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XCG File #5-997-02-03

December 21, 2004

FINAL

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY FORMER NL INDUSTRIES SITE 3241 WALDEN AVENUE DEPEW, NEW YORK

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GLOSSARY

ARARs	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental Resource Conservation and Liability Act
CLP	Contract Laboratory Program
CFR	Code of Federal Regulations
ECL	Environmental Conservation Law
ELAP	Environmental Laboratory Approval Program
ESA	Environmental Site Assessment
GSL	Geosynthetic Liner
IRIS	Integrated Risk Information System
IRM	Interim Remedial Measures
LDR	Land Disposal Restrictions
MDL	Method Detection Limit
MEP	Multiple Extraction Procedure
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NTUs	Nephelometric Turbidity Units
NYSDEC	New York State Department of Conservation
OSHA	Occupational Safety and Health Administration
PAHs	Polycyclic Aromatic Hydrocarbons
ppm	Parts Per Million
PRP	Potentially Responsible Party
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
6NYCRR	Title 6 of the New York Codes, Rules, and Regulations
SARA	Superfund Amendment and Reauthorization Act
SCGs	Standards, Criteria, and Guidelines
SITE	Superfund Innovative Technology Evaluation
SPLP	Synthetic Precipitation Leaching Procedure
SPT	Standard Penetration Test
STARS1	Spill Technology and Remediation Series Memo #1
SVOCs	Semi-Volatile Organic Compounds

TAGM	Technical Administrative Guidance Document
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TOGS	Technical and Operational Guidance Series
TOV	Total Organic Vapours
USEPA	United States Environmental Protection Agency
UTS	Universal Treatment Standards
VOCs	Volatile Organic Compounds
XRF	X-ray fluorescence

1. *INTRODUCTION*

1.1 *Purpose of Report*

The New York State Department of Environmental Conservation (NYSDEC) is responsible for the enforcement of Article 27, Title 13 of the Environmental Conservation Law (ECL) of the State of New York, entitled "Inactive Hazardous Waste Disposal Sites." An Order on Consent was issued pursuant to NYSDEC's authority under the ECL for the property located at 3241 Walden Avenue in Depew, New York. On July 14, 1999, Norampac Industries, Inc. signed this Order On Consent, which required the development and implementation of an Interim Remedial Measure (IRM) program and Remedial Investigation/Feasibility Study (RI/FS). Norampac Industries, Inc. completed the IRM on July 26, 1999. An IRM closure report was filed and approved by NYSDEC in September 1999. The completion of this RI/FS (with approval by NYSDEC) fulfills the tasks outlined in the Order on Consent.

In September 1999, Norampac, Inc. (Norampac), a member of the Cascades Group, retained XCG Consultants Ltd. (XCG) to carry out the RI/FS of the subject property. Prior to conducting the RI, XCG had completed a number of investigations at the subject property, including a Limited Phase 1 Environmental Site Assessment (ESA) and several Phase 2 ESAs. These studies were initiated in October 1998 at the request of NYSDEC. The NYSDEC concerns were related to historical environmental impacts in the area of a former on-site lagoon and marsh, located at the south end of the central portion of the property. Specific contaminants of concern included metals (e.g. lead, copper, and zinc) and several polycyclic aromatic hydrocarbons (PAHs). The initial subsurface investigation focused on this area while the subsequent testing expanded to cover the other portions of the property.

XCG conducted the previous subsurface investigations in a phased approach, and as such, the extent and types of contamination at the site have been well characterized. Additional field investigations were conducted as part of the RI to fill-in data gaps existing from the previous studies. All data and information gathered by XCG in prior environmental investigations of the site are set out and discussed here.

The RI/FS was completed in accordance with XCG's work plan entitled "Remedial Investigation/Feasibility Study Work Plan, 3241 Walden Avenue, Depew, New York," dated February 11, 2000. This work plan was approved by NYSDEC and, at its request, the findings of the RI and FS were combined into one single report.

