilot study testing. The objective of adding the biological amendments would be to treat any residual SPH on the excavation sidewalls that would be exposed to the clean backfill and form a type of permeable reactive barrier between the residual SPH and the clean backfill. The one remaining exceedance of the site-specific NYSDEC-recommended soil cleanup level for PCBs in OU-3 lies within the mobile SPH excavation limits and would be removed as part of the excavation.

8.1.2.1.2 Excavation of Visually Hydrocarbon-Impacted Surface Soil

The extent of visually hydrocarbon-impacted surface soil lies to the north, west and east of the former Engine House, partly within the bounds of the historic SPH plume and the limits of the mobile SPH plume excavation (Figure 5). This area occupies approximately 0.5 acre and is impacted to an average depth of approximately 1-foot bls. The visually impacted surface soil would be excavated to the limits shown on Figure 5, and backfilled with soil/fill from on-site sources. Excluding the portion of the visually impacted surface soil that coincides with the mobile SPH excavation, approximately 450 CY of soil would be excavated and disposed off-site.

The one remaining exceedance of the site-specific NYSDEC-recommended soil cleanup level for lead lies within the extent of visually hydrocarbon-impacted surface soil. Deeper excavation (average depth of 3 feet) would be performed at this location to address this exceedance.

8.1.2.1.3 Removal of Fuel Pump Vaults and Exterior Engine House Inspection Pits

The fuel pump structures (underground concrete vaults and associated fuel pumps) would be removed to facilitate the hydrocarbon-impacted surface soil excavation. Piping from the pump vaults to the former UST Area would be traced and removed, as necessary. The fuel pump vault excavations would be backfilled with approved onsite soil from sources within OU-4.

The two Former Engine House exterior inspection pits would also be removed to facilitate the excavation of the visually hydrocarbon-impacted surface soil. The exterior inspection pits are approximately 3 feet deep. Locations of the exterior inspection pits are shown on Figure 5. The inspection pits excavation would be backfilled with approved onsite soil from sources within OU-4.

8.1.2.1.4 In Situ Biodegradation Baseline Testing

Soil samples would be collected from the 2-foot interval straddling the oil/water interface near MW-77. The soil samples would be submitted for analysis to characterize the physical, chemical, and biological properties of soil to be treated. The parameters to be analyzed would be consistent with those of the bench-scale study baseline characterization sampling. These parameters would include SVOCs (PAHs), DRO and HRO (collectively TPH), ammonia, nitrate, nitrite, nitrogen, phosphorus, total heterotrophic plate count, and TOC.

The analytical results would be compared to the bench-scale and pilot-scale baseline characterization sampling to correlate subsurface soil conditions. Nutrients and/or microorganism amendments would be applied based on this comparison so that the biodegradation rates and results of the bench-scale could be duplicated in the field application.

8.1.2.1.5 Injection of Amendments/Microorganisms

The bench-scale study and planned pilot-scale study will provide information regarding the optimum mode of enhancing biodegradation (i.e., anaerobic) and the requisite oxygen source, nutrient amendments and/or microorganisms to be applied. The nutrient amendments and/or microorganisms would be delivered to the subsurface through injection using direct-push borings. Monitoring of soil pH, nutrient balance, oxygen content, and moisture content would be performed monthly to ensure the soil conditions are favorable for biodegradation, thus providing confidence in the estimated biodegradation rates.

Initially, field parameters including pH, dissolved oxygen, temperature, and redox potential would be measured weekly. Water levels and apparent SPH thickness measurements would also be measured weekly. Soil samples would be collected monthly throughout the treatment (approximately 8 months treatment duration), submitted for nitrate, total SVOCs, DRO and HRO analysis, and compared to the baseline sampling data. Soil sampling would be discontinued once the treatment was completed and sampling results indicated that the treatment performance goal for total SVOCs (500 ppm) was achieved. In the event the treatment performance goal was not achieved at the end of the treatment duration, the efficacy of additional application of the biological amendments would be evaluated.

8.1.2.1.6 Cleaning of Interior Engine House Service Pits

As discussed in Section 7.2.2, the contents of the former Engine House interior service pits require removal because sludge and SPH samples collected from the inspection pit is expected to be a NYS B003 listed hazardous waste. To enable the removal of the sludge, water, and any debris found within the service pits, the concrete cover within the footprint of the service pits would be removed by sawcutting. All water and SPH in the service pits would be removed using a high-powered vacuum truck, containerized, and sampled for waste characterization purposes for off-site disposal. Debris, including former equipment and machinery, and soil/sludge found within the pits would be removed and disposed off-site.

Any surface accumulation of sludge would be removed using manual scraping tools. As discussed in Section 7.2.2, the concrete would be cleaned using a high-pressure wash with commercial detergent to remove any remaining residue. The wash water generated during the pressure washing would be collected using a vacuum truck and containerized for off-site disposal.

The service pits would be backfilled with soil/fill from on-site sources within OU-4 or from off-site certified sources. The backfill would be placed to the grade of the undisturbed surrounding concrete cover. In accordance with the draft DER-10, the source of the soil/fill would be approved by the NYDSEC DER prior to backfill activities. Crushed concrete generated from the removal of portions of the concrete cover to access the service pits may also be considered for backfill material.

8.1.2.1.7 Removal of the USTs

The two UST areas contain nine USTs that were previously taken out of service by filling with sand and/or water. Three USTs are located in the west UST area and six USTs are located in the east UST area. The tanks in the west UST area were connected by underground pipelines to the Fuel Transfer Area, located northeast of the former Engine House. The tanks in the east UST area were connected by underground pipelines to a boiler house previously located at the southwestern end of the former Engine House and the Fuel Transfer Area. Due to limited available information regarding the location of the piping associated with the nine USTs, the pipe would need to be located by tracing the pipes from the tanks. Once located, the pipes would be drained, cut, and removed, in accordance with 6 NYCRR 613.9.

Of the seven USTs that were investigated (Section 2.2.3), four of the USTs (Nos. 1, 2, 3 and 5) were filled with sand and water and two of the USTs (Nos. 6 and 9) were filled with water only. It is anticipated that the remaining two USTs (Nos. 7 and 8) are also filled with water. Tank No. 4 was filled with sand only. Each tank would be removed and disposed off site. All liquid and sand would be removed from the USTs, sampled for waste characterization purposes, and containerized for off-site disposal. If eligible for reuse, the sand would be stockpiled for reuse as backfill. The liquid would be disposed either off-site at a disposal facility or discharged under permit to the on site sewer. Post-excavation sampling, including sidewall sampling, would be performed in accordance with DER-10.

8.1.2.1.8 Performance Monitoring

Groundwater monitoring would be performed to monitor the performance of both the mobile SPH excavation and the enhanced in situ biodegradation. The groundwater monitoring would periodically gauge the post-excavation apparent SPH thickness measurements in monitoring wells located downgradient from the mobile SPH excavation and downgradient of the excavation sidewalls that were treated with nutrient amendments to promote biodegradation. Quarterly groundwater monitoring would be conducted for 2 years and would consist of documentation of groundwater and SPH measurements, if any, and the collection of groundwater samples for COCs and the parameters outlined in the Spill Technology and Remediation Series (STARS) Memo #1. Monitoring and sampling would satisfy the RAO of preventing impacts to groundwater.

The post-excavation monitoring program would consist of the installation of seven monitoring wells. Four wells would be installed north of the Amtrak property boundary and downgradient of the mobile SPH excavation. These four monitoring wells would be installed at the locations of four of the Pre-Delineation borings that aided in defining the northern extent of mobile SPH (i.e., CTB-1, CTB-19, CTB-20, and CTB-21). One monitoring well would be installed on each side of the North Runner Track (two monitoring wells in total) to monitor the SPH within the tract of soil that would not be excavated. Lastly, one monitoring well would be installed in the center of the mobile SPH excavation, subsequent to the excavation and backfill. This monitoring well would observe any SPH that mobilizes into the backfilled area. The proposed locations of the monitoring wells are provided on Figure 5. In addition to the newly installed wells, the existing monitoring wells within OU-3 would continue to be monitored.

As discussed in Section 8.1.2.1.5, during the enhanced biodegradation treatment, field parameters including pH, dissolved oxygen, temperature, and redox potential would be measured weekly. Water levels and apparent SPH thickness measurements would also be measured weekly. As the enhanced biodegradation treatment progressed and reduction of apparent SPH thickness measurements were observed, the frequency of SPH monitoring in the MW-77 treatment area would be reduced to biweekly. Once apparent SPH thickness measurements in monitoring wells of less than 0.1-foot were consistently observed, the monitoring would be performed monthly. Monthly monitoring would likely continue for one year.

A monitoring well would be installed in the southern portion of the historic SPH plume in the vicinity of the bioremediation infiltration piping. The monitoring of this well would identify any measurable SPH in this area and initiate the usage of the bioremediation infiltration piping to deliver biological amendments for enhancing biodegradation in this area.

The monitoring plan would be incorporated in an OM&M Plan, which would be incorporated into the Site Management Plan. All results of the monitoring and sampling would be reported to the NYSDEC on a quarterly basis.

8.1.2.1.9 Ambient Air Monitoring

The soil excavations, cleaning of the former Engine House service pits, and the UST closure activities would require air monitoring. These activities include the sawcutting of concrete and handling of impacted material (SPH, sand/liquid from the USTs, and liquid contents of the service pits). The air monitoring program would be implemented during all intrusive remedial actions to measure the concentration of particulates in ambient air in the work zone and the perimeter of the Yard. A Community Air Monitoring Plan (CAMP) that specifies the components of this program would be developed in accordance with the NYSDOH Generic Community Air Monitoring Plan contained in Appendix 1A of the draft DER-10 (NYSDEC, 2002).

The air monitoring program would include real-time continuous particulate monitoring using particulate monitoring devices. The need for air samples for COC analysis would be confirmed during the Remedial Design.

Dust would be controlled by spraying a water mist over the work area if perimeter action levels established in the CAMP are exceeded. This would be generated by connecting a misting device to a hose, which would be connected to any potable water source. The degree to which these measures would be used would depend on particulate levels in ambient air at the perimeter of the Yard as determined through implementation of the CAMP.

8.1.2.1.10 Transportation and Off-Site Disposal

Under this alternative, the remediation-derived waste would be transported off-site for disposal. Remediation-derived waste would include:

- Petroleum hydrocarbon-impacted soil from mobile SPH and surface soil excavation
- PCB-impacted soil
- Liquid waste and sludge removed from former Engine House service pits
- Wash water generated from pressure washing the former Engine House service pits
- Sand and liquid removed from USTs
- Metal debris from UST removal.
- Debris removed from the interior Engine House service pits
- Bulk concrete from the interior Engine House service pit cap removal
- Bulk concrete from fuel pump vault and exterior Engine House inspection pit removal

Segregation of each of the remediation-derived wastes would be performed based on media (e.g., concrete, debris) with the exception of the liquid wastes. Approximately 3,600 CY of soil would be generated from the mobile SPH excavation. The soil within the mobile SPH excavation known to exceed the site-specific NYSDEC-recommended soil cleanup level for PCBs is located within the mobile SPH excavation and is estimated to be approximately 100 CY. Based on a review of current SPH analytical results, it was assumed that the waste characterization sampling of soils excavated from the mobile SPH plume may classify the soil as PCB-hazardous waste due to the PCB concentrations in the mobile SPH. Therefore, for cost estimating purposes, it was assumed that a total of approximately 5 percent of the total soil volume excavated from the mobile SPH plume (3,600 CY) would be classified as PCB-hazardous waste. The total anticipated PCB-hazardous waste is approximately 180 CY.

Approximately 575 CY of soil would be generated from the visually hydrocarbon-impacted surface soil excavation. The one remaining exceedance of the site-specific NYSDEC-recommended soil cleanup level for lead in OU-3 is located within the surface soil excavation. Based on previous sampling data, it is not anticipated that the lead-impacted soil would receive separate classification or require separate handling and disposal.

Based on limited data from the SPH and sludge within the former Engine House service pits, it is expected that this sludge and SPH will contain PCBs and may be classified as a NYS B003 hazardous waste and TSCA waste. For this reason, this waste would be segregated from other liquid waste. As discussed in Section 7.2.2, it is not possible to quantify the amount of water present in the interior service pits due to the presence of the concrete cover. It is anticipated that 80 percent of the service pits volume is filled with liquids and therefore, approximately 87,000 gallons of liquids are present. For cost estimating purposes, it is assumed that approximately 25 percent of the liquid waste would be classified as hazardous liquid waste (21,750 gallons) and 75 percent would be classified as non-hazardous liquid waste (65,250 gallons). Waste characterization samples would be collected to confirm waste classifications.

Similarly, the wash water from cleaning the service pits may contain PCBs and would require separate handling and disposal. The quantity of wash water is not quantifiable because the surface area of service pits that require cleaning would not be known until the service pits are accessed. The water from the UST removal activities is expected to be disposed as non-hazardous waste or discharged under permit to the on-site sewer. Again, the water within the tanks is difficult to quantify because of limited records regarding the capacities of the tanks and proportion of the tanks that are filled with water. For cost estimating purposes, the water within the USTs is estimated to be approximately 45,000 gallons. Waste characterization samples would be collected to confirm waste classifications. All liquids would be stored in temporary on-site tanks to await disposal. Similarly, the quantity of sand within the tanks is difficult to quantify due to limited tank records. It is estimated that approximately 400 CY of sand exists within the USTs. Waste characterization samples would be collected to classify the sand and determine if disposal is required. The sand is not anticipated to be impacted and may be eligible for onsite reuse.

Based on limited information, the type of debris that may be encountered in the former Engine House service pits is unknown and therefore, not quantifiable. It is expected that the debris will consist primarily of wood, scrap metal debris, and possibly some equipment and machinery.

The concrete bulk waste from sawcutting access ways to the former Engine House service pits would not be in contact with contaminants and is expected to be classified as construction and demolition (C&D) waste. Concrete that is not crushed and used for backfill of the service pits would be transported to a concrete recycler or a State-approved solid waste landfill facility. An average density of 1.5 tons per cubic yard was assumed for concrete. Based on this density assumption, it is estimated that approximately 465 tons of concrete would be generated.

Due to existing covers on the fuel pump vaults and one of the exterior Engine House inspection pits, the presence of hydrocarbon impacts cannot be determined. For this reason, it was assumed that approximately 20 percent of the bulk concrete from the removal of these structures would be disposed as non-hazardous petroleum-impacted concrete. The remaining 80 percent would be disposed as construction and demolition (C&D) waste. Any concrete designated as C&D waste would be stockpiled with the interior Engine House service pit concrete waste and either crushed for reuse as backfill or disposed at a concrete recycler or State-approved solid waste landfill facility.

It is estimated that one waste characterization sample would be collected for every 22-ton truckload of soil and concrete for disposal and one waste characterization sample would be collected for every 10,000 gallons of liquid waste. Waste characterization samples would be submitted for analysis for the disposal facility requirements, which may include PCBs, total lead, TCLP VOCs, TCLP SVOCs, TCLP metals, and RCRA characteristics.

8.1.2.1.11 Site Management Plan

Following the remedy completion, COCs would remain in the OU-3 soil at concentrations less than the site-specific NYSDEC-recommended soil cleanup levels yet in excess of the NYSDEC TAGM 4046 Recommended Soil Cleanup Objectives and soil exhibiting SPH-impacts may be present in the subsurface. For this reason, a Site Management Plan would be developed. Operations personnel at the Yard would retain a copy of the Site Management Plan for reference by on-site workers. The primary components of the Site Management Plan would include:

- Soil Management Plan
- Use Restrictions

- OM&M Plan/Groundwater Monitoring

Soil Management Plan

The Soil Management Plan would be prepared and implemented to minimize the potential exposure of workers to low-level COCs in soil and groundwater after the remediation is completed. Further, the Soil Management Plan would establish applicable management practices for the future disturbance/reuse of Yard soils, particularly in remediated portions of the Yard that are under a use restriction.

Specifically, the Soil Management Plan would describe proper procedures for the disturbance of soil in a manner that would protect workers from exposure and identify proper soil management protocols. Routine maintenance activities (e.g., utility and track installation, repair, and maintenance) would involve worker contact with residual COCs in the OU-3 soil/fill. The Soil Management Plan would outline the procedures that would provide worker safety and proper handling of any waste that is generated.

The Soil Management Plan would provide requirements for the analytical testing of soil in areas requiring excavation work as part of routine maintenance activities at the Yard. In the event that analytical testing of the soil is not performed prior to maintenance activities, the soil would be stockpiled and sampled for analytical testing. Any debris within the soil would be segregated for off-site disposal. Analytical results would be evaluated for the determination of soil reuse at the Yard. The Soil Management Plan would also provide guidelines for workers in the event soil requires off-site disposal. Soil requiring off-site disposal would be sampled for waste characterization analysis to be determined by the waste disposal facility.

Use Restriction Program

Any future development in areas with use restrictions (e.g., the subsurface structures to remain in place) would need to be performed in accordance with NYSDEC regulations. Removal of the subsurface structures or their contents would require submittal of a work plan and approval by NYSDEC.

A monitoring program for areas with a use restriction would be developed. The monitoring program would include monitoring downgradient of the subsurface structures to remain in OU-3. Although the Metro Shed interior was cleaned prior to demolition of the structure and placement of clean fill in the inspection pit, groundwater monitoring would be performed downgradient from the Metro Shed to identify any future SPH-impacts. Similarly, the Oil House basement was cleaned prior to placement of soil/fill. Groundwater monitoring would be performed downgradient of the Oil House basement as well. A monitoring well would be installed near the northwest portion of the Metro Shed and to the northwest of the Oil House basement. Following the interior Engine House service pit cleaning, a monitoring well would be installed downgradient of the former Engine House to identify any future SPH impacts. Existing monitoring well MW-70 is also located downgradient of the former Engine House and would be monitored.

OM&M/Groundwater Monitoring

The groundwater monitoring plan, as described in Section 8.1.2.1.8, to monitor the performance of the mobile SPH excavation and the enhanced biodegradation of the residual SPH would be incorporated into the Site Management Plan.

8.1.2.1.12 Environmental Easements

An environmental easement is a form of institutional control that acts as an enforcement mechanism to ensure required institutional and engineering controls remain in place (NYSDEC, 2004). The environmental easement would:

- require compliance with the Site Management Plan
- identify areas of residual contamination remaining in OU3 with concentrations below the SCGs that would be managed in place (e.g., residual SPH, subsurface structures);
- restrict the use of groundwater as a source of potable water, without necessary water quality treatment; and
- require an annual certification that certifies the institutional and engineering controls are unchanged from the previous annual certification and nothing has occurred to impair the ability of the controls to protect human health and the environment.

An agreement with LIRR would be established where an institutional control would be recorded with the deed to document the presence of residual SPH. Residual SPH would be managed on the LIRR property in the same manner as on site residual SPH. Additionally, a covenant would be placed on the deed regarding future use of this area.

8.1.2.2 Evaluation

The following sections provide a detailed evaluation of Remedial Alternative II based on the seven specific evaluation criteria.

8.1.2.2.1 Overall Protection of Human Health and the Environment

This alternative would meet all of the RAOs for the mobile and residual SPH and hydrocarbon-impacted soil and the subsurface structures, thus in effect providing protection to human health and the environment. Protection is afforded by: removing all mobile SPH, reducing the mass of SPH in areas exhibiting measurable quantities of residual SPH in the subsurface; removing the hydrocarbon-impacted surface soil, removing the PCB-impacted liquid waste and any debris from the former Engine House service pits; removing the nine USTs in accordance with NYSDEC regulation; and removing the exterior Engine House inspection pits and fuel pump vaults. Future risk of exposure for workers to PCB and hydrocarbon -impacted material is mitigated from OU-3 by implementing this remedial action alternative. Protection of the environment is provided through removal of all mobile SPH having a potential to impact groundwater.

8.1.2.2.2 Compliance with SCGs

A summary of the applicable SCGs is presented in Table 13. This remedial action alternative would comply with the applicable chemical and action-specific SCGs for the media of concern.

Specifically, Remedial Alternative II would:

- Comply with the chemical specific SCGs for soil (i.e., NYSDEC recommended soil cleanup levels, TSCA);
- Address the 6 NYCRR Part 375 goal to eliminate or mitigate all significant threats to public health and the environment;
- Address the 6 NYCRR Part 613 requirement for removal or permanent closure of out of service storage tanks;
- Comply with the performance criterion for residual SPH reduction to less than 0.01-foot apparent SPH thickness as observed in monitoring wells and the treatment performance goal as measured by total SVOCs analysis of soil;

- Address Article 12 and NCP requirements for recovering oil and mitigating its effects using chemical and physical methods consistent with public health and welfare and the environment; and
- Effectively remove "consequential" amounts of NYS listed hazardous waste in accordance with 6 NYCRR Part 375.

Remedial Alternative II would not comply with the remedial goal to restore OU-3 to pre-disposal/pre-release conditions. However, OU-3 has operated as a railyard for 95 years and its intended future use is for continued operations as a railyard.

8.1.2.2.3 Long Term Effectiveness and Permanence

Remedial Alternative II provides long-term effectiveness for each medium of concern. Biodegradation results in the permanent reduction of SPH mass in areas targeted for treatment. Excavation of mobile SPH and hydrocarbon-impacted surface soil would permanently remove hydrocarbon-impacted media from OU-3. The cleaning and repair of the former Engine House service pits permanently removes the PCB-impacted waste from OU-3 and backfilling provides permanent closure. The Metro Shed inspection pit and Oil House basement was cleaned prior to the placement of backfill and does not require remedial action. Lastly, the removal of the nine USTs would be performed in accordance with NYSDEC regulations.