The objectives of the RI/FS were as follows:

- Delineate the lateral and vertical extent of contaminants of concern in the soil, and their relative concentrations throughout the subject property;
- Investigate and identify the groundwater quality on the subject property;

- Investigate and identify contaminants, if any, off-site;
- Characterize the site geology and hydrogeology to assist in assessing the fate and migration of the contaminants of concern;
- Conduct a qualitative baseline risk assessment to determine the potential risks at the subject property; and,
- Evaluate various technologies and develop a site-wide remedial management plan.

The RI/FS was conducted using the guidance outlined in the United States Environmental Protection Agency (USEPA) document entitled "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final," dated October 1998. In addition, the selection of remedial actions was carried out in accordance with the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4030 "Selection of Remedial Actions at Inactive Hazardous Waste Sites," dated May 15, 1990. Other USEPA and NYSDEC guidance documents were used in carrying out the RI/FS and are discussed throughout the remainder of this report.

The RIFS was conducted with considerable input from Norampac and the previous property owner, NL Industries Inc. (NL), and its agent, Efficasey Environmental (Efficasey). As part of the FS, various remedial alternatives were developed and evaluated, and in the end, a preferred remedial alternative was agreed upon between Norampac and NL. Comments on the draft version of the RI/FS report (July 5, 2001) from NYSDEC and NL's consultant, Advanced GeoServices Corp. (AGC), were also incorporated into this final report. Additional comments from NYSDEC on the Final Draft version of the report (November 4, 2002) were also incorporated into this final report. The design concept of the preferred remedial alternative was developed by AGC based on discussions between representatives of NL, Norampac, and NYSDEC at a meeting held on July 23, 2002.

1.2 Site Background

1.2.1 Site Description

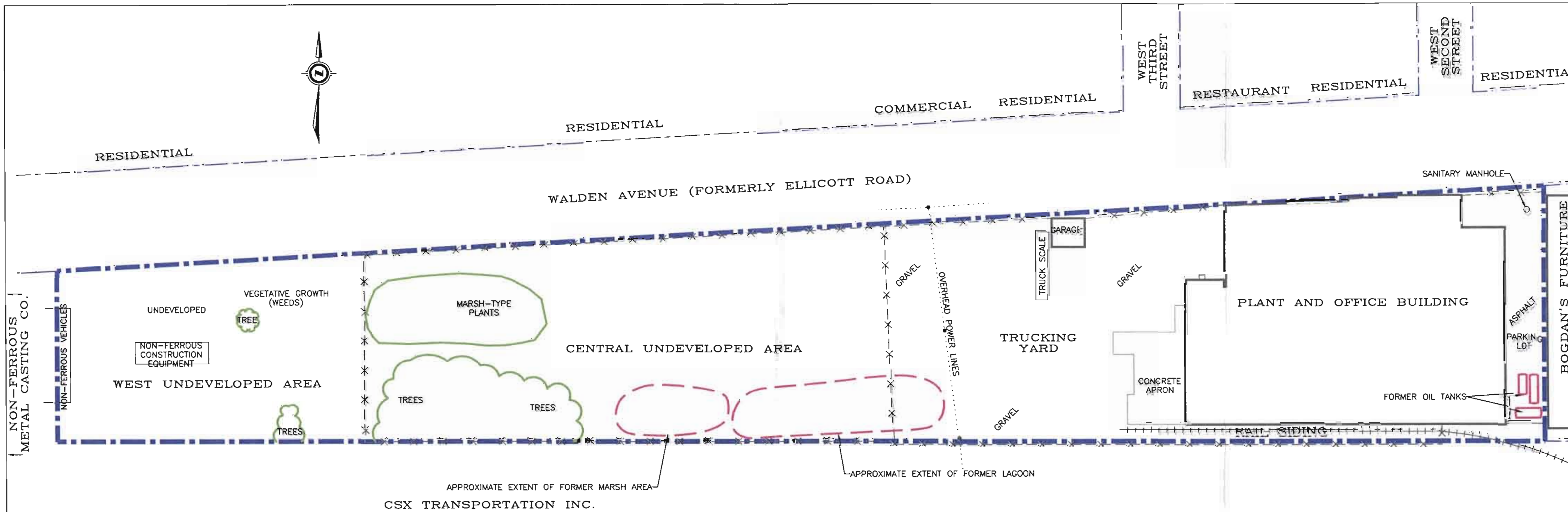
The subject property is located at 3241 Walden Avenue in Depew, New York, which is a suburb to the east of Buffalo. The property is situated on the south side of Walden Avenue, approximately 584.42 feet (178.1 metres) west of the centre line of Transit Road. The property is legally described as Part of Lot 68, Township 11, Range 7 of the Holland Land Company's Survey in the Village of Depew, Town of Cheektowaga, County of Erie.