8.1.2.2.4 Reduction of Toxicity, Mobility, or Volume

Excavation of the mobile SPH plume and the hydrocarbon-impacted surface soil would effectively reduce the mobility and volume of SPH present in OU-3. As stated above, the biodegradation of SPH in the subsurface would permanently reduce the mass of the SPH through the process of mineralizing the SPH to carbon dioxide and water, in turn reducing the toxicity, mobility, and volume of SPH present. Likewise, the cleaning of the former Engine House service pits would effectively remove the PCB-impacted material; thereby reducing the toxicity, mobility, and volume of PCB-impacted material from OU-3. The fuel pump vaults and exterior Engine House inspection pits do not appear to be a source of contamination or known to contain impacted material yet would be removed to facilitate the hydrocarbon-impacted surface soil excavation. The Metro Shed inspection pit and Oil House basement do not require remedial action since they were cleaned prior to placement of clean soil/fill. The USTs in the UST area were emptied of their contents prior to being filled with sand and/or water. Therefore, there is no reduction of toxicity, mobility, or volume of impacted material associated with the closure of the USTs. The disconnection of the associated piping would include draining of residual SPH, if required, and capping of the piping. In the event SPH is encountered in the piping and draining is required, the volume and mobility of SPH would be reduced.

8.1.2.2.5 Short-Term Effectiveness

This alternative poses moderate short-term effects for remedial workers and on-site workers that work in this area of the Yard. Remedial workers would not be in direct contact with the residual SPH or hydrocarbon-impacted soil. All enhanced biodegradation treatment would occur through direct injection into the subsurface from grade level.

Short-term effects are increased for remedial workers during the mobile SPH and hydrocarbon-impacted soil excavations and cleaning of the former Engine House service pits. PCB-impacted liquid waste would be contained since it would be removed using a vacuum truck and directly containerized in temporary storage tanks. However, workers would need to enter the service pits for accessing and effectively cleaning the service pit interior. Pressure wash cleaning of the service pit interior would create a mist during implementation. Engineering controls including proper PPE requirements can reduce the short-term effects to workers while conducting this work.

Moderate exposure concerns are expected during the UST removal. As stated above, the fuel oil was removed from the USTs previously and exposure to hydrocarbon-impacted material should be minimal.

Potential short-term risks to the community would be posed from transportation of a relatively small quantity of waste to off-site disposal facilities. Approximately 375 truckloads of soil and concrete and 25 tanker truck loads liquids would be required, assuming none of the concrete is used for backfill of the Engine House pits and non-hazardous liquids require disposal rather than permitted discharge. Potential exposure would result from releases from haul vehicles along the transportation route. Haul vehicles would be secured prior to exiting the Yard to prevent release of waste.

8.1.2.2.6 Implementability

The technologies to be used in this alternative are readily available. Experienced remedial contractors are readily available to implement the remedial activities associated with this alternative. Enhanced biodegradation requires minimal construction of treatment equipment. In the event treatment is required in the southern portion of the historic SPH plume, the bioinfiltration piping is available for injection of biological amendments. Oxygen/nutrient amendments can be injected using direct push boring methods (e.g., Geoprobe) and the monitoring wells would be installed using conventional drilling methods. The equipment required for the cleaning of the former Engine House service pits would be conventional demolition equipment and vacuum trucks. Excavation equipment and contractors are readily available for the mobile SPH, hydrocarbon-impacted surface soil, and limited subsurface structure removal.

Of the primary technologies to be applied, the enhanced biodegradation technology poses the most concern for technical reliability since maintaining optimum soil conditions throughout the treatment duration drives the success of the process and ultimately the time schedule for treatment. However, routine monitoring minimizes the risk of soil parameters fluctuating out of the targeted range. Further, nutrients and other amendments that may be added to re-stabilize soil conditions are readily available and rather inexpensive.

Permits to complete these remedial actions would be obtainable with reasonable effort. Disposal tracking and waste characterization sampling would require moderate effort due to the anticipated various waste classifications.

8.1.2.2.7 Cost

The estimated capital cost to implement Remedial Alternative II is $4,238,582. The estimated present worth cost for OM&M tasks associated with groundwater monitoring for two years and performance monitoring of the in situ biodegradation treatment area is $75,811. Therefore, the total net present value of Remedial Alternative II is $4,314,393.

8.1.3 Remedial Alternative III: Excavation/Off-Site Disposal of All Mobile and Residual SPH and All Hydrocarbon-Impacted Soil/Off-Site Disposal of Subsurface Structures and USTs

The following sections provide a description of the Remedial Alternative III elements and discuss how media of concern is addressed. An evaluation based on the seven specific evaluation criteria is also presented below.

8.1.3.1 Description

In accordance with 6 NYCRR Part 375, the remedial goal for each site registered in the Inactive Hazardous Waste Program is to return the site to pre-disposal conditions, to the extent feasible and authorized by law. Remedial Alternative III was developed to evaluate achieving this goal through the removal of all materials associated with the media of concern. Specifically, mobile and residual SPH and associated hydrocarbon-impacted soil within the extent of the historic SPH plume would be excavated and disposed off-site, visually hydrocarbon-impacted surface soil would be excavated and disposed off-site, the former interior and exterior Engine House service pits, the former Metro Shed inspection pit, fuel pump vaults, and the Oil House basement would be removed in their entirety and disposed off-site, and the nine USTs in the UST areas would be removed and disposed off-site. Figure 6 shows the areas to be addressed and the technologies proposed for this alternative. This alternative would include the following remedial tasks:

- Excavation of All Mobile and Residual SPH and Associated Hydrocarbon-Impacted Soil
- Excavation of Visually Hydrocarbon-Impacted Surface Soil
- Excavation of Subsurface Structures
- Ambient Air Monitoring
- Transportation and Off-Site Disposal
- Site Management Plan
- Environmental Easement

It is estimated that this alternative would require 12 to 18 months to complete. These tasks would begin upon NYSDEC approval of the Remedial Design for this alternative. Groundwater monitoring would be conducted beyond this timeframe.

8.1.3.1.1 Excavation of SPH and Associated Hydrocarbon-Impacted Soil

To satisfy the restoration to pre-disposal goal for all Inactive Hazardous Waste Sites (6 NYCRR 375), all mobile SPH, residual SPH, and associated hydrocarbon-impacted soil within the historic zero-foot contour would be excavated to a depth of one-foot below the water table. For cost estimating purposes, it was assumed that the depth of excavation would be 5 feet bls. Additionally, visually hydrocarbon-impacted surface soil outside of the extent of the historic zero-foot contour would be excavated to a depth of 1-foot. Approximately 24,000 CY of soil would be excavated for off-site disposal.

Since this is an active portion of the Yard with the only access road for the northern portion of the Yard transecting the excavation area, this excavation would be performed in stages to minimize disturbance of all railroad operations in this area and allow for the rerouting of the access road. Extensive engineering controls would be associated with this excavation. Several tracks would require relocation or protection. Utility clearance by Amtrak personnel would be required. Extensive dewatering system and liquids management would be required. Fencing would be constructed around the perimeter of the active excavation area and relocated as the excavation sequenced.

8.1.3.1.2 Excavation of Subsurface Structures

The former Engine House service pits would be accessed in the same manner as that described for Remedial Alternative II in Section 8.1.2.1.6. The entire concrete cover over the former Engine House foundation would be removed using standard demolition practices. The service pits were individually capped prior to the construction of the comprehensive concrete cover. The service pit caps are constructed of metal decking and concrete of 1-foot thickness. These service pit caps extended approximately 2 feet above the surrounding former Engine House floor. The concrete cover was subsequently constructed and incorporated with the service pit caps. The concrete cover is approximately 5-inches in thickness with approximately 2-feet of compacted fill underneath. The compacted fill was placed on the former Engine House floor in an effort to incorporate the concrete cover with the raised service pit caps and to form a comprehensive cover over the entire former Engine House footprint.

Once the service pits are accessed, all water and SPH in the service pits would be removed using a vacuum truck, containerized, and sampled for waste characterization purposes. All debris, including former equipment, machinery, or construction debris, would be removed, temporarily stockpiled, and disposed off-site. All concrete and metal debris would be temporarily stockpiled while awaiting transport for off-site disposal.

The Metro Shed was formerly demolished to the concrete floor slab and the inspection pit was filled with soil/fill. Portions of the Metro Shed have since been filled with additional soil/fill for grading purposes. All soil/fill placed on top of the former Metro Shed concrete floor slab and within the inspection pit would be excavated. This soil would be temporarily stockpiled and sampled for waste characterization sampling. It is anticipated that this soil/fill would be considered clean fill and would be eligible for re-use at the Yard. Once the concrete floor and inspection pit are accessed, all concrete associated with the Metro Shed foundation would be removed using standard demolition equipment.

Additional subsurface structures to be removed would include the Oil House basement, the exterior Engine House inspection pits, and the fuel pump vaults. The Oil House basement was previously cleaned and filled with soil/fill. The concrete slab over the basement would be removed and all soil/fill excavated. Any contents, including soil/fill, SPH, and sludge would be removed from the subsurface structures and sampled for waste characterization purposes. It is anticipated that the soil/fill from the Oil House basement would be considered clean fill and would be eligible for re-use at the Yard. The concrete structures and foundations would be removed using standard demolition equipment.

The UST areas would require soil removal to uncover the tanks. As described in Section 8.2.4, all piping would be traced, drained, if necessary, and removed. All water within those tanks filled with water or water/sand would be pumped prior to excavation and containerized for off-site disposal or permitted discharge to the on site sewer. The sand and metal would be segregated and temporarily stockpiled while awaiting waste characterization sampling and off-site disposal. Post-excavation sampling, including sidewall sampling, would be performed in accordance with DER-10.

All excavations would be backfilled with soil/fill from on-site sources within OU-4 or from certified off-site sources. The source of the backfill material would be approved by the DER in advance, in accordance with the draft DER-10.

8.1.3.1.3 Ambient Air Monitoring

Due to the significant size of the excavations and concrete structures to be removed, air monitoring would be a major component of the remediation under this alternative. The air monitoring program would be implemented during all remedial actions to measure the concentration of particulates in ambient air in the work zone and the perimeter of the Yard. A CAMP that specifies the components of this program would be developed in accordance with the NYSDOH Generic Community Air Monitoring Plan contained in Appendix 1A of the draft DER-10 (NYSDEC, 2002). The air monitoring program would include real-time continuous particulate monitoring using particulate monitoring devices. The need for air samples for COC analysis would be confirmed during the Remedial Design.

Dust would be controlled by spraying a water mist over the work area if perimeter action levels established in the CAMP are exceeded. This would be generated by connecting a misting device to a hose, which would be connected to any potable water source. The degree to which these measures would be used would depend on particulate levels in ambient air at the perimeter of the Yard as determined through implementation of the CAMP.

8.1.3.1.4 Transportation and Off-Site Disposal

For this alternative, the remediation-derived waste would be transported off-site for disposal. Remediation-derived waste would include:

- Bulk concrete, soil/fill, and metal debris from the excavation of the former Engine House foundation and service pits;
- Liquid waste and sludge removed from former Engine House service pits;
- Debris removed from former Engine House service pits;
- Bulk concrete and subsurface structures contents, if any, from the excavation of the former Metro Shed foundation and inspection pit, exterior Engine House inspection pits, fuel pump vaults, and the Oil House basement;

- Soil from the excavation of mobile SPH, residual SPH, and hydrocarbon-impacted surface soil; and
- Water, sand, and scrap metal from removal of the USTs.

Segregation of each of the remediation-derived wastes would be performed based on media (e.g., concrete, debris) with the exception of the liquid wastes. Based on limited data from the liquid within the former Engine House service pits, it is expected that the sludge/SPH will contain PCBs and may be classified as a NYS B003 hazardous waste and TSCA waste. For this reason, this waste would be segregated from other liquid waste. As discussed in Section 7.2.2, it is not possible to quantify the amount of water present in the inspection pit system due to the presence of the concrete cover. For estimating purposes, it is anticipated that 80 percent of the service pits' volume is filled with water and therefore, approximately 87,000 gallons of water are present. For cost estimating purposes, it is assumed that approximately 25 percent of the liquid waste would be classified as hazardous liquid waste (21,750 gallons) and 75 percent would be classified as non-hazardous liquid waste (65,250 gallons). Waste characterization samples would be collected to confirm waste classifications. Based on limited information, the type of debris that may be encountered in the former Engine House service pits is unknown and therefore, not quantifiable. It is expected that the debris will consist primarily of wood, scrap metal debris, and possibly some equipment and machinery.

The water from the UST removal activities is expected to be characterized as non-hazardous waste. The water within the tanks is difficult to quantify because of limited records regarding the capacities of the tanks and proportion of the tank that is filled with water. For cost estimating purposes, the water within the USTs is estimated to be approximately 45,000 gallons. Waste characterization samples would be collected to confirm waste classifications. All liquids would be stored in temporary on-site tanks to await disposal or permitted discharge to the on-site sewer.

The concrete bulk waste from the former Engine House concrete cover and service pit caps would not be in contact with contaminants and is expected to be classified as C&D waste. Concrete that is not crushed and used for backfill of the service pits would be transported to a concrete recycler or a State-approved solid waste landfill facility. An average density of 1.5 tons per cubic yard was assumed for concrete. Based on this density assumption, it is estimated that approximately 700 tons of concrete would be generated from the former Engine House foundation and service pit excavation.

Due to existing covers on the fuel pump vaults and one of the exterior Engine House inspection pits, the presence of hydrocarbon impacts cannot be determined. For this reason, it was assumed that approximately 20 percent of the bulk concrete from the removal of these structures would be disposed as non-hazardous petroleum-impacted concrete. The remaining 80 percent would be disposed as C&D waste. Any concrete designated as C&D waste would be stockpiled with the interior Engine House service pit concrete waste and either crushed for reuse as backfill or disposed at a concrete recycler or State-approved solid waste landfill facility.

The concrete from the former Engine House service pit and former Metro Shed inspection pit would likely be disposed as non-hazardous concrete. Waste characterization sampling would be performed to confirm the waste classification. It is estimated that 2,500 tons of concrete would be transported for off-site disposal.

Approximately 24,000 CY of soil would be generated from the mobile and residual SPH excavation and the visually hydrocarbon-impacted surface soil excavation. It is anticipated that this soil would be disposed off-site as petroleum-impacted non-hazardous waste. The soil within the mobile SPH excavation known to exceed the site-specific NYSDEC-recommended soil cleanup level for PCBs is located within the mobile SPH excavation and is estimated to be approximately 100 CY. Therefore, for cost estimating purposes, it was assumed that a total of approximately 5 percent of the total soil volume excavated from the mobile SPH plume (3,600 CY) would be classified as PCB-hazardous waste. The total anticipated PCB-hazardous waste is approximately 180 CY.

The one remaining exceedance of the site-specific NYSDEC-recommended soil cleanup level for lead in OU-3 is located within the surface soil excavation. Based on previous sampling data, it is not anticipated that the lead-impacted soil would receive separate classification or require separate handling and disposal.

It is estimated that one waste characterization sample would be collected for every 22-ton truckload of soil and concrete for disposal and one waste characterization sample would be collected for every 10,000 gallons of liquid waste. For cost estimating purposes, it was assumed that one soil/fill sample would be collected for every 750 CY. Waste characterization samples would be submitted for analysis for the disposal facility requirements, which may include PCBs, total lead, TCLP VOCs, TCLP SVOCs, TCLP metals, and RCRA characteristics.

8.1.3.1.5 Site Management Plan

Following the remedy completion, COCs would remain be present in the OU-3 soil at concentrations less than the site-specific NYSDEC-recommended soil cleanup levels yet in excess of the NYSDEC TAGM 4046 Recommended Soil Cleanup Objectives. For this reason, a Site Management Plan would be developed. Onsite personnel at the Yard would retain a copy of the Site Management Plan for reference by on-site workers. The primary components of the Site Management Plan would include the Soil Management Plan

The Soil Management Plan would be prepared and implemented to minimize the potential exposure of workers to low-level COCs in soil and groundwater after the remediation is completed. Further, the Soil Management Plan would establish applicable management practices for the future disturbance/reuse of Yard soils, particularly in remediated portions of the Yard.

Specifically, the Soil Management Plan would describe proper procedures for the disturbance of soil in a manner that would protect workers from exposure and identify proper soil management protocols. Routine maintenance activities (e.g., utility and track installation, repair, and maintenance) would involve worker contact with residual COCs in the OU-3 soil/fill. The Soil Management Plan would outline the procedures that would provide worker safety and proper handling of any waste that is generated.

The Soil Management Plan would provide requirements for the analytical testing of soil in areas requiring excavation work as part of routine maintenance activities at the Yard. In the event that analytical testing of the soil is not performed prior to maintenance activities, the soil would be stockpiled and sampled for analytical testing. Any debris within the soil would be segregated for off-site disposal. Analytical results would be evaluated for the determination of soil reuse at the

Yard. The Soil Management Plan would also provide guidelines for workers in the event soil requires off-site disposal. Soil requiring off-site disposal would be sampled for waste characterization analysis to be determined by the waste disposal facility.

8.1.3.1.6 Environmental Easements

An environmental easement is a form of institutional control that acts as an enforcement mechanism to ensure required institutional and engineering controls remain in place (NYSDEC, 2004). The environmental easement would:

- require compliance with the Site Management Plan
- identify areas of residual contamination remaining in OU3 with concentrations below the SCGs that would be managed in place;
- restrict the use of groundwater as a source of potable water, without necessary water quality treatment; and
- require an annual certification that certifies the institutional and engineering controls are unchanged from the previous annual certification and nothing has occurred to impair the ability of the controls to protect human health and the environment.

An agreement with LIRR would be established where an institutional control would be recorded with the deed to document the presence of soil with COC concentrations below the site-specific NYSDEC-recommended cleanup levels yet greater than the TAGM RSCOs. Additionally, a covenant would be placed on the deed regarding future use of this area.

8.1.3.2 Evaluation

The following sections provide a detailed evaluation of Remedial Alternative III based on the seven specific evaluation criteria.

8.1.3.2.1 Overall Protection of Human Health and the Environment

Remedial Alternative III would provide protection of human health and the environment. The protection afforded can be measured by the remedial alternatives' ability to satisfy the RAOs. Remedial Alternative III would satisfy all of the RAOs presented in Section 6.2.1.2 and 6.2.2.2. This would be accomplished by:

- Reducing the mass of SPH in the subsurface through excavation;

- Removing the PCB-impacted liquid waste and sludge from the former Engine House service pits;
- Removing all soil in OU-3 with COC concentrations in excess of the site-specific NYSDEC-recommended soil cleanup levels for the COCs;
- Removing all construction material associated with the interior and exterior Engine House service pits, the former Metro Shed inspection pit, the Oil House basement, and the fuel pump vaults;
- Removing the USTs; and
- Off-site disposal of remediation waste.

By removing all impacted materials, the possibility of current and future human exposure and exposure to the surrounding environment would be eliminated.

8.1.3.2.2 Compliance with SCGs

A summary of the applicable SCGs is presented in Table 13. Remedial Alternative III would comply with the applicable chemical and action specific SCGs for the media of concern. Specifically, Remedial Alternative III would:

- Comply with the chemical specific SCGs for soil (i.e., NYSDEC recommended soil cleanup levels, TSCA);
- Address the 6 NYCRR Part 375 goal to eliminate or mitigate all significant threats to public health and the environment and restore OU-3 to pre-disposal/pre-release conditions;
- Effectively remove "consequential" amounts of NYS listed hazardous waste in accordance with 6 NYCRR Part 375;
- Address the 6 NYCRR Part 613 requirement for removal or permanent closure of out of service storage tanks; and
- Address the performance criterion for residual SPH reduction to less than 0.01-foot apparent SPH thickness as observed in monitoring wells and the treatment performance goal as measured by total SVOCs analysis of soil;
- Address Article 12 and NCP requirements for recovering oil and mitigating its effects using chemical and physical methods consistent with public health and welfare and the environment.

8.1.3.2.3 Long-Term Effectiveness and Permanence

All impacted material and associated construction material would be removed from OU-3 and disposed off-site, thereby providing a permanent remedy. Although this alternative does not provide long-term effectiveness through treatment of contaminants, long-term effectiveness and permanence are afforded through the removal of contaminants from OU-3 and containment of remediation waste in an off-site secure landfill system. Any risks of exposure are eliminated from the subsurface structures and hydrocarbon-impacted material addressed in this alternative and transferred to the off-site disposal facility.

8.1.3.2.4 Reduction of Toxicity, Mobility, or Volume

This criterion evaluates changes in the toxicity, mobility, and volume of listed hazardous waste, COCs and SPH. NYS B003 listed PCB hazardous waste is present in the former Engine House service pits. In addition, debris in the former Engine House service pits may be impacted with PCBs. Under this alternative, all PCB-impacted remediation waste would be removed from OU-3. This would eliminate the mobility and volume of hazardous waste and COCs at this location.

Excavation of all mobile and residual SPH and hydrocarbon-impacted surface soil would completely remove the volume of SPH, thus removing the risk of SPH mobility. The nine USTs and all associated piping would be excavated, thereby removing any remaining SPH that may have been present in the UST piping. These remedial actions would reduce the mobility, and volume of SPH in OU-3.

The Metro Shed inspection pit, Oil House basement, fuel pump vaults and exterior Engine House inspection pits do not appear to be a source of contamination or known to contain impacted material yet would be removed.

All waste generated from the remedial actions would be transported off-site for disposal. Consequently, this material would no longer present an on-site risk, as the material would be relocated to a secure land disposal facility. The toxicity associated with the remediation waste would be removed from OU-3, however these remedial actions would not alter the toxicity of the remediation waste itself. The toxicity risk is transferred to the secure land disposal facility, specifically designed and equipped to manage the waste.

8.1.3.2.5 Short-Term Effectiveness

The total time required to complete Remedial Alternative III is expected to be 12 to 18 months following NYSDEC approval of the Remedial Design. Remedial Alternative III requires the greatest amount of earthwork and remediation waste handling. Risk of exposure to the hazardous waste, COCs, and SPH exists for remedial contractors during the excavation activities. Remedial contractors would be in direct contact with the hazardous liquid waste and impacted concrete within the former Engine House service pits and SPH in the soil and UST piping, thereby presenting dermal, ingestion, and inhalation pathways. The risk of exposure would be minimized through the use of appropriate PPE, continuous air monitoring, and implementing engineering controls. Particulate monitoring would be performed at work zones and at the Yard perimeter. Air sampling for COCs may be performed, if required.

This alternative presents the greatest potential for short-term effects to the community from construction activities and off-site transport. The potential for temporary increase of risk to the community and workers due to dust (particulate emissions) during the subsurface structure, SPH, and hydrocarbon-impacted soil excavations would be controlled by the use of dust control measures discussed in Section 8.1.3.1.3. Remedial contractors would also be protected by the use of proper PPE and respirators, if required. Additionally, the potential for odor nuisance is greatest for this remedial alternative during the SPH and hydrocarbon-impacted soil excavation. Odor reducing foam would be employed to minimize any odor nuisances. Risk associated with transport of remediation waste through the surrounding community would be mitigated, to the extent possible, via engineering controls and decontamination procedures prior to leaving the work zone.

The remedial activities would cause a considerable increase in the truck traffic in the community. It is estimated that 2,100 truckloads would leave the Yard during implementation of the remedial alternative. The surrounding neighborhood is largely commercial and industrial, however, residential areas must be traversed when exiting the Yard. Given the large number of trucks that would be needed for this remedial alternative, the increased truck traffic and associated emissions may pose considerable concerns to the surrounding community.

8.1.3.2.6 Implementability

Although remedial and demolition contractors are readily available to perform the work and the technologies associated with Remedial Alternative III are well-proven, implementation of this alternative would be challenging given that OU-3 is a considerably active portion of the Yard, with the only access road for the north portion of the Yard traversing through the center of OU-3. Excavation of the mobile and residual SPH and subsurface structures would require considerable staging areas for remediation waste awaiting off-site disposal. Providing adequate areas for staging waste stockpiles and temporary containers would be difficult. Further, the schedule of the excavations may be slowed if insufficient space is available for staging and progress is contingent on waiting for disposal of excavated materials and clearance of staging areas prior to being able to stage additional waste. Establishing staging areas in other portions of the Yard is not easily implemented due to the numerous tracks in the Yard and the inability of crossing tracks with excavation equipment and haul vehicles.

The proximity of the excavations to active tracks would also pose a challenge. Additional precautions (e.g., engineering controls) or taking the tracks temporarily out of service may be required. Disposal tracking and waste characterization sampling would require a significant effort due to the large quantity of waste to be disposed and the multiple waste classifications that are expected. Permits to perform this work would be obtainable with reasonable effort.

8.1.3.2.7 Cost

The estimated total net present value to implement Remedial Alternative III is $12,099,326. This alternative does not have associated OM&M tasks and therefore no future costs.

8.2 Comparison of Remedial Alternatives

This section provides a comparison of the remedial action alternatives that were developed to address the media of concern in OU-3. The NCP and the NYSDEC regulation and guidance on the selection of remedial alternatives for inactive hazardous waste disposal sites require that the seven evaluation criteria be used to individually evaluate the remedial action alternatives and also evaluate comparatively to identify advantages and disadvantages of each alternative relative one another (NYSDEC, 1990 and NYSDEC, 2002).

The NCP and the NYSDEC guidance also require that alternatives be evaluated based on community acceptance. In accordance with NYSDEC guidance, alternatives are evaluated for community acceptance after the public comment period.

8.2.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment and compliance with SCGs are threshold criteria. Therefore, the remedial action alternatives must adequately protect the human health and the environment and successfully comply with SCGs to be considered for selection as a recommended alternative. The protection of human health and the environment can be measured by the alternative's ability to satisfy the RAOs.

Remedial Alternative I – No Action would not reduce or control the potential for exposure risk for impacted media and would not satisfy the SPH and subsurface structures RAOs. The presence of mobile and residual SPH and hydrocarbon-impacted surface soil would continue to pose an exposure risk to on-site workers. Further, the presence of SPH and hazardous PCB waste would persist in the subsurface and this alternative would provide no protection from further impacts to the subsurface from these contaminants. Therefore, this alternative would not offer a sufficient level of protection to human health and the environment.

The two remaining remedial alternatives, Remedial Alternatives II and III, would provide adequate protection to human health and the environment by reducing, removing, or controlling risks through:

- Engineering and institutional controls;
- Excavation of mobile SPH and visually hydrocarbon-impacted surface soil
- Excavation or treatment of residual SPH and associated hydrocarbon-impacted soil;
- Excavation of soil with COC concentrations in excess of the site-specific NYSDEC-recommended soil cleanup levels for PCBs and lead;

- Removal of PCB-impacted contents of the former Engine House service pits; and
- Removal of the nine USTs.

Remedial Alternative II would provide an adequate level of protection to human health and the environment. All PCB hazardous waste would be removed from the former Engine House service pits. Mobile SPH and visually hydrocarbon-impacted surface soil would be excavated and disposed off site. The SPH mass would be reduced in areas of residual SPH and associated hydrocarbon -impacted soil. By removing these contaminants, the exposure risks associated with the contaminants are removed from OU-3. The nine USTs, fuel pump vaults and exterior Engine House inspection pits would be removed. The former Metro Shed inspection pit and Oil House basement would be routinely monitored for any impacts to the subsurface that could pose an exposure. Additionally, the groundwater monitoring program would be implemented to identify any new occurrences of measurable SPH downgradient of the mobile SPH excavation, enhanced biodegradation treatment areas, and southern portion of the SPH plume near the bioinfiltration system.

Remedial Alternative II would include use restrictions for the subsurface structures. However, this alternative would not rely on these use restrictions to prevent exposure to these structures since impacted contents of the subsurface structures would be removed. Further, the Soil Management Plan would be implemented to address worker exposure to soil/fill exhibiting hydrocarbon-impacts and soil with concentrations less than the site-specific NYSDEC-recommended soil cleanup levels for the COCs but in excess of the NYSDEC TAGM 4046 RSCOs.

Remedial Alternative III provides a similar level of protection to human health and the environment as Remedial Alternative II. Both alternatives include the removal PCB-hazardous waste within the former Engine House service pits. Remedial Alternative III, however, removes all concrete associated with the former Engine House service pits as well, whereas Remedial Alternative II includes cleaning of the service pits. Nevertheless, the potential for exposure to the contents of the former Engine House service pits is removed under both remedial alternatives. Similarly, the exposure risk associated with the residual SPH and associated hydrocarbon-impacted soil is decreased through excavation. Remedial Alternative III does not rely on institutional controls for preventing worker exposure to the subsurface structures, since the former Engine House service pits, the former Metro Shed, Oil House basement, fuel pump vaults, and USTs are removed.

In summary, Remedial Alternatives II and III would adequately provide protection to human health and the environment. Remedial Alternative I would provide the least protection to human health and the environment.

8.2.2 Compliance with SCGs

Compliance with SCGs, also a threshold criterion, determines whether an alternative satisfies regulatory requirements. The SCGs for the media of concern were provided on Table 13 and discussed in Sections 6.2.1.2 and 6.2.2.2.

Remedial Alternative I would not satisfy the applicable chemical and action specific SCGs. In addition, Remedial Alternative I would not address the remedial goals provided in 6 NYCRR Part 375 to: eliminate or mitigate all significant risk to public health and the environment; restore the site to pre-disposal/pre-release conditions, to the extent feasible and authorized by law; and remove "consequential" amounts of listed hazardous waste.

With the exception of 6 NYCRR Part 375, Remedial Alternatives II and III would meet all of the applicable chemical and action-specific SCGs. Both alternatives would meet the 6 NYCRR Part 375 goals to eliminate or mitigate all significant risk to public health and the environment and remove "consequential" amounts of listed hazardous waste. Only Remedial Alternative III would restore the site to pre-disposal/pre-release conditions.

8.2.3 Long-Term Effectiveness and Permanence

Long-term effectiveness examines the effectiveness of the alternative to providing protection to human health and the environment and is measured by the magnitude of residual risk remaining after the remedial actions and by adequacy and reliability of controls.

Remedial Alternative I provides neither long-term effectiveness nor permanence since the volume of SPH and contents of subsurface structures would remain the same. Existing engineering controls including the former Engine House service pits concrete cover would not be maintained. Further, no institutional controls would be maintained to prevent on-site workers from accessing areas of mobile and residual SPH, and the subsurface structures.

Remedial Alternatives II and III both provide adequate long-term effectiveness and permanence. Remedial Alternative III provides a slightly higher level of permanence through the added removal of all subsurface structures and excavation of residual SPH and associated hydrocarbon-impacted soil. Remedial Alternative II relies on the performance of the in situ biodegradation treatment to effectively reduce SPH concentrations while Remedial Alternative III removes areas of measurable apparent SPH from OU-3 through excavation and off-site disposal. Remedial Alternative II provides contingency measures for the remaining subsurface structures in the form of groundwater monitoring. Meanwhile, Remedial Alternative III foregoes groundwater monitoring of the structures by removing the structures in their entirety. However, future concerns with respect to the subsurface structures are not anticipated for Remedial Alternative II because the impacted material associated with the structures would be removed and the USTs would be removed in accordance with 6 NYCRR 613.

In summary, Remedial Alternative I provides no long-term effectiveness and permanence. Remedial Alternatives II and III provide similar levels of long-term effectiveness and permanence. Both remove the impacted material associated with the subsurface structures and reduce the mass of SPH within the subsurface. Remedial Alternative II would successfully provide long-term effectiveness with permanence of remedy monitored through groundwater monitoring. Remedial Alternative III successfully provides both long-term effectiveness and permanence.

8.2.4 Reduction of Toxicity, Mobility, or Volume

This criterion evaluates the anticipated performance of the remedial action alternative in terms of the treatment used to reduce the toxicity, mobility, or volume, the type and quantity of residuals remaining after treatment, and the degree to which the treatment is irreversible. Specifically, this criterion evaluates the remedial alternative's ability to reduce the toxicity, mobility, or volume of the PCB-hazardous waste within the former Engine House service pits, the mobile and residual SPH in soil, visually hydrocarbon-impacted surface soil, and any remaining SPH associated with the UST areas. The former Metro Shed inspection pit and Oil House basement were cleaned and filled with clean soil/fill and no evidence of COCs or SPH have been observed. Therefore, the former Metro Shed inspection pit and Oil House basement is omitted from this discussion.

Remedial Alternative I would not reduce the toxicity, mobility, or volume of media of concern. The toxicity and volume of the NYS B003 PCB hazardous waste would not be reduced and Remedial Alternative I does not provide any controls to ensure the mobility of this waste continues to be prevented. Limited natural biodegradation of SPH in the subsurface may be expected.

Although a larger quantity of material would be removed as part of Remedial Alternative III, Alternative II is as protective as Remedial Alternative III in removing all mobile SPH and reducing an equal volume of measurable residual SPH through in situ treatment. Both alternatives remove the NYS B003 listed PCB hazardous waste from the former Engine House service pits and transport for off-site disposal. This method does not reduce the toxicity of this remediation waste. However, the residual risk associated with the toxicity of this remediation waste would be transferred to the disposal facility. Remedial Alternative II employs treatment and cleaning techniques to reduce the volume of the residual SPH in soil. The excavation of the subsurface structures in their entirety would not increase the level of reduction afforded, since the majority of the waste generated from the subsurface structure excavation is anticipated to be classified as non-contaminated C&D waste.

8.2.5 Short-Term Effectiveness

Short-term effectiveness refers to the potential effects and related risks associated with the implementation of the remedial action alternative. Potential short-term effects would occur during construction and operation of the remedy. Since Remedial Alternative I does not include any remedial actions, it would not have any short-term impacts.

Potential short-term impacts from the implementation of Remedial Alternatives II and III include:

- Direct exposure to impacted subsurface structure material and hydrocarbon-impacted soil;

- Odor and air emissions;
- Transportation risks; and
- Remedial contractor and on-site worker safety.

The above short-term impacts would be greater during implementation of Remedial Alternative III than Remedial Alternative II. Direct exposure would be greater with Remedial Alternative III due to the handling larger volumes of hydrocarbon -impacted soil and the remediation waste generated from the excavation of the subsurface structures. Air emissions would also be a greater concern while implementing the intrusive activities related to Remedial Alternative III (i.e., excavation of subsurface structures, excavation of the hydrocarbon-impacted soils). The number of disposal trucks would be considerably greater for Remedial Alternative III. Lastly, remedial contractor safety concerns would be greater due to the enormity of the subsurface structure excavations. Added engineering controls would be required to prevent exposure to impacted materials and provide safety protection for on-site workers (e.g., excavation perimeter fencing) to prevent hazards resulting from the large excavations.

Minimal exposure risks are associated with the removal of the nine USTs and the in situ biodegradation. Groundwater monitoring associated with Remedial Alternative II would pose very little exposure risk.

8.2.6 Implementability

The implementability criterion evaluates the feasibility of an alternative based on the ability to construct and operate the technology, reliability of the technology, ease of undertaking additional remedial actions, if necessary, ability to monitor effectiveness, the administrative feasibility, and the availability of services and materials.

Remedial Alternative I can be implemented with relative ease. No active construction or remedial actions would be performed. This alternative would not provide any reliability in reducing exposure risks.

Remedial Alternative II would be technically and administratively feasible. As stated in Section 8.1.2.2.6, bioremediation products are readily available and injection of nutrient amendments is performed using conventional direct-push boring methods. The cleaning of the former Engine House service pits would be performed using standard demolition equipment for access, vacuum trucks to remove liquid waste, and standard pressure washing equipment for cleaning activities. Remedial contractors specializing in the removal of USTs and soil excavation are readily available. Groundwater monitoring can be easily implemented using existing monitoring wells or new monitoring wells installed using conventional drilling equipment. Permits to perform these remedial actions would be obtainable with reasonable effort.

Remedial Alternative III would be technically implementable. The equipment required to perform the work would consist of standard demolition and excavation equipment. Remedial contractors are readily available to perform this work. Although this alternative is technically feasible, Remedial Alternative III would pose difficulties due to the lack of working space and staging areas for stockpiling waste within OU-3, the level of disruption that would be caused to on-site workers that require this area for routine track operations, access via the only access road to other portions of the Yard, and the increased truck traffic through the surrounding community caused by removing an increased quantity of waste. Significant dewatering and sheeting would also be required. Establishing staging areas in other portions of the Yard is not easily implementable due to numerous tracks in the Yard and the inability of crossing tracks with excavation equipment and haul vehicles. Additionally, active tracks are located within OU-3. Excavation work near these active tracks would require additional engineering controls to protect the tracks or taking the tracks temporarily out of service. Both of these measures would cause added disruption to routine track operations in OU-3.

Remedial Alternative III would be administratively challenging as well. Disposal tracking and waste characterization sampling would require a significant level of effort due to the large quantity of waste to be disposed, multiple types of waste (e.g., concrete, soil/fill, liquid, metal) and the multiple waste classifications that are anticipated.

8.2.7 Cost

The following is a summary of the estimated costs for each of the remedial action alternatives. The detailed cost estimates are provided in Appendix A.

	Capital Cost	Contingency	Indirect Costs	OM&M NPV	Total NPV
Alternative I	$0	$0	$0	$0	$0
Alternative II	$2,312,374	$693,712	$1,232,496	$75,811	$4,314,393
Alternative III	$6,843,510	$2,053,053	$3,202,763	$0	$12,099,326

As noted above, Remedial Alternative I does not have any associated costs. Remedial Alternative III has significantly higher capital costs, largely due to the increased off-site disposal associated with this alternative. Remedial Alternative II would have higher OM&M costs. The cost associated with Remedial Alternative III is approximately $7.8 million greater (or 280 percent higher) than Remedial Alternative II. Since Remedial Alternative II would provide an equal level of protection to human health and the environment with reduced short-term impacts to the community, the increased level of effort for implementation and associated expenditure of Remedial Alternative III is not warranted.

9.0 RECOMMENDED REMEDIAL ACTION ALTERNATIVE

The recommended remedial action alternative for mobile SPH, residual SPH and associated hydrocarbon-impacted soil, visually hydrocarbon-impacted surface soil, the former Engine House service pits, the former Metro Shed inspection pit, the Oil House basement, fuel pump vaults and UST areas is Remedial Alternative II. Remedial Alternative II would comply with the majority of the applicable chemical and action-specific SCGs.

Each of the remedial tasks associated with Remedial Alternative II would provide long-term effectiveness and permanence. All mobile SPH, visually hydrocarbon-impacted surface soil, and soil with concentrations in excess of the site-specific NYSDEC-recommended soil cleanup levels for the COCs would be excavated. PCB-hazardous liquid waste would be permanently removed from OU-3. The mass of residual SPH in areas of measurable apparent SPH thickness less than 0.1-foot would be permanently degraded. Additionally, Remedial Alternative II provides readily implementable contingency plans of action for potential areas of measurable apparent SPH thickness less than 0.1-foot identified in the future by groundwater monitoring. Through these actions, the overall mobility and volume of SPH would be greatly reduced and PCB-hazardous waste would be removed.

Remedial Alternative II poses fewer short-term impacts to on-site workers and remedial contractors, in comparison to Remedial Alternative III. Remedial actions would also pose fewer operational disruptions to on-site operations causing implementation of this alternative to be more technically feasible. Remedial Alternative II would be administratively feasible, with a reasonable level of effort in obtaining permits and for disposal tracking. Lastly, given the above evaluation, Remedial Alternative II is equally protective to human health and the environment and is the more cost effective alternative.

<u>Conclusion</u>

To demonstrate the completeness of remedy for OU-3 provided by Remedial Alternative II, the following presents the recommended remedial action for each medium of concern.

- Mobile SPH — Excavation and off-site disposal of soil within the 0.1-foot apparent thickness contour

• Visually Hydrocarbon-Impacted Surface Soil	Excavation and off-site disposal
• Exterior Former Engine House Inspection Pits	Excavation and off-site disposal
• Fuel Pump Vaults	Excavation and off-site disposal
• Residual SPH/Associated hydrocarbon-impacted Soil	Enhanced in situ biodegradation
• Interior Former Engine House Service Pits	Removal and off-site disposal of liquid waste and debris, in-place cleaning of sidewalls and bottom, backfill with clean soil/fill from on site sources
• Former Metro Shed Inspection Pit	Downgradient groundwater monitoring (Inspection pit was previously cleaned prior to backfill with clean soil/fill)
• UST Areas	Removal per NYSDEC regulation (6 NYCRR 613.9)
• Groundwater Monitoring	Routine groundwater monitoring to measure performance of the mobile SPH excavation, identify any future impacts due to subsurface structures, and identify any areas of measurable apparent SPH thickness that would require enhanced biodegradation treatment
• Site Management Plan	Implemented to minimize exposure to residual low-level COCs in soil (below the site-specific NYSDEC-recommended soil cleanup levels but in excess of TAGM RSCOs) and groundwater after the completion of the IRM and final remedy. Site Management Plan would include a Soil Management Plan, Use Restrictions Program, and OM&M Plan for groundwater monitoring.
• Environmental Easements	Establishes an institutional control that acts as an enforcement mechanism to ensure required institutional and engineering controls remain in place. Environmental easements would be required for on-site portions of OU-3 and portions of OU-3 on LIRR property.