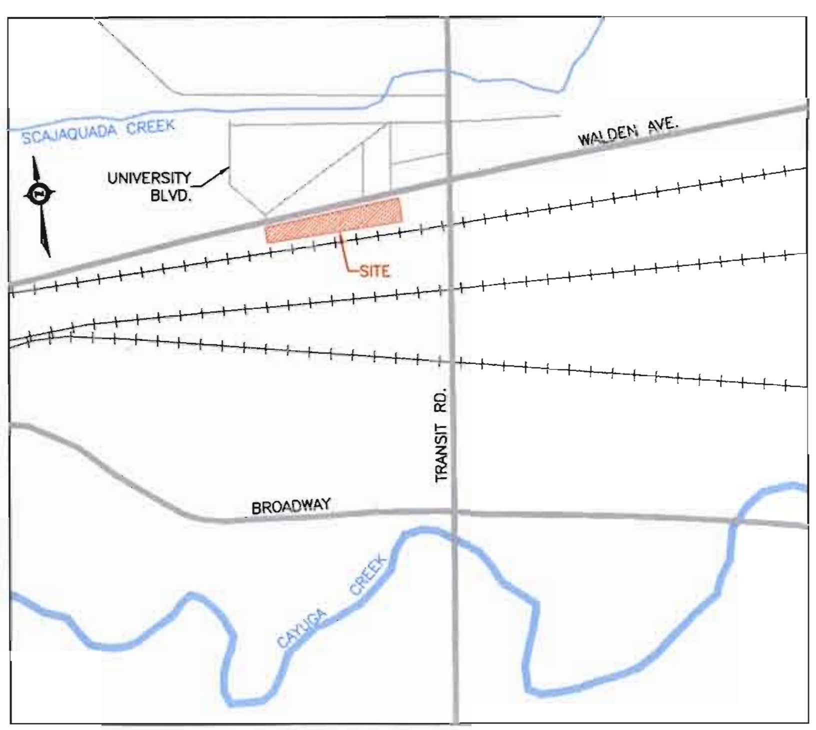
The subject property is approximately 3.04 hectares (7.5 acres) in size. The site is located in a mixed commercial/industrial and residential area. Commercial/ industrial properties adjoin the east and west sides of the subject site. The properties located across the street, on the north side of Walden Avenue, are a mixture of residential and some commercial sites (e.g. restaurant). The south side of the property is bordered by railway tracks, while a concrete mixing plant is situated further to the south. The topography of the subject property and immediate surrounding area has a generally flat grade. The property location and layout are shown on Figure 1. The facility is currently used to operate paper fibre recycling activities, and XCG understands that it will continue to be used for industrial purposes.