Respectfully submitted,

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Table 1. Summary of SVOCs Detected in Soil for Pre-Design Study Baseline Characterization Sampling, OU-3 Feasibility Study, Sunnyside Yard, Queens, New York

Parameter (Concentrations in µg/kg) — **Sample Designation:** / **Sample Date:** / **Sample Depth (ft bls):**	PDB-1 04/16/04 0.5-2.5	PDB-1 04/16/04 2.5-4.5	PDB-2 04/16/04 3-5	PDB-2 04/16/04 5-7	PDB-3 04/16/04 2-4	PDB-3 04/16/04 4-6	PDB-4 04/16/04 3-5	PDB-4 04/16/04 5-7	PDB-5 04/16/04 0.5-2.5	PDB-5 04/16/04 2.5-4.5	PDB-6 04/16/04 0-2	PDB-6 04/16/04 2-4
1,2,4-Trichlorobenzene	2100	1500 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	780 U	1700 U	780 U
1,2-Dichlorobenzene	170 J	1500 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	780 U	1700 U	780 U
1,3-Dichlorobenzene	1400 J	1500 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	780 U	1700 U	780 U
1,4-Dichlorobenzene	8500	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	780 U	1700 U	780 U
2,2-oxybis (1-chloropropane)	1400 U	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	6300 U	1700 U	780 U
2,4,5-Trichlorophenol	7000 U	73000 U	3800 U	3700 U	3600 U	3700 U	7100 U	7500 U	8300 U	30000 U	8300 U	3800 U
2,4,6-Trichlorophenol	1400 U	1500 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	6300 U	1700 U	780 U
2,4-Dichlorophenol	1400 U	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	780 U	1700 U	780 U
2,4-Dimethylphenol	1400 U	1500 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	6300 U	1700 U	780 U
2,4-Dinitrophenol	7000 U	7300 U	3800 U	3700 U	3600 U	3700 U	7100 U	7500 U	8300 U	30000 U	8300 U	3800 U
2,4-Dinitrotoluene	1400 U	15000 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	6300 U	1700 U	780 U
2,6-Dinitrotoluene	1400 U	1500 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	6300 U	1700 U	780 U
2-Chloronaphthalene	1400 U	1500 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	6300 U	1700 U	780 U
2-Chlorophenol	1400 U	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	780 U	1700 U	780 U
2-Methylnaphthalene	4100	94000	780 J	67000	220 J	770 U	1500	2300	23000	31000	1000 J	5400
2-Methylphenol	1400 U	1500 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	6300 U	1700 U	780 U
2-Nitroaniline	7000 U	73000 U	3800 U	74000 U	3600 U	3700 U	7100 U	7500 U	17000 U	3800 U	8300 U	3800 U
2-Nitrophenol	1400 U	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	780 U	1700 U	780 U
3,3-Dichlorobenzidine	2900 U	30000 U	1600 U	30000 U	1500 U	1500 U	2900 U	3100 U	6800 U	13000 U	3400 U	1600 U
3-Nitroaniline	7000 U	7300 U	3800 U	3700 U	3600 U	3700 U	7100 U	7500 U	8300 U	30000 U	8300 U	3800 U
4,6-Dinitro-2-methylphenol	7000 U	73000 U	3800 U	3700 U	3600 U	3700 U	7100 U	7500 U	8300 U	30000 U	8300 U	3800 U
4-Bromophenyl phenyl ether	1400 U	15000 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	6300 U	1700 U	780 U
4-Chloro-3-methylphenol	1400 U	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	780 U	1700 U	780 U
4-Chloroaniline	1400 U	1500 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	780 U	1700 U	780 U
4-Chlorophenyl phenyl ether	1400 U	1500 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	780 U	1700 U	780 U
4-Methylphenol	1400 U	1500 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	780 U	1700 U	780 U
4-Nitroaniline	2900 U	3000 U	1600 U	30000 U	1500 U	1500 U	2900 U	3100 U	6800 U	1600 U	3400 U	1600 U
4-Nitrophenol	7000 U	73000 U	3800 U	74000 U	3600 U	3700 U	7100 U	7500 U	17000 U	3800 U	8300 U	3800 U
Acenaphthene	1900	1500 U	200 J	15000 U	70 J	770 U	1200 J	2000	2500 J	780 U	630 J	260 J
Acenaphthylene	1400 U	15000 U	260 J	15000 U	340 J	770 U	1500 U	1500 U	3400 U	780 U	330 J	780 U
Anthracene	1400 J	1900 J	310 J	1000	470 J	770 U	2100	3600	1200 J	790 J	940 J	210 J
Benzo(a)anthracene	1200 J	15000 U	150 J	110 J	650 J	770 U	1500 U	1500 U	170 J	6300 U	530 J	120 J
Benzo(a)pyrene	810 J	210 J	150 J	100 J	460 J	770 U	1500 U	1500 U	3400 U	53 J	670 J	78 J
Benzo(b)fluoranthene	1300 J	310 J	250 J	15000 U	750	770 U	1500 U	1500 U	3400 U	780 U	710 J	780 U
Benzo(g,h,i)perylene	660 J	15000 U	270 J	120 J	440 J	770 U	1500 U	1500 U	1700 U	6300 U	510 J	55 J
Benzo(k)fluoranthene	1200 J	15000 U	150 J	760 U	520 J	770 U	1500 U	1500 U	3400 U	6300 U	530 J	780 U
Benzyl alcohol	1400 U	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	6300 U	1700 U	780 U
Bis(2-chloroethoxy)methane	1400 U	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	6300 U	1700 U	780 U
Bis(2-chloroethyl)ether	1400 U	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	780 U	1700 U	780 U
Bis(2-ethylhexyl)phthalate	850 J	1500 U	790 U	760 U	80 U	770 U	160 U	1500 U	1700 U	110 J	300 J	780 U

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Parameter (Concentrations in µg/kg)	**Sample Designation:**	PDB-1	PDB-1	PDB-2	PDB-2	PDB-3	PDB-3	PDB-4	PDB-4	PDB-5	PDB-5	PDB-6	PDB-6
	Sample Date:	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04
	Sample Depth (ft bls):	0.5-2.5	2.5-4.5	3-5	5-7	2-4	4-6	3-5	5-7	0.5-2.5	2.5-4.5	0-2	2-4
Butyl benzylphthalate		1400 U	1500 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	780 U	1700 U	780 U
Carbazole		1400 U	1500 U	130 J	15000 U	81 J	770 U	1500 U	1500 U	3400 U	780 U	180 J	780 U
Chrysene		1300 J	500 J	270 J	15000 U	950	52 J	120 J	150 J	250 J	150 J	810 J	230 J
Di-n-butyl phthalate		61 UB	640 UB	34 UB	32 UB	120 JB	33 UB	62 UB	65 UB	73 UB	270 UB	73 UB	33 UB
Di-n-octyl phthalate		1400 U	15000 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	6300 U	1700 U	780 U
Dibenzo(a h)anthracene		210 J	1500 U	86 J	760 U	150 J	770 U	1500 U	1500 U	1700 U	780 U	160 J	780 U
Dibenzofuran		1400 U	5600 J	790 U	760 U	160 J	770 U	1500 U	1500 U	1700 U	6300 U	570 J	780 U
Diethyl phthalate		1400 U	15000 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	6300 U	1700 U	780 U
Dimethyl phthalate		1400 U	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	780 U	1700 U	780 U
Fluoranthene		3700	950 J	280 J	15000 U	1300	770 U	150 J	1500 U	510 J	780 U	1500 J	450 J
Fluorene		2100	5500	350 J	3100	140 J	300 J	1500 U	2600	5400	4300 J	1200 J	590 J
Hexachlorobenzene		1400 U	1500 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	780 U	1700 U	780 U
Hexachlorobutadiene		1400 U	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	6300 U	1700 U	780 U
Hexachlorocyclopentadiene		1400 U	1500 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	780 U	1700 U	780 U
Hexachloroethane		1400 U	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	6300 U	1700 U	780 U
Indeno(1,2,3-cd)pyrene		600 J	15000 U	230 J	110 J	380 J	770 U	1500 U	1500 U	1700 U	6300 U	430 J	780 U
Isophorone		1400 U	15000 U	790 U	15000 U	740 U	770 U	1500 U	1500 U	3400 U	780 U	1700 U	780 U
n-Nitroso-di-n-propylamine		1400 U	1500 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	6300 U	1700 U	780 U
n-Nitrosodiphenylamine		1400 U	11000	790 U	15000 U	740 U	1500	1500 U	1500 U	3400 U	780 U	1700 U	780 U
Naphthalene		1400 U	15000 U	320 J	760 U	110 J	770 U	1500 U	1500 U	2200	6300 U	210 J	780 U
Nitrobenzene		1400 U	1500 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	6300 U	1700 U	780 U
Pentachlorophenol		7000 U	73000 U	3800 U	3700 U	3600 U	3700 U	7100 U	7500 U	8300 U	30000 U	8300 U	3800 U
Phenanthrene		3500	17000	670 J	12000 J	650 J	310 J	1500 U	1500 U	9200	10000	3000	1100
Phenol		1400 U	1500 U	790 U	760 U	740 U	770 U	1500 U	1500 U	1700 U	780 U	1700 U	780 U
Pyrene		10000	2400 J	350 J	1100	1200	190 J	690 J	740 J	1200 J	1100 J	1700	620 J
Total cPAHs:		6620	1020	1286	320	3860	52	120	150	420	203	3840	428
Total PAHs:		33980	122770	5076	84640	8800	852	5760	11390	45630	47393	14860	9113
Total SVOCs:		47000	139370	5206	84640	9161	2352	5760	11390	45630	47503	15910	9113

Notes:
B - Analyte detected in laboratory blank
J - Estimated value
U - Not detected, detection limit is shown
ft bls - Feet below land surface
µg/kg - Micrograms per kilogram

Table 2. Summary of Diesel Range Organics Detected in Soil for Pre-Design Study Baseline Characterization Sampling, OU-3 Feasibility Study, Sunnyside Yard, Queens, New York

Parameter (Concentrations in mg/kg)	Sample Designation: Sample Date: Sample Depth (ft bls):	PDB-1 04/16/04 0.5-2.5	PDB-1 04/16/04 2.5-4.5	PDB-2 04/16/04 3-5	PDB-2 04/16/04 5-7	PDB-3 04/16/04 2-4	PDB-3 04/16/04 4-6	PDB-4 04/16/04 3-5	PDB-4 04/16/04 5-7	PDB-5 04/16/04 0.5-2.5	PDB-5 04/16/04 2.5-4.5	PDB-6 04/16/04 0-2	PDB-6 04/16/04 2-4
Diesel Range Organics		14000	10000	2400	7500	190	6900	8800	9600	7100	5900	5400	7100

Notes:
ft bls - Feet below land surface
mg/kg - Milligrams per kilogram
DRO - Diesel Range Organics

Table 3. Summary of pH, Percent Solids and Moisture Content in Soil for Pre-Design Study Baseline Characterization Sampling, OU-3 Feasibility Study, Sunnyside Yard, Queens, NY

Parameter	Units	**Sample Designation:**	PDB-1	PDB-1	PDB-2	PDB-2	PDB-3	PDB-3	PDB-4	PDB-4	PDB-5	PDB-5	PDB-6	PDB-6
		Sample Date:	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04
		Sample Depth (ft bls):	0.5-2.5	2.5-4.5	3-5	5-7	2-4	4-6	3-5	5-7	0.5-2.5	2.5-4.5	0-2	2-4
Percent Moisture	%		12.8	12.8	16.8	16.1	12.8	15.7	11.4	14.8	23.4	16.1	24.4	18.3
Percent Solids	%		87.2	87.2	83.2	83.9	87.2	84.3	88.6	85.2	76.6	83.9	75.6	81.7
pH	pH Units		5.59	5.12	6.08	6.52	5.48	6.14	6.06	6.63	6.02	5.49	6.05	6.13

Notes:
ft bls - Feet below land surface

Table 4. Summary of Ammonia, Nitrate, Nitrite and Phosphorus Detected in Soil for Pre-Design Study Baseline Characterization Sampling, OU-3 Feasibility Study, Sunnyside Yard, Queens, New York

Parameter (Concentrations in mg/kg)	**Sample Designation:**	PDB-1	PDB-1	PDB-2	PDB-2	PDB-3	PDB-3	PDB-4	PDB-4	PDB-5	PDB-5	PDB-6	PDB-6
	Sample Date:	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04
	Sample Depth (ft bls):	0.5-2.5	2.5-4.5	3-5	5-7	2-4	4-6	3-5	5-7	0.5-2.5	2.5-4.5	0-2	2-4
Ammonia		2.1 B	8.2	8.1	7.3	2.3 U	2.3 U	0.21 B	1.5 B	29	0.034 B	0.89 B	16
Nitrate		0.37 B	0.4 B	1.1 B	0.35 B	0.38 B	0.39 B	0.32 B	0.4 B	0.42 B	0.41 B	0.41 B	0.43 B
Nitrite		1.1 U	1.1 U	1.2 U	1.2 U	1.1 U	1.2 U	1.1 U	1.2 U	1.3 U	1.2 U	1.3 U	1.2 U
Nitrogen		410	147	422	198	439	99	124	127	596	136	737	446
Phosphorus		85.3	46.9	6	50.8	70.4	145	35.9	95.5	65.7	54	45.4	111

Notes:
B - Analyte detected in laboratory blank
U - Not detected, detection limit is shown
ft bls - Feet below land surface
mg/kg - Milligrams per kilogram

Table 5. Summary of Total Organic Carbon Detected in Soil for Pre-Design Study Baseline Characterization Sampling, OU-3 Feasibility Study, Sunnyside Yard, Queens, New York

Parameter (Concentrations in mg/kg)	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	PDB-1 04/16/04 0.5-2.5	PDB-1 04/16/04 2.5-4.5	PDB-2 04/16/04 3-5	PDB-2 04/16/04 5-7	PDB-3 04/16/04 2-4	PDB-3 04/16/04 4-6	PDB-4 04/16/04 3-5	PDB-4 04/16/04 5-7	PDB-5 04/16/04 0.5-2.5	PDB-5 04/16/04 2.5-4.5	PDB-6 04/16/04 0-2	PDB-6 04/16/04 2-4
Total Organic Carbon		47000	5420	50100	14700	51800	8170	24200	3910	60200	1470	43600	17600

Notes:
ft bls - Feet below land surface
mg/kg - Milligrams per kilogram

Table 6. Summary of Microbial Data in Soil for Pre-Design Study Baseline Characterization Sampling, OU-3 Feasibility Study, Sunnyside Yard, Queens, New York

Parameter (Concentrations in CFUs/gram)	**Sample Designation:**	PDB-1	PDB-1	PDB-2	PDB-2	PDB-3	PDB-3	PDB-4	PDB-4	PDB-5	PDB-5	PDB-6	PDB-6
	Sample Date:	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04	04/16/04
	Sample Depth (ft bls):	0.5-2.5	2.5-4.5	3-5	5-7	2-4	4-6	3-5	5-7	0.5-2.5	2.5-4.5	0-2	2-4
Total Heterotrophic Plate Count		590000	30000 U	47000	58000	30000 U	12000 J	30000 U	33000	30000 U	30000 U	760000	38000

Notes:
ft bls - Feet below land surface
CFUs/gram- Colony Forming Units per gram
J - Estimated value
U - Not detected, detection limit is shown

Table 7. Summary of Ammonia, Nitrate, Sulfate, and Sulfide in Groundwater for Pre-Design Baseline Characterization Sampling, OU-3 Feasibility Study, Sunnyside Yard, Queens, NY

Parameter (Concentrations in mg/l)	**Sample Designation:**	MW-74 06/14/04	MW-75 06/14/04	MW-77 06/14/04	MW-73 06/14/04	MW-16 06/15/04	MW-49 06/15/04	MW-50 06/15/04
Nitrate		0.047	0.002 U	0.002 U	0.002 U	0.002 U	0.037	0.002 U
Sulfate		0.603	37.1	2.63	19.9	0.329	0.258	0.323
Sulfide		0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U
Ammonia, as N		1.1	2	2.2	6.6	3.4	2.3	1

Notes:
mg/l - milligrams per liter
U - Not detected, detection limit is shown

Table 8. Summary of Iron and Manganese in Groundwater for Pre-Design Baseline Characterization Sampling, OU-3 Feasibility Study, Sunnyside Yard, Queens, New York

Parameter (Concentrations in ug/l)	**Sample Designation:**	MW-74 06/14/04	MW-75 06/14/04	MW-77 06/14/04	MW-73 06/14/04	MW-16 06/15/04	MW-49 06/15/04	MW-50 06/15/04
Iron		15,500	41,600	41,700	57,800	13,400	68,300	14,600
Manganese		331	2,510.0	4,570.00	784	332	1,240	2,440

Notes:
ug/l - micrograms per liter

Table 9. Summary of PCBs Detected in SPH for Pre-Design Study Baseline Characterization Sampling, OU-3 Feasibility Study, Sunnyside Yard, Queens, New York

Parameter (Concentrations in µg/kg)	Sample Designation: Sample Date:	MW-16 04/22/04	MW-50 04/22/04	MW-52 04/22/04	MW-72 04/22/04	MW-73 04/22/04	MW-77 04/22/04	RW-1 04/22/04
Aroclor-1016		9900 U	24000 U	2300 U	23000 U	25000 U	500 U	2400 U
Aroclor-1221		20000 U	49000 U	4700 U	47000 U	49000 U	990 U	4900 U
Aroclor-1232		9900 U	24000 U	2300 U	23000 U	25000 U	500 U	2400 U
Aroclor-1242		9900 U	24000 U	2300 U	23000 U	25000 U	500 U	2400 U
Aroclor-1248		9900 U	24000 U	2300 U	23000 U	25000 U	500 U	2400 U
Aroclor-1254		13000 M	24000 U	8000	18000 JM	25000 U	500 U	4700
Aroclor-1260		38000	45000	2900	47000	270000	460 JM	7500
Total PCBs:		51000	45000	10900	65000	270000	460	12200

Notes:
J - Estimated value
M - Manually integrated compound
U - Not detected, detection limit is shown
PCB - Polychlorinated Biphenyl Compound
µg/kg - Micrograms per kilogram

Table 10. Summary of Baseline Treatability Study Sampling, OU-3 Feasibility Study, Sunnyside Yard, Queens, New York

Parameter	Units	PT-1	PT-2	PT-3	PT-4
Sand	%	67	94	95	68
Silt	%	27	4	4	25
Clay	%	6	2	1	7
Soil Texture		Sandy Loam	Sand	Sand	Sandy Loam
pH (2:1 extraction)		6.70	7.36	6.34	7.47
Available Phosphorus	µg/g	5.6	1.1	4.4	0.8
Available Potassium	µg/g	42	16	8	35
Nitrogen, Total Kjeldahl (Soil)	%	0.12	0.13	0.15	0.098
Total Inorganic Carbon	%	0.03	ND	ND	2.35
Total Organic Carbon	%	0.92	3.38	3.61	1.11
PAHs					
Naphthalene	ug/g	0.3	6.4	6.6	0.28
Acenaphthylene	ug/g	0.09	3.7	4.3	0.11
Acenaphthene	ug/g	0.34	23	17	0.54
Fluorene	ug/g	0.54	30	23	0.59
Phenanthrene	ug/g	0.92	54	48	4.6
Anthracene	ug/g	0.16	9.3	9	1.1
Fluoranthene	ug/g	0.46	5.6	13	4.8
Pyrene	ug/g	0.44	11	16	4.1
Benzo(a)anthracene	ug/g	0.17	1.3	3.3	2.1
Chrysene	ug/g	0.32	2	4.9	2.3
Benzo(b)Fluoranthene	ug/g	0.35	1.7	4.7	2.3
Benzo(k)Fluoranthene	ug/g	0.12	0.6	1.7	0.95
Benzo(a)pyrene	ug/g	0.16	0.76	2	1.47
Indeno(1,2,3-cd)pyrene	ug/g	ND	0.47	1.4	0.94
Dibenzo(a,h)anthracene	ug/g	ND	ND	0.35	0.24
Benzo(g,h,i)perylene	ug/g	ND	0.49	1.3	0.7
Total PAHs	**ug/g**	**4**	**150**	**157**	**27**
Diesel Range TPH	ug/g	690	48,800	31,700	267
Heavy Range TPH	ug/g	0	1,500	2,500	0
Total Petroleum Hydrocarbons	**ug/g**	**690**	**50,300**	**34,200**	**267**
COD	ug/g	NA	NA	20,000	NA
PCB (Aroclor 1260)	ug/g	NA	NA	2.4	ND

Notes:
ug/g - micrograms per gram
ND - Not Detected
COD - Chemical oxygen demand
TPH - Total petroleum hydrocarbons
PAH - Polycyclic Aromatic Hydrocarbons
NA - Not analyzed

Table 11. Summary of EHC-O Bench-Scale Treatability Study Testing Results, OU-3 Feasibility Study, Sunnyside Yard, Queens, New York

Sampling #1

	Units	PT-3 Soil Initial	CONTROL Composite J1-3 9-Mar	2% EHC-O Composite J4-6 9-Mar	1% EHC-O Composite J7-9 9-Mar	0.5% EHC-O Composite J10-12 9-Mar
PAHs						
Naphthalene	ug/g	6.6	8	6.2	6.6	6.2
Acenaphthylene	ug/g	4.3	2.5	2.6	2.8	2.9
Acenaphthene	ug/g	17	17	18	14	13
Fluorene	ug/g	23	23	20	22	20
Phenanthrene	ug/g	48	39	38	44	42
Anthracene	ug/g	9	11	7.2	8.8	8.5
Fluoranthene	ug/g	13	16	11	13	28
Pyrene	ug/g	16	20	14	17	27
Benzo(a)anthracene	ug/g	3.3	4.2	3	3.5	7.2
Chrysene	ug/g	4.9	5.7	4.2	5.1	16
Benzo(b)Fluoranthene	ug/g	4.7	5.9	4.1	4.8	11
Benzo(k)Fluoranthene	ug/g	1.7	2.1	1.4	1.7	3.9
Benzo(a)pyrene	ug/g	2	2.5	1.6	1.9	3.9
Indeno(1,2,3-cd)pyrene	ug/g	1.4	1.5	1	1.2	2.5
Dibenzo(a,h)anthracene	ug/g	0.35	0.39	0.27	0.3	0.53
Benzo(g,h,i)perylene	ug/g	1.3	1.3	0.91	1	2.1
Total PAHs	**ug/g**	**157**	**160**	**133**	**148**	**195**
% Removal				**15%**	**6%**	**-24%**

		PT-3 Soil Initial 9-Mar	CONTROL Composite J1-3 9-Mar	2% EHC-O Composite J4-6 9-Mar	1% EHC-O Composite J7-9 9-Mar	0.5% EHC-O Composite J10-12 9-Mar
Diesel Range TPH	ug/g	31,700	33,900	31,900	29,300	31,350
Heavy Range TPH	ug/g	2,500	3,970	3,720	3,400	3,865
Total Petroleum Hydrocarbons	**ug/g**	**34,200**	**37,870**	**35,620**	**32,700**	**35,215**
% Removal				**6%**	**14%**	**7%**
% removal Diesel Range TPH				**6%**	**14%**	**8%**
% removal Heavy Range TPH				**6%**	**14%**	**3%**

Sampling #2

	Units	PT-3 Soil Initial	CONTROL Composite J1-3 12-Apr	2% EHC-O Composite J4-6 12-Apr	1% EHC-O Composite J7-9 12-Apr	0.5% EHC-O Composite J10-12 12-Apr
PAHs						
Naphthalene	ug/g	6.6	2.1	2	1.4	2.8
Acenaphthylene	ug/g	4.3	0.53	1.3	1	2.1
Acenaphthene	ug/g	17	5.4	5.5	4.5	4.1
Fluorene	ug/g	23	8.3	10	8.3	0.82
Phenanthrene	ug/g	48	12	23	20	8.5
Anthracene	ug/g	9	2.3	2.8	2.5	1.1
Fluoranthene	ug/g	13	7.3	5.4	4.5	14
Pyrene	ug/g	16	8.2	6.3	5.5	15
Benzo(a)anthracene	ug/g	3.3	1.6	1.4	0.96	4.8
Chrysene	ug/g	4.9	2.2	1.9	1.4	7
Benzo(b)Fluoranthene	ug/g	4.7	1.3	1.1	0.92	1.2
Benzo(k)Fluoranthene	ug/g	1.7	1.1	0.94	0.79	0.9
Benzo(a)pyrene	ug/g	2	0.7	0.74	0.7	0.61
Indeno(1,2,3-cd)pyrene	ug/g	1.4	0.62	0.51	0.46	0.35
Dibenzo(a,h)anthracene	ug/g	0.35	0.29	0.27	0.18	0.15
Benzo(g,h,i)perylene	ug/g	1.3	0.68	0.62	0.54	0.41
Total PAHs	**ug/g**	**157**	**55**	**64**	**54**	**64**
% Removal				-17%	2%	-17%

		PT-3 Soil Initial 12-Apr	CONTROL Composite J1-3 12-Apr	2% EHC-O Composite J4-6 12-Apr	1% EHC-O Composite J7-9 12-Apr	0.5% EHC-O Composite J10-12 12-Apr
Diesel Range TPH	ug/g	31700	24,700	31,500	27,500	32,600
Heavy Range TPH	ug/g	2500	3,480	4,300	3,780	4,910
Total Petroleum Hydrocarbons	**ug/g**	**34,200**	**28,180**	**35,800**	**31,280**	**37,510**
% Removal from Control				**-27%**	**-11%**	**-33%**
% Removal from 3/9				**-1%**	**4%**	**-7%**
% removal Diesel Range TPH from Control				**-28%**	**13%**	**-19%**
% removal Diesel Range TPH from 3/9				**1%**	**6%**	**-4%**
% removal Heavy Range TPH from Control				**-27%**	**13%**	**-20%**
% removal Diesel Range TPH from 3/9				**-1%**	**4%**	**-27%**

Notes:
ug/g - microgram per gram
PAH - Polycyclic aromatic hydrocarbons
TPH - Total petroleum hydrocarbons

Table 12. Summary of Daramend®/Terramend® Bench-Scale Treatability Study Testing Results, OU-3 Feasibility Study, Sunnyside Yard, Queens, New York

	PT-3 CONTROL		5% A4000 19-5-8		2% D2010 19-5-8		5% A4000 14-14-14		2% D2010 14-14-14		
PAHs	**Day 28**	**Day 55**	**Day 28**	**Day 55**	**Day 28**	**Day 55**	**Day 28**	**Day 55**	**Day 28**	**Day 55**	**Units**
Naphthalene	1.4	0.62	1.4	1.2	1.2	1.3	1.2	1.1	1.1	1.2	ug/g
Acenaphthylene	1.6	0.43	1.0	2.8	0.7	2.0	1.7	2.1	1.3	2.4	ug/g
Acenaphthene	5.1	1.9	3.7	1.7	0.6	1.2	5.1	4.0	3.9	4.4	ug/g
Fluorene	5.8	0.18	2.0	0.3	0.8	0.5	5.5	5.4	4.1	5.9	ug/g
Phenanthrene	12.6	0.41	3.2	3.3	0.9	2.5	16.2	9.9	14.3	13.0	ug/g
Anthracene	5.3	7	3.2	3.1	2.4	0.8	21.8	1.7	3.9	2.0	ug/g
Fluoranthene	9.2	1.7	8.3	2.4	8.7	7.4	8.2	4.6	7.2	5.8	ug/g
Pyrene	9.1	0.27	7.9	6.7	8.4	7.2	8.2	4.8	6.9	5.3	ug/g
Benzo(a)anthracene	2.5	1.1	2.1	1.4	2.3	1.5	2.1	1.0	1.7	1.2	ug/g
Chrysene	2.4	1.5	2.3	2.1	2.5	2.2	2.5	1.5	1.9	1.6	ug/g
Benzo(b)Fluoranthene	2.2	0.89	2.3	1.0	2.0	1.6	2.3	0.95	1.7	1.4	ug/g
Benzo(k)Fluoranthene	0.9	0.64	0.9	0.7	0.8	1.2	0.6	0.77	0.7	1.1	ug/g
Benzo(a)pyrene	1.0	0.59	1.1	0.7	1.0	0.8	0.8	0.7	0.8	0.8	ug/g
Indeno(1,2,3-cd)pyrene	0.8	0.2	1.0	0.3	1.0	0.5	0.7	0.32	0.7	0.4	ug/g
Dibenzo(a,h)anthracene	0.2	0.06	0.2	0.1	0.2	0.2	0.2	0.11	0.2	0.1	ug/g
Benzo(g,h,i)perylene	0.6	0.2	0.8	0.3	0.7	0.5	0.7	0.32	0.5	0.3	ug/g
Total PAHs	**61**	**18**	**41**	**28**	**34**	**31**	**78**	**39**	**51**	**47**	**ug/g**

	PT3 Soil	PT3 CONTROL		5% A4000 19-5-8		2% D2010 19-5-8		5% A4000 14-14-14		2% D2010 14-14-14		
	Initial	**Day 28**	**Day 55**	**Day 28**	**Day 55**	**Day 28**	**Day 55**	**Day 28**	**Day 55**	**Day 28**	**Day 55**	**Units**
Diesel Range TPH	31,700	28,000	13,000	18,000	8,700	22,000	5,700	18,000	4,900	25,000	3,200	ug/g
Heavy Range TPH	2,500	28,000	16,000	20,000	10,000	22,000	7,200	16,000	9,100	20,000	6,800	ug/g
TPH	**34,200**	**56,000**	**29,000**	**38,000**	**18,700**	**44,000**	**12,900**	**34,000**	**14,000**	**45,000**	**10,000**	**ug/g**
Total TPH - Percentage Removal after 28 days				32%		21%		39%		20%		
Total TPH - Percentage Removal after 55 days					**36%**		**56%**		**52%**		**66%**	

Notes:
PAH - Polyaromatic hydrocarbons
TPH - Total petroleum hydrocarbons
ug/g - microgram per gram

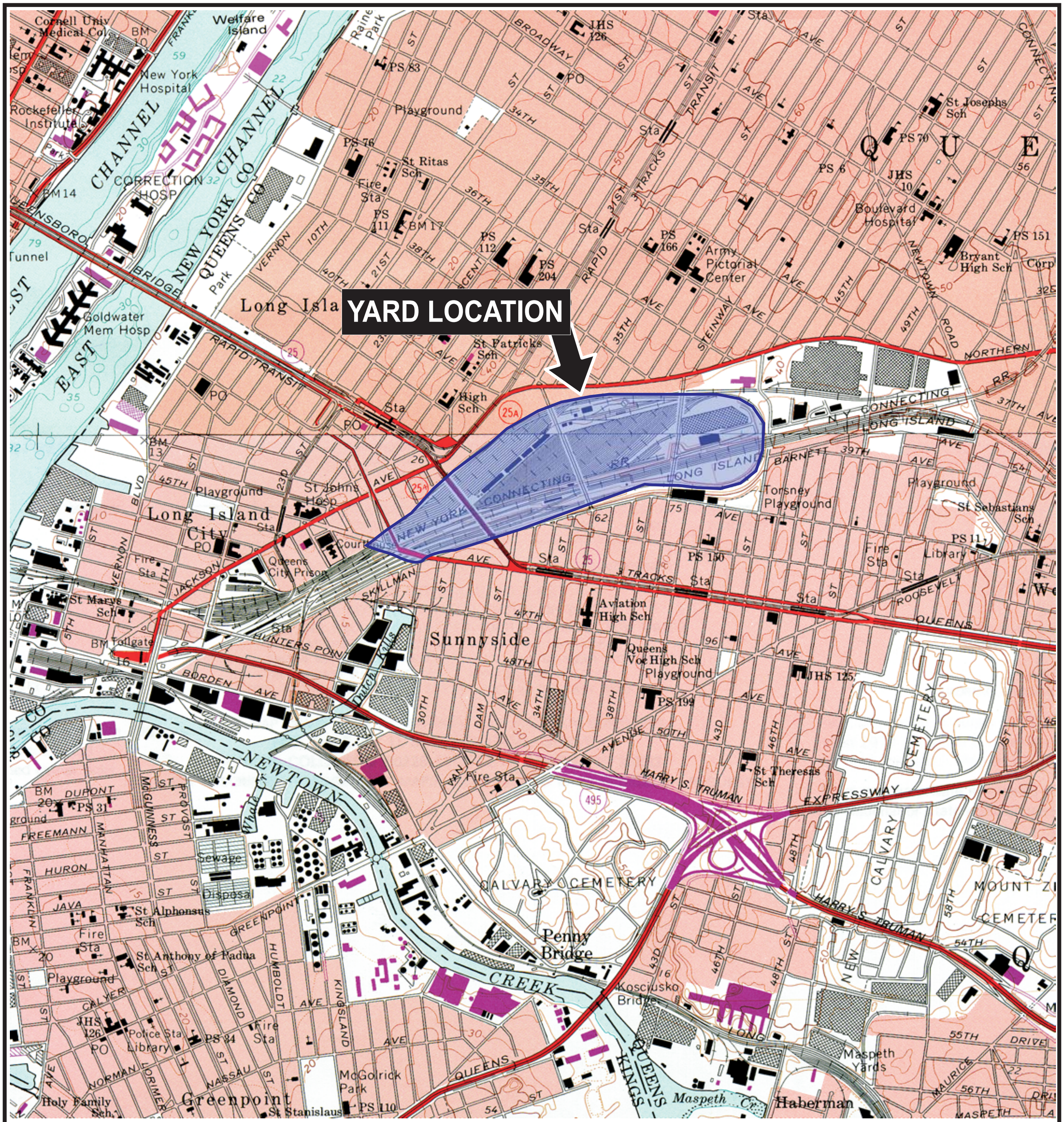
Citation	Title	SCG Type	Applicability for Developing Remedial Action Objectives	Applicability for Evaluation of Remedial Action Alternatives
Soil/Subsurface Structures				
6 NYCRR Part 364	Waste Transporter Permits	Action	Not applicable	This standard relates to remedial actions that involve waste removal
6 NYCRR Part 598	Handling and Storage of Hazardous Substances	Action	Not applicable	This standard relates to remedial actions that include handling and storage of hazardous substances
6 NYCRR 360-1.15	Beneficial Use	Action	Not applicable	This standard provides requirements for allowing beneficial reuse of on-site soil/fill designated as solid waste
6 NYCRR Part 370 through 373	Hazardous Waste Management Regulations	Action, Chemical	This standard relates to identification of hazardous waste and will be used in developing the remedial requirements and RAOs for hazardous waste in OU-3.	This standard is applicable to the management of hazardous waste in the Engine House inspection pits
6 NYCRR Part 375	Inactive Hazardous Waste Disposal Sites	Action	This standards establishes requirements in developing the RAOs and remedial alternatives for sites in the Inactive Hazardous Waste Disposal Sites Registry	This standard relates to both remedy selection and remedial actions
6 NYCRR Part 376	Land Disposal Restrictions	Action, Chemical	Not applicable	This standard provides hazardous waste disposal requirements
6 NYCRR Parts 703	Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations	Action, Chemical	This standard provides promulgated numeric standards applicable to remedial actions related to groundwater	This standard relates to the Common Action of groundwater monitoring
40 CFR 261	Identification and Listing of Hazardous Waste	Action, Chemical	This standard identifies hazardous wastes and is used in determining the remedial requirements and RAOs for hazardous waste in OU-3	This standard is applicable to the management of hazardous waste in the Engine House inspection pits
40 CFR 262	Standards Applicable to Generators of Hazardous Waste	Action	Not applicable	Relates to the disposal of hazardous waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste	Action	Not applicable	Relates to the transportation of hazardous waste.
NCP, 40 CFR 300.430	Remedial Investigation/Feasibility Study and Selection of Remedy	Action	Provides the basis for developing RAOs and remedy selection	This standard relates to both remedy selection and remedial actions

Citation	Title	SCG Type	Applicability for Developing Remedial Action Objectives	Applicability for Evaluation of Remedial Action Alternatives
TSCA, 40 CFR 761.61	PCB Remediation Waste	Action, Chemical	This standard is applicable in identifying PCB hazardous waste and RAOs relative to PCB impacted material.	This standard is applicable for determining the treatment, storage and disposal requirements of PCB-impacted material. This standard is also applied in the evaluation of the effectiveness of a remedial alternative.
RCNY Titles 1,15,16	Rules of the City of New York	Action	Not applicable	May relate to remedial action activities with respect to noise, transportation, and fire codes
Underground Storage Tanks				
6 NYCRR 613.9	Handling and Storage of Petroleum	Action	Provides closure requirements for permanently out of service USTS	Relates to closure of out of service tanks in the UST areas
Separate Phase Hydrocarbon				
6 NYCRR Part 611.6	Environmental Priorities and Procedures in Petroleum Cleanup and Removal	Action	Sets the requirement for reduction of SPH mass in the subsurface	This standard relates to remedial requirements for the SPH plume cleanup and removal
Article 12 of the NYS Navigation Law (New York Oil Spill, Control, and Compensation Act)	Oil Spill Cleanup and Removal	Action	Relates to the remedial requirements and RAOs for SPH releases in the subsurface	This standard relates to remedial requirements for the SPH plume cleanup and removal
NCP, 40 CFR 300.310	Operational Response Phases for Oil Removal, Phase III--Containment, countermeasures, cleanup, and disposal.	Action	Sets forth remedial requirements for oil releases. This standard provides the basis for the RAO of SPH mass reduction in the subsurface	This standard relates to remedial requirements for the SPH plume cleanup and removal
General				
6 NYCRR Part 257	Air Quality Standards	Action	Not Applicable	May relate to remedial action activities
29 CFR 1910	Occupational Safety and Health Standards	Action	Not Applicable	May relate to remedial action activities
29 CFR 1926	Occupational Safety and Health	Action	Not Applicable	May relate to remedial action activities
6 NYCRR 621	Uniform Procedures	Action	Not applicable	Provides the procedures required for obtaining permits for implementation of remedial actions per 6 NYCRR Part 360.
Guidance				
TAGM 4030	Selection of Remedial Actions at Inactive Hazardous Waste Sites	Action	Guidance is applicable to developing RAOs and remedy selection	Provides criteria for comparison and selection of remedial action alternatives

Citation	Title	SCG Type	Applicability for Developing Remedial Action Objectives	Applicability for Evaluation of Remedial Action Alternatives
TAGM 4041	Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites	Action	Not applicable	May relate to required activities during remedy implementation
TAGM 4048	Interim Remedial Measures	Action	Not applicable	Not directly applicable but appropriate and relevant to the Common Action of groundwater monitoring for performance of the IRM activities.
NYSDOH CAMP for Ground Intrusive Activities	Generic Community Air Monitoring Plan	Action	Not applicable	Would relate to intrusive remedial actions
NYSDEC TOGS 1.1.1	Ambient Water Quality Standards and Guidance Values	Chemical	Provides numeric guidance values for groundwater. Guidance would be applicable for development of RAOs related to groundwater impacts from residual SPH and subsurface structure contents	Guidance would be directly applicable to Common Action No. 1.
NYSDEC Draft DER-10	Technical Guidance for Site Investigation and Remediation	Action	Guidance provides procedures for developing RAOs	Guidance provides procedures for all remedial actions including alternative screening and selection
STARS #1	Petroleum Contaminated Soil Guidance Policy	Action	Not applicable for developing RAOs or cleanup levels. STARs list of compounds will be used as guidance.	Provides guidance for the SPH plume cleanup and removal
TBCs				
Letters from NYSDEC dated 2/25/97 and 3/27/98	Letter containing NYSDEC recommended soil cleanup levels for COCs	Chemical	Applicable to the remedial goals and RAOs for soil	Provides standard of performance for remedial actions pertaining to soil

Glossary of Acronyms

CFR	Code of Federal Regulations
NYSDEC	New York State Department of Environmental Conservation
NYCRR	New York Code of Rules and Regulations
OSHA	Occupational Safety and Health
SCG	Standards, Criteria, and Guidance
TBC	To Be Considered Information
USEPA	United States Environmental Protection Agency
DER	Department of Environmental Remediation



SOURCE:
CENTRAL PARK AND BROOKLYN, NEW YORK
QUADRANGLE 7.5 MINUTE SERIES (TOPOGRAPHIC)

QUADRANGLE
LOCATION

N

0 2000'

Title:

LOCATION OF SITE

OU-3 FEASIBILITY STUDY
SUNNYSIDE YARD, QUEENS, NEW YORK

Prepared for:

AMTRAK

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: J.P.	Date: 16AUG05	FIGURE
Prepared by: G.M.	Scale: 1"=2000'	1
Project Mgr.: H.G.	Office: NY	
File No.: AM4513001.CDR	Project No.: 05545Y07	

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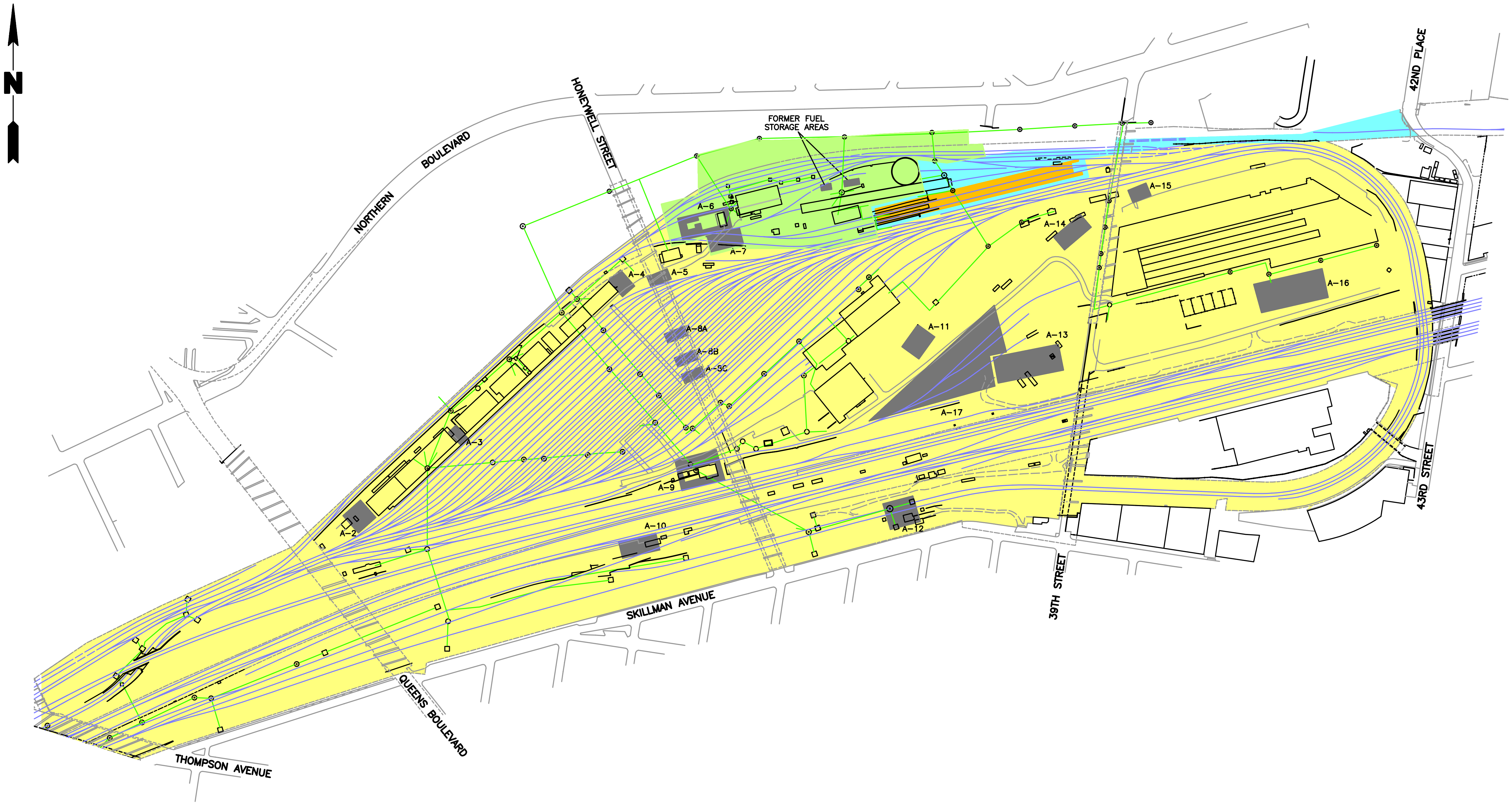