The site has one main building located at the east side of the property. The building is estimated to occupy an area of approximately 5,890 m^2 (63,400 ft^2). The east side of the property is paved with asphalt for employee parking. A truck loading/unloading and trailer parking area is located west of the building. The trucking area was surfaced with gravel during the investigations and at the time of the completion of the final draft version of the RIFS report (November 4, 2002), and is surrounded by a chain-link fence. In November 1999, the trucking yard was re-surfaced with new gravel. Norampac indicated that approximately 400 tons of gravel was imported to the site to provide a minimum cover of approximately 3 inches (8 centimetres). In December 2004, Metro Waste paved the trucking yard to provide a better driving surface for the daily trucks that enter the property to load and unload shipments. The existing granular surface was considered a sufficient subbase and was graded prior to installing the asphalt, which consisted of 4.5 inches of binder and 1.5 inches of asphalt topcoat. In addition to the asphalt, a new concrete apron, approximately 6 inches thick, was constructed adjacent to the the west side of the building.

The area west of the fenced-off trucking yard, to the tree-covered area, is described as the central portion of the property, for the purpose of this report. This area is not used for the paper fibre recycling activities and is currently vacant. The former lagoon and marsh area was located at the south side of the central undeveloped area. In July 1999, Norampac implemented an IRM program in the central portion of the property. The IRM consisted of constructing a hydroseeded-topsoil cover and erecting a chain link fence surrounding this area. These interim remedial measures were carried out to eliminate potential direct human exposure with the metals impacted fill, until a final remedial solution was developed.

The area between the central portion of the property and the west property line is defined as the west undeveloped area, for the purpose of this report. The west undeveloped area of the property is also vacant and is not used for on-site operations. This area is covered with imported fill, including construction debris (i.e. brick and large concrete fragments), and is partially occupied by heavy equipment and miscellaneous items stored by the adjacent business to the west.





KEYMAP (not to scale)

LEGEND:

- PROPERTY BOUNDARY
- FENCE

SCALE:

0 20 40 60m

0 100 200 ft.

SITE PLAN		
3241 WALDEN AVE. DEPEW, NEW YORK		
XCG CONSULTANTS LTD.		
DATE	JOB NO.	FIGURE NO.
JUNE 2001	5-997-02-03	1

DRAWING REFERENCE: Based on survey drawing by Norampac, Inc. (Millard & McKay)
NOTE: Locations of buildings, underground utilities, etc. are for reference only and should not be relied upon for detail design, excavation, or construction purposes.

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1.2.2 Site History

The site history was reviewed as part of a Limited Phase 1 ESA conducted by XCG for Norampac. Details of the findings of this study are provided in XCG's report entitled "Limited Phase 1 Environmental Site Assessment, Former N.L. Industries Site, 3241 Walden Avenue, Depew, New York," dated June 11, 1999. The site history is briefly summarized below.

Metro Waste Paper Recovery Inc. (Metro Waste), a member of the Cascades Group, is currently operating paper fibre recycling activities at the subject property. The operations are limited to the east side of the property (i.e. as far west as the fenced-off trucking yard). Paper fibre recycling has been conducted on the site by various companies since 1974.

The subject property was first developed for industrial use in 1892. Past on-site activities have included brass foundry operations conducted between 1892 and 1972 (i.e. 80 years), smelting operations carried out in the early part of the century, and the processing of babbitt. These operations were performed by various companies, beginning with Buffalo Brass Company (Buffalo Brass) at the east side of the property. Magnus Metal Corporation (Magnus) acquired this portion of the subject property from Buffalo Brass in 1899 and continued the brass foundry operations until 1936. During the early 1900s, Empire Smelting Company conducted operations in the area of the current trucking yard. National Lead Company acquired the entire property from Magnus in 1936 and continued the brass foundry operations until 1972, when it vacated the site. The name Magnus remained with the company, and was called Magnus Metal, a Division of National Lead Company. National Lead Company eventually changed its name to NL Industries Inc.