NOTES:

1. LOCATIONS OF SEWER COMPONENTS BASED UPON A REVIEW OF AMTRAK-SUPPLIED ENGINEERING DIAGRAMS AND LIMITED FIELD SURVEY.
2. OU-6, GROUND WATER BENEATH THE YARD, IS NOT SHOWN.
3. RI – REMEDIAL INVESTIGATION
4. LIRR – LONG ISLAND RAIL ROAD

LEGEND

	LOCATION OF RAILROAD TRACK
	APPROXIMATE LOCATION OF SEWER
	GRATE COVER CATCH BASIN LOCATION
	SOLID COVER MANHOLE LOCATION
	GRATE COVER MANHOLE LOCATION
A-2	LOCATION AND DESIGNATION OF PREVIOUSLY DETERMINED AREA OF CONCERN
	APPROXIMATE PROPERTY BOUNDARY
	OU-1
	OU-2
	OU-3
	OU-4
	OU-5

Title:

AMTRAK YARD LAYOUT

OU-3 FEASIBILITY STUDY
SUNNYSIDE YARD, QUEENS, NEW YORK

Prepared For: AMTRAK

ROUX ASSOCIATES, INC. Environmental Consulting & Management	Compiled by: J.P.	Date: 16AUG05	FIGURE
	Prepared by: G.M.	Scale: AS SHOWN	2
	Project Mgr: H.G.	Office: NY	
	File No: AM4513001	Project: 05545Y07	

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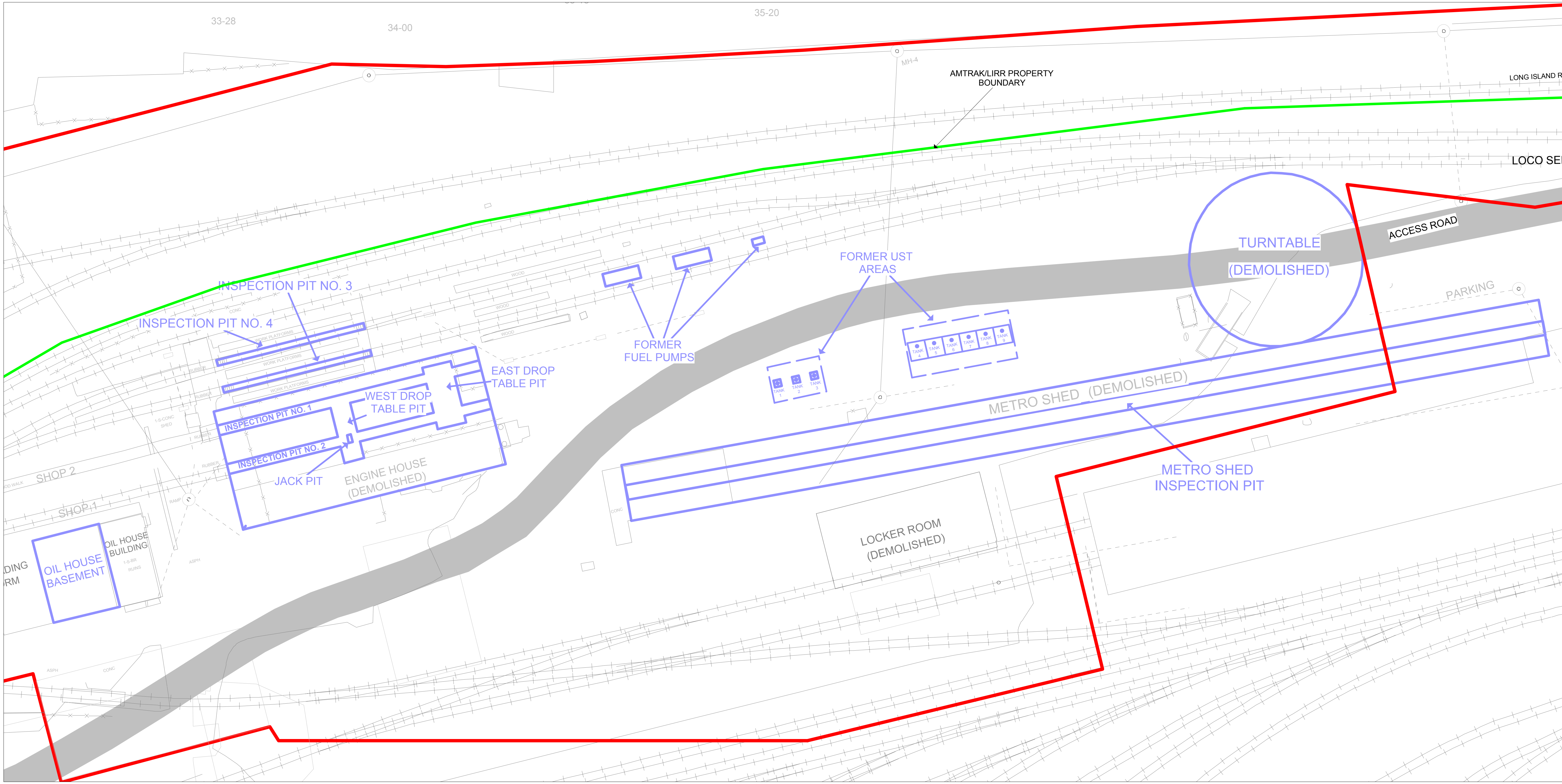


EXPLANATION

EXTENT OF SUBSURFACE STRUCTURE

OU-3 BOUNDARY

NOTE:
THE LOCATIONS OF THE ENGINE HOUSE AND METRO SHED PITS, AND THE OIL HOUSE BASEMENT WERE DETERMINED BASED ON DRAWINGS SUPPLIED BY AMTRAK

60' 0 60'

N

Title:

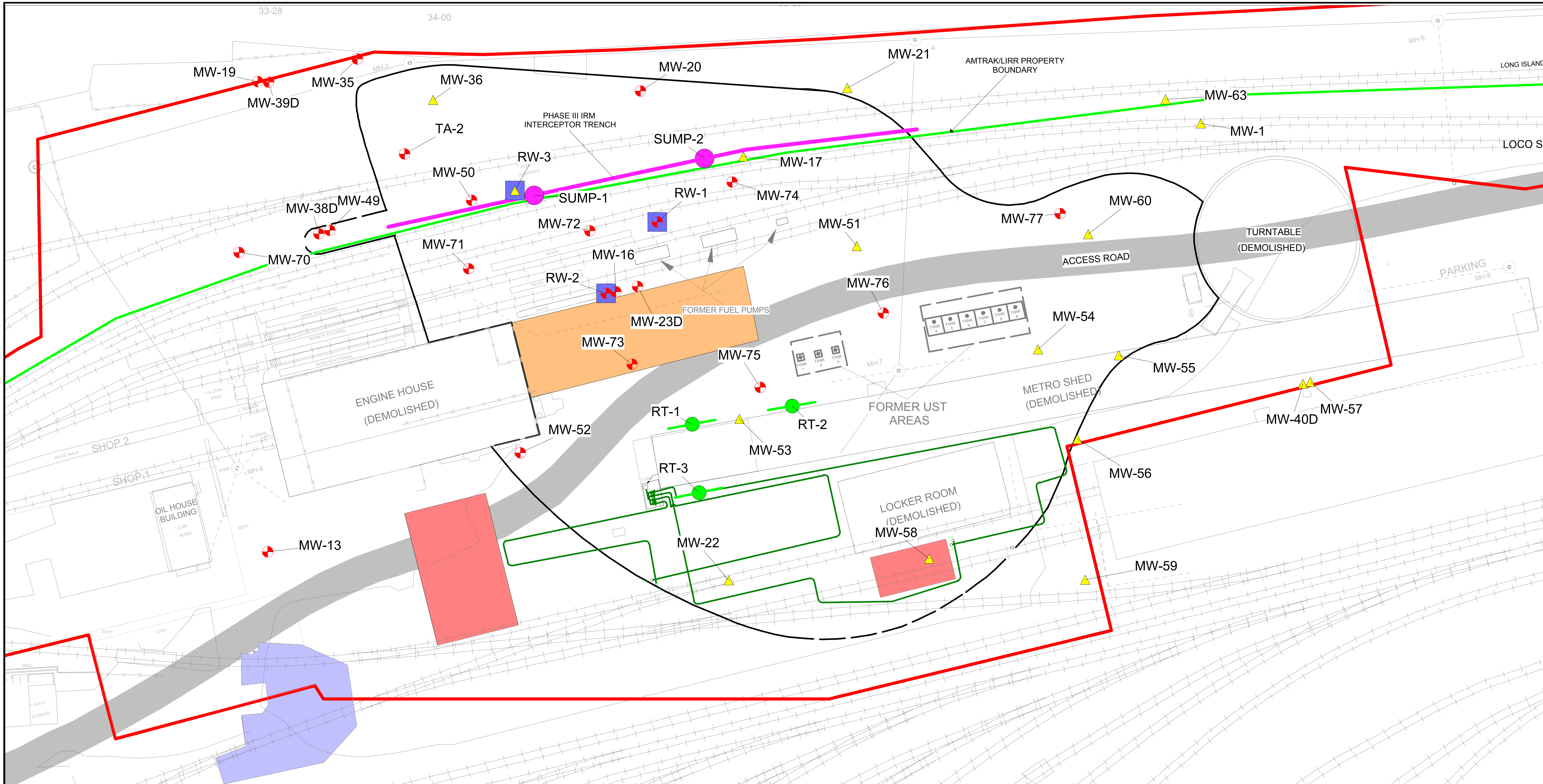
LOCATIONS OF SUBSURFACE STRUCTURES

OU-3 FEASIBILITY STUDY
SUNNYSIDE YARD, QUEENS, NEW YORK

Prepared For: AMTRAK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: RSK	Date: 7/29/2005	FIGURE
Prepared by: JEP	Scale: SHOWN	3
Project Mgr: HG	Office: NY	
File No: AM4513003.WOR	Project: 05545Y07	



RT-1 — LOCATION AND DESIGNATION OF PHASE I IRM RECOVERY TRENCH (SUMPS SHOWN)

RW-1 — LOCATION AND DESIGNATION OF PHASE II IRM RECOVERY WELLS

LOCATION OF PHASE III IRM INTERCEPTOR TRENCH (SUMPS SHOWN)

MW-54 — LOCATION AND DESIGNATION OF FORMER (ABANDONED OR DESTROYED) MONITORING WELL INSTALLED BY ROUX ASSOCIATES, INC.

MW-16 — LOCATION AND DESIGNATION OF MONITORING WELL

AREA REMEDIATED TO 0.5 FT BELOW HISTORIC GRADE (1985-1986)

AREA REMEDIATED TO 2 FT BELOW HISTORIC GRADE (1998)

AREA REMEDIATED TO BETWEEN 3 AND 8 FT BELOW HISTORIC GRADE (1999)

APPROXIMATE BOUNDARY OF HISTORIC SPH PLUME (ZERO CONTOUR)

OU-3 BOUNDARY

BIOINFILTRATION PIPING

NOTES

IRM - INTERIM REMEDIAL MEASURE

SPH - SEPARATE-PHASE HYDROCARBON

OU-3 - OPERABLE UNIT 3

RI - REMEDIAL INVESTIGATION

LIRR - LONG ISLAND RAIL ROAD

N

60' 0 60'

Title:

LOCATIONS OF PREVIOUS AND EXISTING SPH IRMs AND SOIL IRMs

OU-3 FEASIBILITY STUDY
SUNNYSIDE YARD, QUEENS, NEW YORK

Prepared For: AMTRAK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: RSK	Date: 11/21/2005	FIGURE
Prepared by: RSK	Scale: SHOWN	4
Project Mgr: HG	Office: NY	
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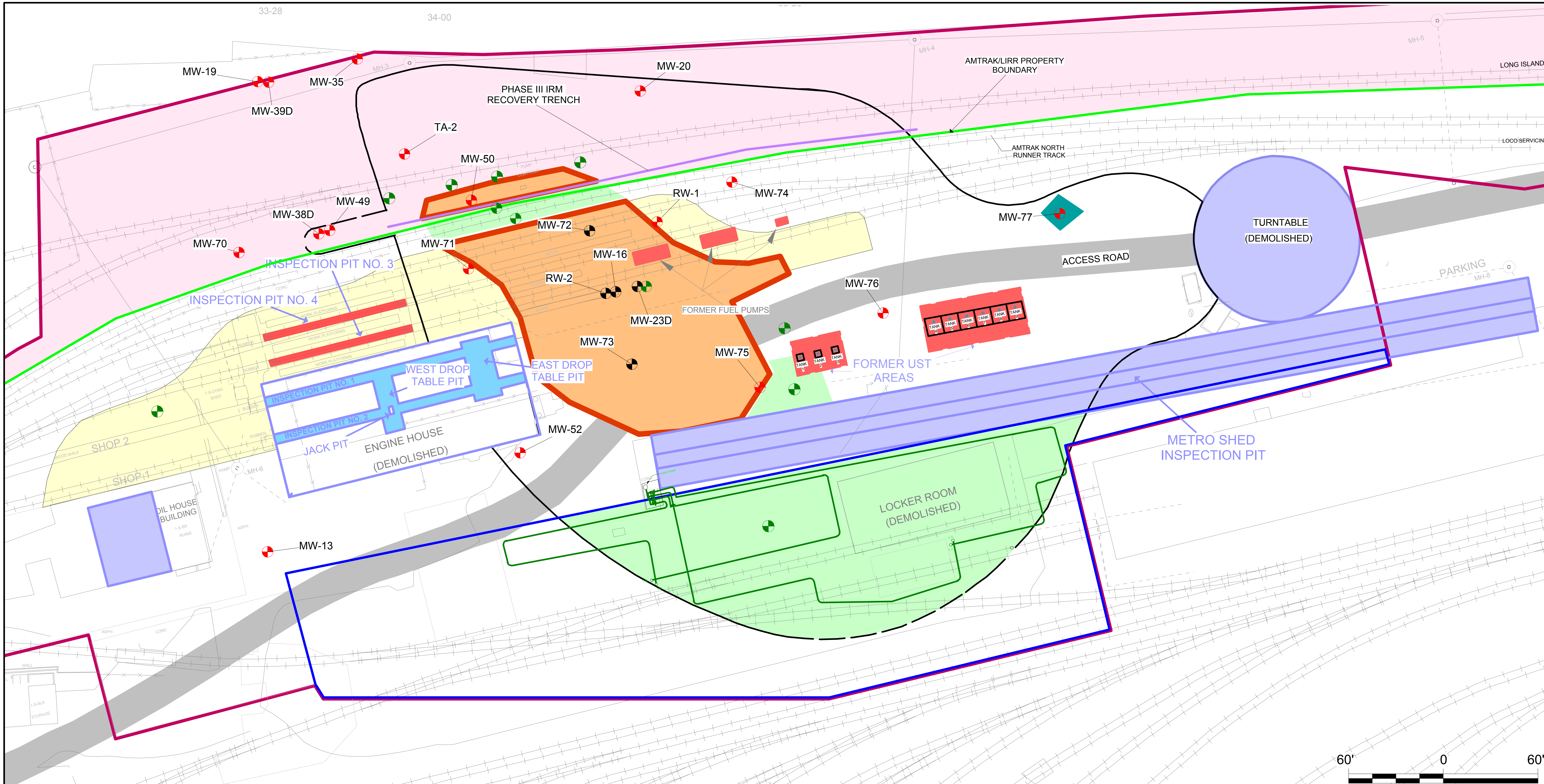

MW-76 LOCATION AND DESIGNATION OF MONITORING WELL

LOCATION OF PROPOSED MONITORING WELL

MW-16 LOCATION AND DESIGNATION OF MONITORING WELL TO BE REMOVED BY PHASE IV IRM

EXTENT OF AREA TO BE ADDRESSED BY ENHANCED BIODEGRADATION

AREAS TO BE MONITORED AND ADDRESSED BY ENHANCED BIODEGRADATION, IF NECESSARY

SUBSURFACE STRUCTURES TO BE CLEANED/ CLOSED IN PLACE

EXTENT OF LIRR PROPERTY UNDER ENVIRONMENTAL EASEMENT

SUBSURFACE STRUCTURES THAT DO NOT REQUIRE FURTHER REMEDIATION (METRO SHED TO BE MONITORED)

SUBSURFACE STRUCTURE TO BE REMOVED

APPROXIMATE EXTENT OF MOBILE SPH EXCAVATION AREA

APPROXIMATE EXTENT OF HYDROCARBON IMPACTED SURFACE SOIL EXCAVATION

APPROXIMATE BOUNDARY OF HISTORIC SPH PLUME (ZERO CONTOUR)

OU-3 BOUNDARY

LIMIT OF AREA PREVIOUSLY ADDRESSED DURING HST CONSTRUCTION

EXCAVATION SIDEWALLS TO BE TREATED BY ENHANCED BIODEGRADATION

BIOINFILTRATION PIPING

PHASE III IRM INTERCEPTOR TRENCH

NOTES

IRM - INTERIM REMEDIAL MEASURE

SPH - SEPARATE-PHASE HYDROCARBON

OU-3 - OPERABLE UNIT 3

RI - REMEDIAL INVESTIGATION

LIRR - LONG ISLAND RAIL ROAD

N

Title:

REMEDIAL ALTERNATIVE II

OU-3 FEASIBILITY STUDY
SUNNYSIDE YARD, QUEENS, NEW YORK

Prepared For: AMTRAK

ROUX
ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: JEP	Date: 11/21/2005	FIGURE
Prepared by: JEP	Scale: SHOWN	5
Project Mgr: HG	Office: NY	
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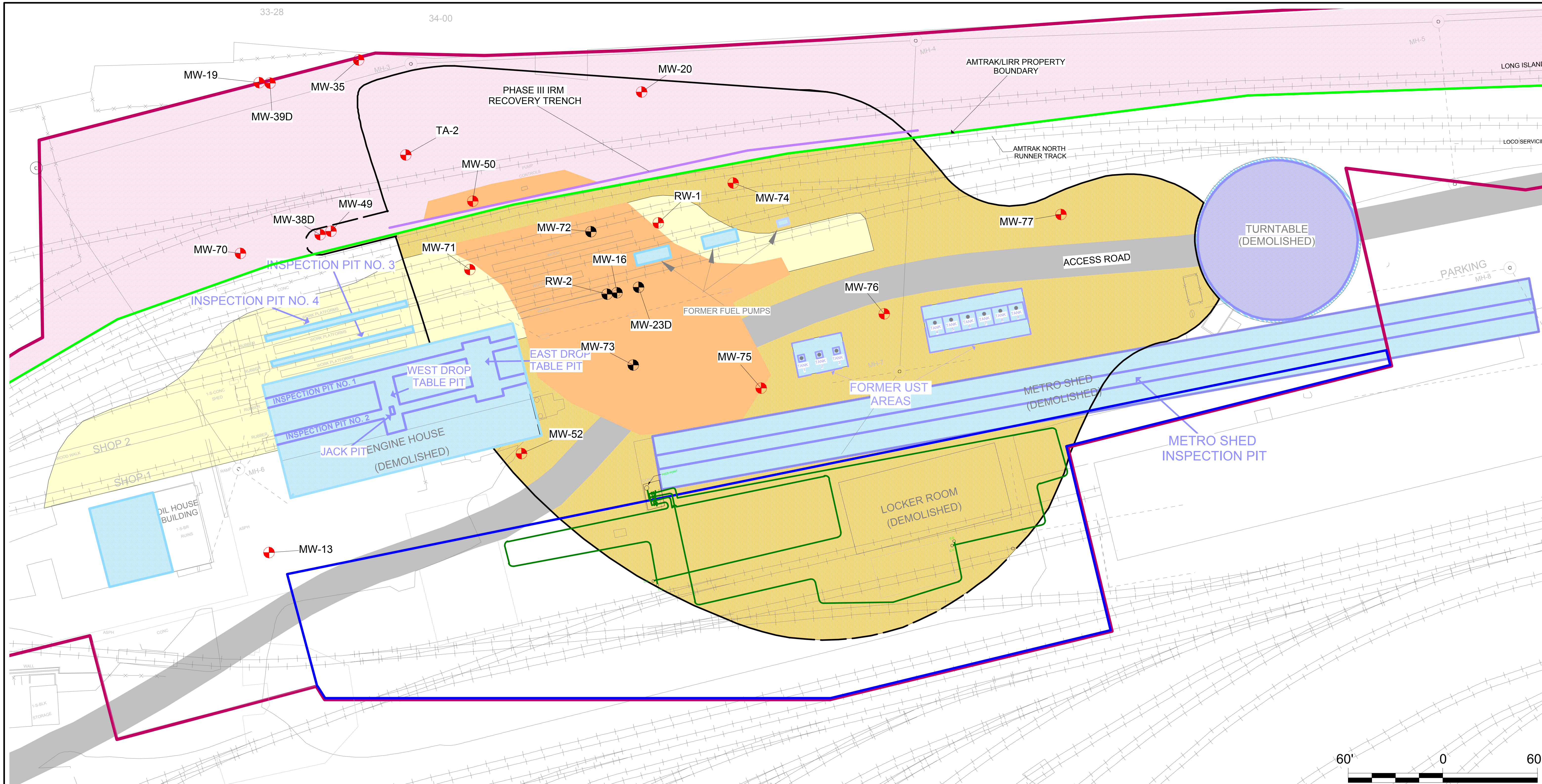


MW-76 LOCATION AND DESIGNATION OF MONITORING WELL

MW-16 LOCATION AND DESIGNATION OF MONITORING WELL TO BE REMOVED BY MOBILE SPH EXCAVATION

EXTENT OF RESIDUAL SPH EXCAVATION AREA

SUBSURFACE STRUCTURE TO BE REMOVED

EXTENT OF LIRR PROPERTY UNDER ENVIRONMENTAL EASEMENT

SUBSURFACE STRUCTURES THAT DO NOT REQUIRE FURTHER REMEDIATION

APPROXIMATE EXTENT OF MOBILE SPH EXCAVATION AREA

APPROXIMATE EXTENT OF HYDROCARBON IMPACTED SURFACE SOIL EXCAVATION

APPROXIMATE BOUNDARY OF HISTORIC SPH PLUME (ZERO CONTOUR)

OU-3 BOUNDARY

LIMIT OF AREA PREVIOUSLY ADDRESSED DURING HST CONSTRUCTION

BIOINFILTRATION PIPING

PHASE III IRM INTERCEPTOR TRENCH

NOTES

IRM - INTERIM REMEDIAL MEASURE

SPH - SEPARATE-PHASE HYDROCARBON

OU-3 - OPERABLE UNIT 3

RI - REMEDIAL INVESTIGATION

LIRR - LONG ISLAND RAIL ROAD

N

Title:

REMEDIAL ALTERNATIVE III

OU-3 FEASIBILITY STUDY
SUNNYSIDE YARD, QUEENS, NEW YORK

Prepared For: AMTRAK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: JEP	Date: 11/21/2005
Prepared by: JEP	Scale: SHOWN
Project Mgr: HG	Office: NY
File No: AM4513009.WOR	Project: 05545Y07

FIGURE 6

APPENDIX A

Remedial Action Alternative
Cost Estimation Tables

Table A1. Remedial Alternative II Cost Estimate, OU-3 Feasibility Study
Sunnyside Yard, Queens, New York

Description	Quantity	Unit	Unit Cost	Total Cost	Notes
REMEDIAL ALTERNATIVE II: CAPITAL COSTS					
SITE PREPARATION					
Perimeter Plywood Barrier Installation	760	LF	$19.80	$15,048	(29)
Access Road Relocation			Completed by Amtrak		(30)
Underground Utility Clearance			Completed by Amtrak		(2)
Active Utility Relocation/Replacement			Completed by Amtrak		(2)
Clearance of Surface Features (Rails, RR Cars, etc.)			Completed by Amtrak		(1)
Sewer/Catch Basin Relocation	1	LS	$30,000	$30,000	
Temporary Drainage & Runoff Control	1	LS	$15,000	$15,000	
Subtotal				**$60,048**	
MOBILE SPH PLUME AND PETROLEUM IMPACTED SOIL EXCAVATION					
Excavate and Stockpile Soil	3,600	CY	$21.75	$78,300	(31,32)
Product Skimming within Excavation	48	Day	$800.00	$38,400	(33)
Initial Trenching in South and East Portions of Excavation	340	LF	$7.14	$2,428	(34)
Segregate/Stockpile Wood Railroad Ties and Large Debris	60	CY	$10.00	$600	(27)
Soil Stabilization for Transport	3,600	CY	$35.00	$126,000	(35)
T&D Non-Hazardous Petroleum-Impacted Soil	5,900	Tons	$58.00	$342,171	(36, 37)
T&D Hazardous PCB-impacted Soil	311	Tons	$185.00	$57,443	(38,39)
T&D of Skimmed Product (Non-Hazardous)	10,000	Gal	$0.85	$8,500	(40)
T&D Non-Hazardous Wood (Rail Road Ties)	72	Tons	$100.00	$7,200	(41)
Post-Excavation Sampling	17	Sample	$183.00	$3,111	(42)
Waste Characterization Sampling	8	Sample	$1,000	$8,000	(43)
Application of BioSlurry to Excavation Sidewalls	1	LS	$45,000	$45,000	(44)
Loading/Transportation of Backfill from OU-4 to OU-3 & Placement in Excavation	2,925	CY	$15.00	$43,875	(45)
Placement of Shallow OU-3 Soil Reused as Backfill	675	CY	$8.00	$5,400	(46)
Dust/Odor Control	1	LS	$65,000	$65,000	(47)
Subtotal				**$831,427**	
SURFACE SOIL EXCAVATION					
Excavate and Stockpile Surface Soil (0-1 foot)	575	CY	$21.75	$12,506	(31,48)
Excavate Known Lead Exceedance (Sample S-62)	30	CY	$21.75	$653	(31,49)
Segregate/Stockpile Wood Railroad Ties and Large Debris	90	CY	$10.00	$900	(27)
Loading/Transportation of Backfill from OU-4 to OU-3 & Placement in Excavation	605	CY	$15.00	$9,075	(45)
Soil Stabilization for Transport	605	CY	$35.00	$21,175	(35)
T&D Non-Hazardous Petroleum-Impacted Soil	1044	Tons	$58.00	$60,530	(36)
T&D Non-Hazardous Wood (Rail Road Ties)	108	Tons	$100.00	$10,800	(41)
Lead Confirmatory Soil Samples (Near Sample S-62)	5	Samples	$12	$60	(50)
Waste Characterization Sampling	2	Samples	$1,000	$2,000	(43)
Subtotal				**$117,699**	

Table A1. Remedial Alternative II Cost Estimate, OU-3 Feasibility Study
Sunnyside Yard, Queens, New York

Description		Quantity	Unit	Unit Cost	Total Cost	Notes
RESIDUAL SPH IN SITU BIODEGRADATION						
Baseline Testing						
Soil Sample Collection/Analysis		6	Samples	$1,000	$6,000	(4)
Injection of Amendments/Microorganisms						
Injection Using Direct-Push Borings		1	Injections	$45,000	$45,000	(7)
Soil Monitoring/Soil Sample Collection and Analysis		1	LS	$23,000	$23,000	(5,8)
Groundwater Field Parameters Monitoring/Monitoring Well Gauging		1	LS	$10,500	$10,500	(6,9)
	Subtotal				**$84,500**	
INTERIOR ENGINE HOUSE SERVICE PIT CLEANING						
Concrete Cover Removed by Sawcutting		3,000	SF	$15	$45,000	
Water and SPH Removal in Service Pits		87,000	Gallons	$2.00	$174,000	(20)
Removal of Debris and Equipment/Machinery in Service Pits		50	Tons	$100	$5,000	(21,55)
Manual Removal of Surface Accumulation of SPH/Sludge		1	LS	$20,000	$20,000	
Pressure Washing Service Pits		1	LS	$10,000	$10,000	(11)
Collection of Wash Water		10,000	Gallons	$2.00	$20,000	
Service Pits Backfilled with Soil/Fill Placed to Grade		750	CY	$15	$11,250	(12)
T&D of Bulk Concrete - Engine House Service Pit Cap Removal		315	Tons	$79.35	$24,995	(18)
T&D of PCB-hazardous Liquid Waste - Engine House Service Pits		21,750	Gallons	$5.00	$108,750	(19, 20)
T&D of non-hazardous Liquid Waste - Engine House Service Pits		65,250	Gallons	$0.85	$55,463	(19, 20)
T&D of Debris Removed - Former Engine House Service Pits		50	Tons	$79.35	$3,968	(21,55)
T&D of Wash Water - Pressure Washing the Engine House Service Pits		10,000	Gallons	$0.85	$8,500	(22)
Waste Characterization Sampling - Liquid Waste		10	Samples	$1,000	$9,700	(25)
Waste Characterization Sampling - Concrete		14	Samples	$1,000	$21,000	(24)
	Subtotal				**$517,625**	
EXTERIOR ENGINE HOUSE INSPECTION PIT REMOVAL						
Removal of Soil/Fill		40	CY	$21.75	$870	(31)
Removal of Concrete Structures		1	LS	$40,000	$40,000	
T & D Non-Hazardous Petroleum-Impacted Soil		60	Tons	$58	$3,480	(36)
T & D of Non-Hazardous Petroleum Impacted Concrete		30	Tons	$110.00	$3,300	(51)
T & D of Non-Impacted Concrete		120	Tons	$45.00	$5,400	(51)
Loading, Transportation of Backfill/Ballast from OU-4 to OU-3, Placement in Excavation		46	CY	$15.00	$690	(45)
Waste Characterization Sampling		10	Sample	$1,000	$10,000	(24)
	Subtotal				**$63,740**	
FUEL PUMP VAULTS REMOVAL						
Removal of Residual Product (Non-Hazardous)		1,000	Gal	$0.85	$850	(26)
Removal of Former Fuel Pump Piping		1	LS	$4,000	$4,000	(13)
Removal of Soil/Fill		100	CY	$21.75	$2,175	(31)
Removal of Concrete Structures		1	LS	$60,000	$60,000	
T & D Non-Hazardous Petroleum-Impacted Soil		150	Tons	$58	$8,700	(36)
T & D of Non-Hazardous Petroleum Impacted Concrete		50	Tons	$110.00	$5,500	
T & D of Non-Impacted Concrete		50	Tons	$45.00	$2,250	

Table A1. Remedial Alternative II Cost Estimate, OU-3 Feasibility Study
Sunnyside Yard, Queens, New York

Description		Quantity	Unit	Unit Cost	Total Cost	Notes
Loading, Transportation of Backfill/Ballast from OU-4 to OU-3, Placement in Excavation		40	CY	$15.00	$600	(45)
Waste Characterization Sampling		1	Sample	$1,000	$1,000	(24)
	Subtotal				**$85,075**	
UST REMOVAL						
UST Handling and Disposal Costs		9	EA	$30,000	$270,000	(14,56)
T&D of Water Removed from UST Closure		45,000	Gallons	$1.00	$45,000	(23)
Waste Characterization Sampling - Liquid Waste		5	Samples	$1,000	$4,500	(25)
	Subtotal				**$319,500**	
COMMUNITY AIR MONITORING PLAN						
CAMP Oversight		8	Months	$13,000	$104,000	(15, 27)
CAMP Meters		8	Months	$5,000	$40,000	(16)
CAMP Data Reporting to the NYSDOH and NYSDEC		8	Months	$1,270	$10,160	(27)
Dust Control Using Water Mist over the Work Area		1	LS	$10,000	$10,000	(17)
	Subtotal				**$164,160**	
PERFORMANCE MONITORING						
Installation and Survey of 7 Post-IRM Monitoring Wells		7	EA	$2,600	$18,200	
Subsurface Structure Monitoring Well Installation and Survey		3	EA	$2,600	$7,800	
South Plume Monitoring Well Installation and Survey		1	EA	$2,600	$2,600	
	Subtotal				**$28,600**	
SITE MANAGEMENT PLAN						
Preparation and Implementation of Site Management Plan		1	LS	$15,000	$15,000	
	Subtotal				**$15,000**	
ENVIRONMENTAL EASEMENTS						
Environmental Easements		1	LS	$25,000	$25,000	
	Subtotal				**$25,000**	
				Subtotal Direct Costs	$2,312,374	
				Contingency (30%)	$693,712	
				TOTAL DIRECT COSTS	***$3,006,087***	
				Mobilization/Demobilization (5%)	$150,304	(28)
				Amtrak Site Preparation (10%)	$300,609	(1,2)
				Project Management (6%)	$180,365	(29)
				Remedial Design (12%)	$360,730	(29)
				Construction Management (8%)	$240,487	(29)
				TOTAL INDIRECT COSTS	***$1,232,496***	
				TOTAL CAPITAL COSTS	**$4,238,582**	

Table A1. Remedial Alternative II Cost Estimate, OU-3 Feasibility Study
Sunnyside Yard, Queens, New York

Description	Quantity	Unit	Unit Cost	Total Cost	Notes
REMEDIAL ALTERNATIVE II: FUTURE COSTS					
Quarterly groundwater sampling for 2 years ($12,200/Year)	1	LS	$22,685	$22,685	
Quarterly groundwater gauging for 2 years ($5,200/Year)	1	LS	$9,669	$9,669	
Monthly *In Situ* Biodegradation Performance Monitoring for 1 year ($5,500/year)	1	LS	$5,238	$5,238	
Quarterly Subsurface Structure/South Plume Monitoring and Sampling ($12,400/Year)	2	LS	$23,057	$23,057	
			Subtotal Net Present Worth of OM&M Costs	$60,649	
			Project Management (10%)	$6,065	
			Construction Management (15%)	$9,097	
			TOTAL PRESENT WORTH OF OM&M COSTS	**$75,811**	
			TOTAL OU-3 FS COSTS	**$4,314,393**	

Table A2. Remedial Alternative III Cost Estimate, OU-3 Feasibility Study
Sunnyside Yard, Queens, New York

Description	Quantity	Unit	Unit Cost	Total Cost	Notes
REMEDIAL ALTERNATIVE III: CAPITAL COSTS					
RESIDUAL SPH EXCAVATION					
Perimeter Plywood Fencing for Active Excavation Area	1,000	LF	$19.80	$19,800	(29)
Installation of Steel Sheet Piling to 10 feet depth	13,150	SF	$35.00	$460,250	(52)
Temporary Roadways	600	LF	$8.50	$5,100	(30)
Excavation and Stockpile of SPH-Impacted Soil	19,740	CY	$21.75	$429,345	(31)
Soil Stabilization for Transport	19,740	CY	$35.00	$690,900	(35)
Product Skimming Within Excavation and Stockpile Drainage	45,000	GAL	$0.85	$38,250	(33)
Loading/Transportation of Backfill from OU-4 to OU-3 & Placement in Excavation	19,740	CY	$15.00	$296,100	(45)
T & D Non-Hazardous Petroleum-Impacted Soil	34,545	TONS	$58.00	$2,003,610	(36)
Waste Characterization Sampling - Soil	25	SAMPLES	$1,000	$25,000	(53)
Waste Characterization Sampling - Liquids	4	SAMPLES	$1,000	$4,000	(25)
Subtotal				**$3,972,355**	
MOBILE SPH PLUME EXCAVATION					
Excavate and Stockpile Soil	3,600	CY	$21.75	$78,300	(31,32)
Product Skimming within Excavation	48	Day	$800.00	$38,400	(33)
Initial Trenching in South and East Portions of Excavation	340	LF	$7.14	$2,428	(34)
Segregate/Stockpile Wood Railroad Ties and Large Debris	60	CY	$10.00	$600	(27)
Soil Stabilization for Transport	3,600	CY	$35.00	$126,000	(35)
T & D Non-Hazardous Petroleum-Impacted Soil	5,900	Tons	$58.00	$342,171	(36, 37)
T & D Hazardous PCB-impacted Soil	311	Tons	$185.00	$57,443	(38,39)
T & D of Skimmed Product (Non-Hazardous)	10,000	Gal	$0.85	$8,500	(40)
T & D Non-Hazardous Wood (Rail Road Ties)	72	Tons	$100.00	$7,200	(41)
Post-Excavation Sampling	17	Sample	$183.00	$3,111	(42)
Waste Characterization Sampling	8	Sample	$1,000	$8,000	(43)
Application of BioSlurry to Excavation Sidewalls	1	LS	$45,000	$45,000	(44)
Loading and Transportation of OU-4 soil to OU-3 and Backfill	2,925	CY	$15.00	$43,875	(45)
Placement of Shallow OU-3 Soil Reused as Backfill	675	CY	$8.00	$5,400	(46)
Dust/Odor Control	1	LS	$65,000	$65,000	(47)
Subtotal				**$831,427**	
SURFACE SOIL EXCAVATION					
Excavate and Stockpile Surface Soil (0-1 foot)	575	CY	$21.75	$12,506	(31,48)
Excavate Known Lead Exceedance (Sample S-62)	30	CY	$21.75	$653	(31,49)
Segregate/Stockpile Wood Railroad Ties and Large Debris	90	CY	$10.00	$900	(27)
Loading, Transportation of Backfill/Ballast from REA (OU-4) to □OU-3, and Placeme	605	CY	$15.00	$9,075	(45)
Soil Stabilization for Transport	605	CY	$35.00	$21,175	(35)
T & D Non-Hazardous Petroleum-Impacted Soil	1044	Tons	$58.00	$60,530	(36)
T & D Non-Hazardous Wood (Rail Road Ties)	108	Tons	$100.00	$10,800	(41)
Lead Confirmatory Soil Samples (Near Sample S-62)	5	Samples	$12	$60	(50)
Waste Characterization Sampling	2	Samples	$1,000	$2,000	(43)
Subtotal				**$117,699**	
SUBSURFACE STRUCTURE EXCAVATION					
Temporary Roadways	400	LF	$8.50	$3,400	(30)
Concrete Demolition	2,500	CY	$205	$512,500	(54)
Removal of Soil/Fill	140	CY	$21.75	$3,045	(31)
Excavation and Stockpile Metro Shed Soil/Fill	1,800	CY	$21.75	$39,150	(31)
Debris Removal in Former Engine House	350	TONS	$20.00	$7,000	(21,55)
UST Handling and Disposal Costs	9	EA	$30,000	$270,000	(14,56)
SPH/Water Removal from Engine House	87,000	GAL	$0.55	$47,850	(20)
Loading/Transportation of Backfill from OU-4 to OU-3 & Placement in Excavation	6,300	CY	$15.00	$94,500	(45)
Waste Characterization Sampling - Concrete	157	SAMPLES	$1,000	$156,818	(24)
Waste Characterization Sampling - Soil	6	SAMPLES	$1,000	$6,364	(53)
Waste Characterization Sampling - Liquids	9	SAMPLES	$1,000	$9,000	(25)
T & D Non-Hazardous Petroleum-Impacted Soil	210	Tons	$58	$12,180	(36)

Table A2. Remedial Alternative III Cost Estimate, OU-3 Feasibility Study
Sunnyside Yard, Queens, New York

Description		Quantity	Unit	Unit Cost	Total Cost	Notes
T&D of Non-Hazardous Concrete		2,830	TONS	$45.00	$127,350	(51)
T&D of C&D Bulk Concrete Engine House Cap Removal		620	TONS	$30.00	$18,600	(18)
T&D of PCB-hazardous Liquid Waste - Engine House Service Pits		21,750	Gallons	$5.00	$108,750	(19,20)
T&D of non-hazardous Liquid Waste - Engine House Service Pits		65,250	Gallons	$0.85	$55,463	(19,20)
T&D of Water Removed from UST Closure		45,000	Gallons	$1.00	$45,000	(23)
	Subtotal				**$1,516,969**	
COMMUNITY AIR MONITORING PLAN						
CAMP Oversight		18	MONTHS	$13,000	$234,000	(15, 27
CAMP Meters		18	MONTHS	$5,000	$90,000	(16)
CAMP Data Reporting to the NYSDOH and NYSDEC		18	MONTHS	$1,270	$22,860	(27)
Dust Control Using Water Mist over the Work Area		1	LS	$10,000	$10,000	(17)
	Subtotal				**$346,860**	
PERFORMANCE MONITORING						
Installation and Survey of 7 Additional Monitoring Wells		7	EA	$2,600	$18,200	
	Subtotal				**$18,200**	
SITE MANAGEMENT PLAN						
Preparation and Implementation of Site Management Plan		1	LS	$15,000	$15,000	
	Subtotal				**$15,000**	
ENVIRONMENTAL EASEMENTS						
Environmental Easements		1	LS	$25,000	$25,000	
	Subtotal				**$25,000**	
				Subtotal Direct Costs	**$6,843,510**	
				Contingency (30%)	$2,053,053	
				TOTAL DIRECT COSTS	**$8,896,564**	
				Mobilization/Demobilization (5%)	$444,828	
				Amtrak Site Preparation (5%)	$444,828	
				Project Management (6%)	$533,794	
				Remedial Design (12%)	$1,067,588	
				Construction Management (8%)	$711,725	
				TOTAL INDIRECT COSTS	**$3,202,763**	
				TOTAL CAPITAL COSTS	**$12,099,326**	
				TOTAL OU-3 FS COSTS	**$12,099,326**	

Table A3. Cost Estimation Notes for the OU-3 Feasibility Study
Sunnyside Yard, Queens, New York

1. All surface features, including debris, rails, railroad cars, etc., would require relocation by Amtrak prior to mobilization. Costs associated with performing such work would be provided by Amtrak.
2. All active aboveground and underground electrical, communication, and signal lines within the excavation areas would be deactivated and/or temporarily rerouted by Amtrak prior to mobilization. Costs associated with performing such work would be provided by Amtrak.
3. Amtrak Railroad Protection would be required during all construction activities. Flagmen would be required for the entire working day during work performed near active tracks.
4. Soil samples would be collected from the 2-foot interval spanning the oil/water interface near MW-77. Soil samples would be submitted for analysis to characterize the physical, chemical, and biological properties of the soil to be treated including such parameters as SVOCs (PAHs), DRO and HRO (collectively TPH), ammonia, nitrate, nitrite, nitrogen, phosphorus, total heterotrophic plate count, and TOC.
5. Monitoring of soil pH, nutrient balance, oxygen content, and moisture content would be performed weekly for the treatment duration (estimated 8 months) to ensure that soil conditions are favorable for biodegradation.
6. Field parameters include pH, dissolved oxygen, temperature, and oxidation-reduction (redox) potential. Gauging includes water levels and apparent SPH thickness measurements. Field parameter monitoring would be performed weekly for treatment duration (estimated 8 months). Cost includes data management and reporting.
7. Ammonia nitrate would be injected into the subsurface using a Geoprobe direct push injection method. Cost includes Geoprobe costs for 5 days, ammonia nitrate product costs and pH adjustment.
8. Soil samples collected throughout the treatment, submitted for DRO, HRO, and PAH analysis, and compared to the baseline sampling data. Cost includes data management and reporting.
9. Biweekly monitoring would be performed as treatment progresses and reduction of apparent SPH thickness measurements is observed. Once apparent SPH thickness measurements of less than 0.1-foot are consistently observed, the monitoring would be performed monthly for one year.
10. Samples collected approximately every 30 feet along the service pit sidewalls with one sample collected from each service pit bottom. Wipe samples collected from the same locations as the chip samples.
11. Concrete cleaned using high-pressure washer with commercial detergent to remove any remaining residue.
12. Service pits backfilled with soil/fill from on-site sources within OU-4 or from off-site certified sources. Backfill would be placed to grade of the undisturbed surrounding concrete cover.
13. Pipelines located by tracing pipes from the tanks to the Fuel Transfer Area/Boiler House.
14. UST removal requires pumping the water in the USTs out of the tanks and containerizing.
15. Air monitoring required during the sawcutting of concrete and handling of impacted materials (soil near the USTs and liquid contents of the service pits) to measure the concentration of particulates in ambient air in the work zone and in the perimeter of the Yard.
16. As required by the NYSDOH, CAMP monitoring would include monitoring for VOCs using PIDs, particulate levels using particulate meters, and meteorological monitoring using a weather station to obtain real-time continuous data.
17. If perimeter action levels established in the CAMP are exceeded, a water mist would be sprayed over the work area by connecting a misting device to a hose, which would be connected to a potable water source.