Brass is an alloy of copper and zinc, and babbitt is formed from an alloy of various metals including lead and copper. In addition, antimony is a metallurgical component of babbitt. Although not considered as one of the metals of concern in previous site investigations leading up to this RI/FS, future investigations such as treatability tests will include antimony. Waste produced by these operations, including the dredged material from the former settling lagoon, was apparently spread throughout the property. Waste foundry sands were also potentially disposed of on-site. These historical activities explain the elevated levels of lead, zinc, and copper detected in the fill material.

Historical features of the subject property such as the former lagoon, former reclamation building, former tanks, and interior layout of the building is presented in Figure 2.

1.2.3 Previous Investigations

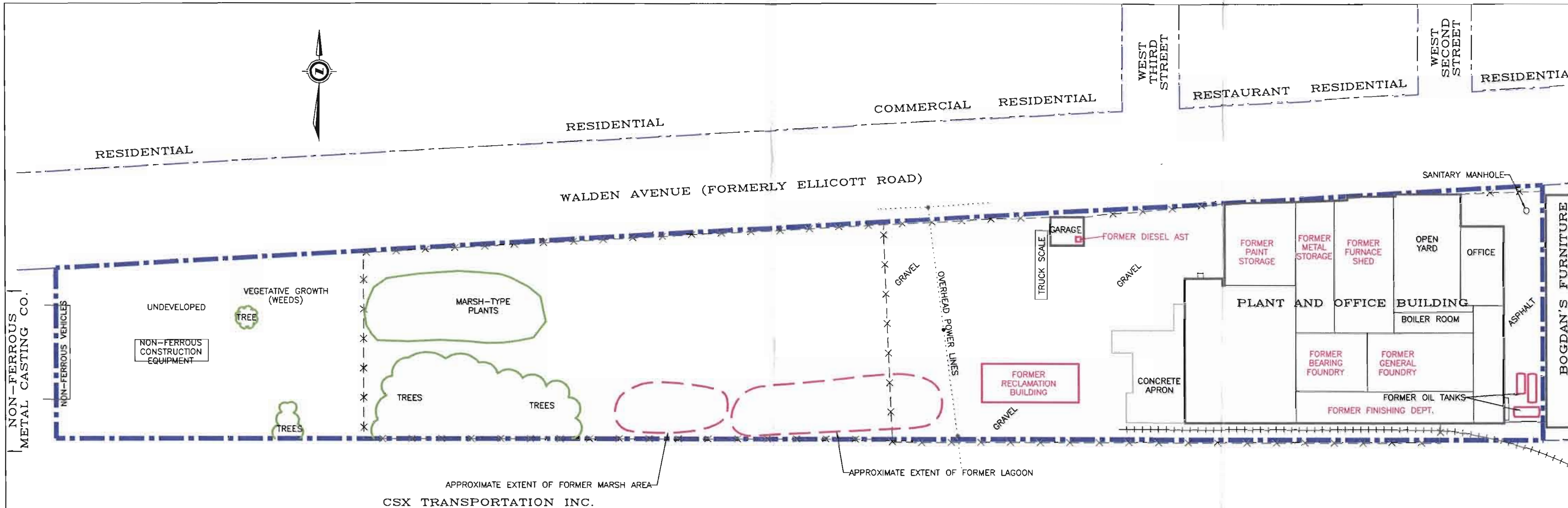
Prior to completing this RI/FS, a number of investigations have been conducted on the subject property since the mid-1980s. These studies are briefly summarized below.