18. Assumes an average density of 1.5 tons per cubic yard for concrete. Also assumes that the concrete bulk waste would be classified as construction and demolition (C&D) waste. Cost provided by Clean Harbors for similar project.

19. This liquid would be segregated from other liquid waste since it is expected to contain PCBs. It is assumed that 25 percent would be classified as hazardous liquid waste and 75 percent would be classified as non-hazardous liquid waste.

20. It is not possible to quantify the amount of water present in the inspection pit system due to the presence of the concrete cover. For estimating purposes, it is anticipated that 80 percent of the service pits volume is filled with water and therefore, approximately 87,000 gallons of water are present.

21. It is expected that the debris would consist primarily of wood, scrap metal debris, and possibly some equipment and machinery. Cost provided by Clean Harbors for similar project.

22. Quantity of wash water was estimated because the surface area of service pits that require cleaning would not be known until the service pits are accessed and the concrete structures are sampled.

23. Assumes disposal as non-hazardous waste. Water within the tanks is estimated because of limited records regarding the capacities of the tanks and proportions of the tanks that are filled with water.

24. Assumes that waste characterization samples would be collected at a rate of 1 sample for every 22-ton truckload of concrete for disposal. Samples would be submitted for analysis based on disposal facility requirements, which may include PCBs, total lead, TCLP VOCs, TCLP SVOCs, TCLP metals, and RCRA characteristics.

25. Assumes that waste characterization samples would be collected at a rate of 1 sample for every 10,000 gallons of liquid waste. Samples would be submitted for analysis based on disposal facility requirements, which may include PCBs, total lead, TCLP VOCs, TCLP SVOCs, TCLP metals, and RCRA characteristics.

26. Four monitoring wells would be installed north of the Amtrak property and downgradient of the mobile SPH excavation at the locations of four Pre-Delineation borings (i.e., CTB-1, CTB-19, CTB-20, and CTB-21). One monitoring well would be installed on each side of the North Runner Track (two monitoring wells in total), and one monitoring well would be installed in the center of the mobile SPH excavation subsequent to backfill.

27. This cost was generated by Roux Associates based on previous engineering experience.

28. The mobilization/demobilization cost includes mobilization of equipment to the Yard; obtaining required permitting; set up of temporary services/utilities; construction of decontamination pads and staging areas for equipment, disposal container storage, soil/fill, etc.; and removal of equipment, temporary services/utilities, and decontamination pads from the Yard.

29. The temporary barrier would be constructed out of plywood, and would be 8-feet high. The temporary barrier would extend around the perimeter of the SPH Plume excavation only. The unit cost was derived by R.S. Means Heavy Construction Cost Data, 2003, P.17

30. The existing access road transects OU-3 and the SPH plume excavation. This access road is the primary accessway for Amtrak personnel within the northern portion of the Yard. This road would require relocation to the south prior to excavation activities.

31. The cost for soil excavation and loading was based on a cost provided by Clean Earth Environmental Services, Inc. on April 9, 2004. The cost provided by Clean Earth was increased by a factor of 50% to account for the affects to productivity associated with completing this work in an active rail yard (e.g., presence of unmapped utilities, railroad protection near active tracks).

32. The volume of soil to be excavated is based on the volume of soil within the 0.1-foot apparent SPH thickness contour to a depth of 1-foot below the water table. This volume estimate includes any visually hydrocarbon-impacted soil that lies within the SPH plume excavation limits.

33. Free floating SPH would be skimmed from the open excavation during soil removal. The duration of product skimming is based upon the time to excavate. It is assumed that approximately 75 CY of soil would be excavated each day (approximately 48 days of excavating).

34. The trenching located in the southern and eastern portion of the SPH excavation would be approximately 2 feet wide, and 4 feet deep. The unit cost was derived by R.S. Means Heavy Construction Cost Data, 2003, P.332.

35. Visual hydrocarbon-impacted surface soil and soil in contact with SPH plume would be water and oil-saturated and would require stabilization prior to transport. It is assumed that stabilization would increase the soil volume by 15 percent.

36. Non-hazardous petroleum impacted soil transportation and disposal cost was provided by Clean Earth Environmental Services, Inc. on April 9, 2004. Soil would be disposed at Clean Earth of Philadelphia, Inc. Average density of material was assumed to be 1.5 tons/cy.

37. Approximately 95 percent of the total quantity of SPH plume associated soil is assumed to be classified as non-hazardous petroleum-impacted soil. Quantity = (stabilized soil volume, CY)(0.95)(1.5 ton/cy)

38. Approximately 5 percent of the total quantity of SPH plume associated soil is assumed to be classified as hazardous PCB-impacted soil. Quantity = (stabilized soil volume, CY)(0.05)(1.5 ton/cy)

39. Hazardous PCB-impacted soil transportation and disposal cost was provided by Clean Harbors. Material would be disposed at Model City. Average density of material was assumed to be 1.5 tons/cy.

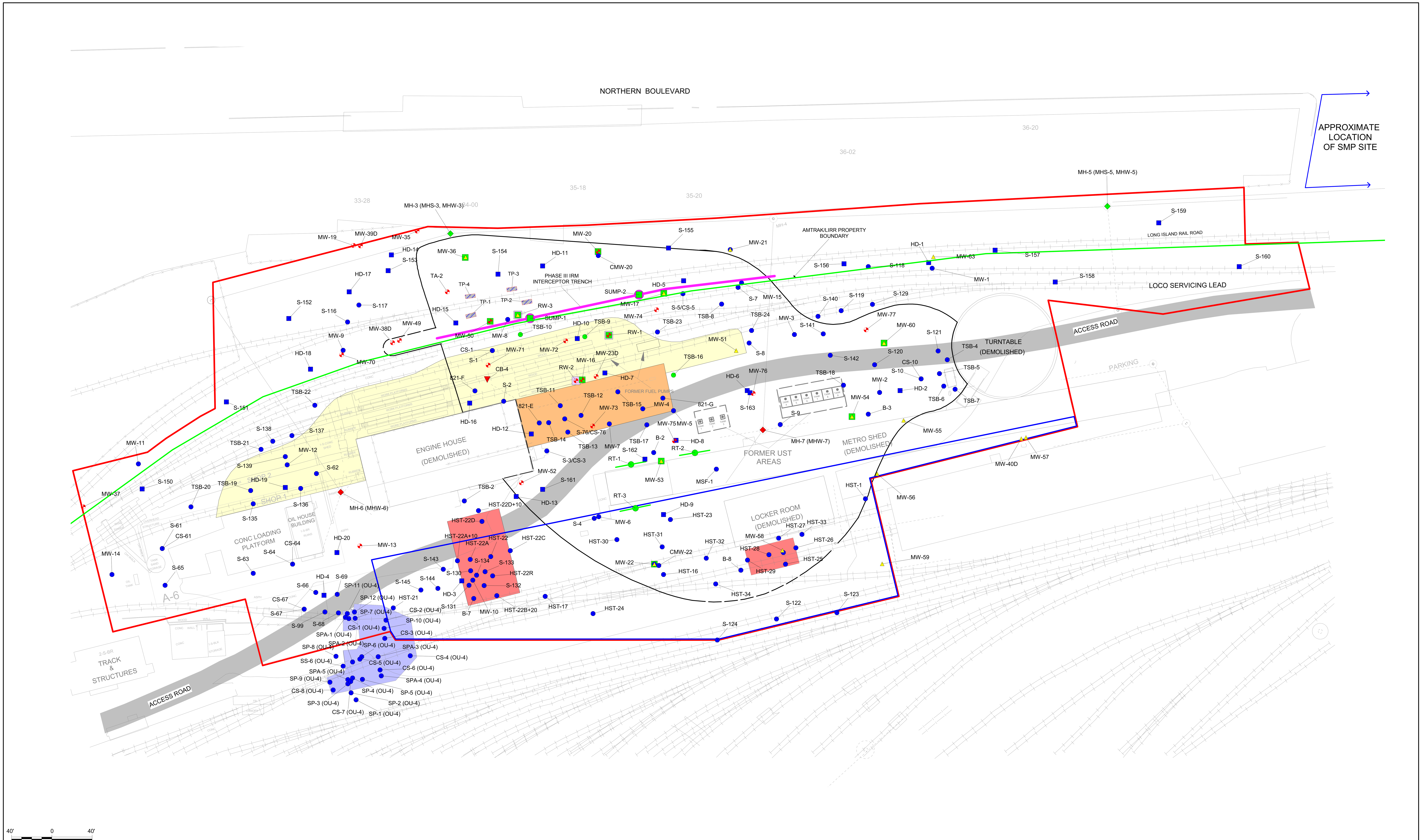
40. 10,000 gallons is an estimate of the product/water skimming recovery total and decon/storage area runoff collection. The non-hazardous disposal rate of $0.85/gallon was provided by a Roux Associates' Subcontractor for a similar project.

41. The quantity of wood for disposal was based on an approximate estimate of railroad ties per length of track (1 tie per 3 lf) to be removed to facilitate the excavation. An average volume for railroad ties of 0.3 cy was estimated and density of 1.2 tons/cy). Approximately 885 lf of track requires removal for the surface soil excavation and 600 lf of track require removal for the SPH plume excavation.

42. The limits of the SPH excavation would be confirmed by collecting post-excavation samples every 2500 sf (40 ft grid) on the excavation bottom and every 100 lf along the bottom of the excavation sidewalls. The post-excavation samples would be submitted for analysis for the COCs. Costs for analyses were provided by Veritech Laboratories.

43. Assumed that waste characterization samples would be collected at a rate of 1 sample for every 500 CY of mobile SPH excavated soil. Samples would be submitted for analyses based on disposal facility requirements. Assumed cost $1,000.00/sample.

44. The cost for the application of BioSlurry to the excavation sidewalls is based on costs provided by Adventus Americas, Inc.
45. This cost includes loading backfill from OU-4, transporting it to OU-3, and placing it in the open excavation. A layer of clean fill material would be placed over all backfilled areas.
46. It is estimated that approximately 675 CY of soil removed from the SPH excavation would be able to be re-used as backfill. This soil is comprised of the upper 2 feet of the soil located in the southern portion of the SPH excavation.
47. The cost for dust/odor control is based on the application of a spray-on foam. This cost includes the product cost, rental of foam applicator unit, and daily application of the foam during excavation activities. Costs were provided by Rusmar Foam Technology.
48. The volume of surface soil to be excavated was based upon delineation of visually hydrocarbon-impacted soil. This volume does **not** include the visually hydrocarbon-impacted soil that lies within the extent of the mobile SPH plume excavation.
49. The 20-foot by 20-foot area of the excavation surrounding sample location S-62 would be completed to a depth of 3 feet bls. This estimate does not include the top 1-foot of soil characterized as visually hydrocarbon impacted surface soil. This soil is expected to be classified as non-hazardous petroleum impacted soil and would not require separate disposal.
50. One soil sample would be collected from each of the four sidewalls, and one soil sample would be collected from the bottom of the excavation surrounding sample location S-62, and would be submitted for analysis for lead only.
51. Assumes that 20 percent of the exterior Engine House inspection pit concrete would be disposed as non-hazardous petroleum-impacted concrete and the remaining 80 percent would be disposed as non-impacted C&D concrete waste.
52. Sheet piling is required for all excavations greater than 5 feet in depth. Approximately 1,315 LF of sheeting would be installed to 10 foot depth and left in place.
53. Assumed that waste characterization samples would be collected from the residual SPH excavated soil at a rate of 1 sample for every 750 CY. Samples would be submitted for analyses based on disposal facility requirements. Assumed cost $1,000.00/sample.
54. The volume is an estimate of concrete from former Engine House service pits, foundations, and cover, the former Metro Shed inspection pit, and the Oil House basement
55. All debris, including former equipment, machinery, or construction debris, would be removed, temporarily stockpiled, and disposed off-site. Quantity of debris is not quantifiable due to the presence of the concrete cover.
56. Cost includes removal of water and sand, removal of USTs from subsurface, and cleaning and dismantling of USTs for disposal.



CS-1 LOCATION AND DESIGNATION OF PREVIOUS SOIL BORING

TSB-9 LOCATION AND DESIGNATION OF SOIL BORING AND TEMPORARY GEOPROBE GROUNDWATER SAMPLING POINT

HD-1 LOCATION AND DESIGNATION OF SUPPLEMENTAL RI SOIL BORING

MW-50 LOCATION AND DESIGNATION OF SPH SAMPLE

MHS-3 MHW-3 LOCATION AND DESIGNATION OF SEWER SEDIMENT ("S") AND WATER ("W") SAMPLE

MHW-6 LOCATION AND DESIGNATION OF SEWER WATER SAMPLE

CB-4 LOCATION AND DESIGNATION OF CATCH BASIN WATER SAMPLE

MW-16 LOCATION AND DESIGNATION OF MONITORING WELL

MW-54 LOCATION AND DESIGNATION OF FORMER MONITORING WELL INSTALLED BY ROUX ASSOCIATES, INC.

RT-1 LOCATION AND DESIGNATION OF PHASE I IRM RECOVERY TRENCH

RW-1 LOCATION AND DESIGNATION OF PHASE II IRM RECOVERY WELLS

LOCATION OF PHASE III IRM INTERCEPTOR TRENCH

APPROXIMATE BOUNDARY OF HISTORIC SPH PLUME (ZERO CONTOUR)

AREA REMEDIATED TO 0.5 FT BELOW HISTORIC GRADE (1985-1986)

AREA REMEDIATED TO 2 FT BELOW HISTORIC GRADE (1998)

AREA REMEDIATED TO BETWEEN 3 AND 8 FT BELOW HISTORIC GRADE (1999)

OU-3 BOUNDARY

LIMIT OF AREA PREVIOUSLY ADDRESSED DURING HST CONSTRUCTION

LOCATION AND DESIGNATION OF TEST PIT

SEWER LINE (DASHED WHERE INFERRED), WITH MANHOLE DESIGNATION (OU-5)

APPROXIMATE EXTENT OF VISUAL HYDROCARBON-IMPACTED SURFACE SOIL

NOTES

IRM - INTERIM REMEDIAL MEASURE
SPH - SEPARATE-PHASE HYDROCARBON
OU-3 - OPERABLE UNIT 3
RI - REMEDIAL INVESTIGATION
HST - HIGH SPEED TRAINSET
SMP - STANDARD MOTOR PRODUCTS
LIRR - LONG ISLAND RAIL ROAD

N

Title:

OU-3 SAMPLE LOCATIONS

OU-3 FEASIBILITY STUDY
SUNNYSIDE YARD, QUEENS, NEW YORK

Prepared For: AMTRAK

ROUX
ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: RSK	Date: 11/21/2005	PLATE
Prepared by: RSK	Scale: AS SHOWN	1
Project Mgr: HG	Office: NY	
File No: AM4513005.WOR	Project: 05545Y07	

PDB-1 LOCATION AND DESIGNATION OF PRE-DESIGN STUDY SOIL BORING

PT-3 LOCATION AND DESIGNATION OF BENCH-SCALE TREATABILITY STUDY SOIL SAMPLE

MW-50 LOCATION AND DESIGNATION OF PRE-DESIGN STUDY SPH SAMPLE

MW-16 LOCATION AND DESIGNATION OF MONITORING WELL

MW-77 LOCATION AND DESIGNATION OF PRE-DESIGN STUDY MONITORING WELL

CTB-1 LOCATION AND DESIGNATION OF PRE-DELINEATION SOIL BORING

LOCATION OF CAPILLARY RISE TEST CASING

TP-1 LOCATION AND DESIGNATION OF TEST PIT

LOCATION OF BIOINFILTRATION PIPING

LOCATION OF PHASE III IRM INTERCEPTOR TRENCH

APPROXIMATE BOUNDARY OF HISTORIC SPH PLUME (ZERO CONTOUR)

0.1 REVISED LINE OF EQUAL APPARENT SPH THICKNESS

BOUNDARY OR PREVIOUS 0.1-FOOT APPARENT SPH THICKNESS CONTOUR

OU-3 BOUNDARY

LIMIT OF AREA PREVIOUSLY ADDRESSED DURING HST CONSTRUCTION

APPROXIMATE EXTENT OF VISUAL HYDROCARBON-IMPACTED SURFACE SOIL

NOTES

IRM - INTERIM REMEDIAL MEASURE
SPH - SEPARATE-PHASE HYDROCARBON
OU-3 - OPERABLE UNIT 3
HST - HIGH SPEED TRAINSET
LIRR - LONG ISLAND RAIL ROAD

40' 0 40'

N

Title:

PRE-DESIGN STUDY SAMPLE LOCATIONS

OU-3 FEASIBILITY STUDY
SUNNYSIDE YARD, QUEENS, NEW YORK

Prepared For: AMTRAK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: RSK	Date: 8/4/2005	PLATE	
Prepared by: JEP	Scale: AS SHOWN	2	
Project Mgr: HG	Office: NY		
File No: AM4516006.WOR	Project: 05545Y07		

EXPLANATION

LOCATION OF EXISTING OU-3 MONITORING WELL THAT DOES NOT CONTAIN MEASURABLE SEPARATE-PHASE PETROLEUM ACCUMULATION

LOCATION OF EXISTING OU-3 MONITORING WELL THAT CONTAINS MEASURABLE SEPARATE-PHASE PETROLEUM ACCUMULATION

LOCATION OF EXISTING OU-3 MONITORING WELL THAT CONTAINS MEASURABLE SEPARATE-PHASE PETROLEUM ACCUMULATION AND PCB IN PRODUCT CONCENTRATION GREATER THAN 25 MG/KG

APPROXIMATE EXTENT OF HISTORIC SEPARATE-PHASE PETROLEUM ACCUMULATION (DASHED WHERE INFERRED)

LOCATION OF PHASE III IRM RECOVERY TRENCH

OU-3 BOUNDARY

MH-4

SEWER LINE (DASHED WHERE INFERRED), WITH MANHOLE DESIGNATION

APPROXIMATE EXTENT OF ACCESS ROAD

NOTES

GRAPHS ARE SHOWN ONLY FOR MONITORING WELLS THAT CONTAINED MEASURABLE QUANTITIES OF SEPARATE-PHASE PRODUCT DURING THE DESIGNATED PREDESIGN STUDY MONITORING PERIOD

SPH - SEPARATE PHASE HYDROCARBON

PCB - POLYCHLORINATED BIPHENYL

MG/KG - MILLIGRAM PER KILOGRAM

OU-3 - OPERABLE UNIT 3

LIRR - LONG ISLAND RAIL ROAD

40' 0 40'

N

SEPARATE-PHASE PETROLEUM MONITORING DATA IN OU-3

OU-3 FEASIBILITY STUDY
SUNNYSIDE YARD, QUEENS, NEW YORK

Prepared For: AMTRAK

ROUX ASSOCIATES INC
Environmental Consulting & Management

PLATE 3