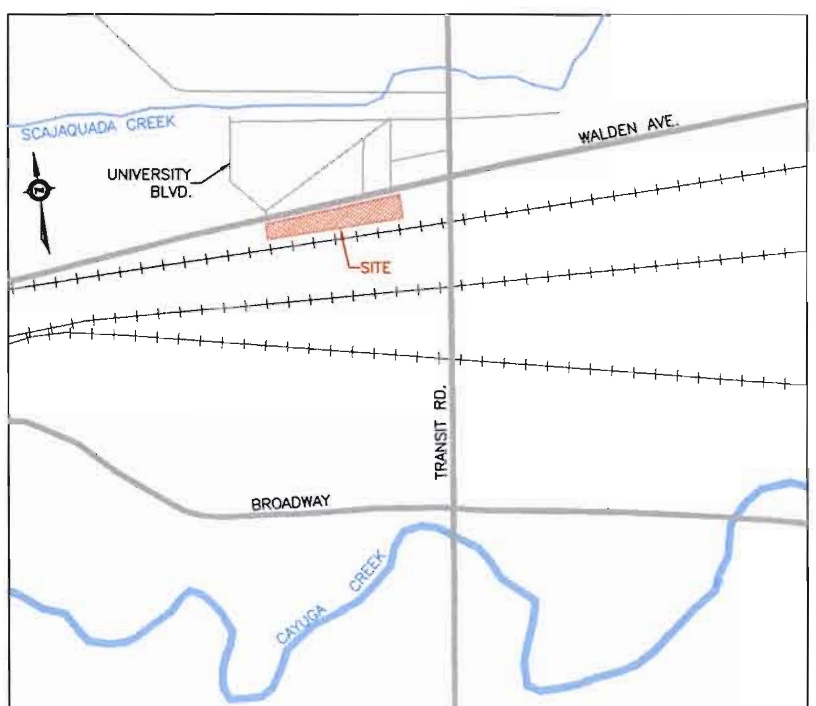
NUS Corporation (NUS) conducted the first environmental investigation of the subject property for the USEPA. NUS completed an off-site reconnaissance of the property in early 1986 and prepared a report entitled "Potential Hazardous Waste Site Preliminary Assessment, N.L. Industries, Inc., 3241 Walden Avenue, Depew, NY, EPA Site ID Number NYD980531636." On March 31, 1987, NUS conducted a site inspection, on behalf of the USEPA, and collected 3 sediment and 4 soil samples for laboratory analyses. Elevated concentrations of several polycyclic aromatic hydrocarbons (PAHs) and metals (e.g. lead, copper, and zinc) were detected in the surficial soils. The results of this investigation are summarized in the NUS report entitled "Site Inspection Report, N.L. Industries/Buffalo Plant, Depew, New York," dated July 29, 1988.

In early 1998, NYSDEC approached Norampac regarding the elevated PAHs and metals detected at the subject property in 1987, and requested that Norampac carry out a subsurface investigation. Since that time, XCG has completed a number of subsurface investigations, in addition to the aforementioned Limited Phase 1 ESA. These investigations are summarized as follows:

- "Draft, Limited Phase 2 Environmental Site Assessment, 3241 Walden Avenue, Depew, New York," February 10, 1999;
- "Draft, Limited Phase 2 Environmental Site Assessment, Former Oil Tanks Area, 3241 Walden Avenue, Depew, New York," February 10, 1999;
- "Draft, Additional Phase 2 Environmental Site Assessment, 3241 Walden Avenue, Depew, New York," May 18, 1999; and,
- "Draft, Off-Site Surficial Soil Investigation, 3241 Walden Avenue, Depew, New York," July 26, 1999.

Copies of these documents have been submitted to the NYSDEC. In addition to the above investigations, XCG conducted additional surficial sampling in June 1999, primarily at the west undeveloped area with some sampling at the central undeveloped area and trucking yard; however, the analytical results of these samples were not summarized in a report. The findings of these investigations are described in Section 4.





KEYMAP (not to scale)

LEGEND:

PROPERTY BOUNDARY

— X — — X — FENCE

SCALE:

0 20 40 60m

0 100 200 ft.

DRAWING REFERENCE: Based on survey drawing by Norampac, Inc. (Millard & McKay)
NOTE: Locations of buildings, underground utilities, etc. are for reference only and should not be relied upon for detail design, excavation, or construction purposes.

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HISTORICAL SITE PLAN

3241 WALDEN AVE.
DEPEW, NEW YORK

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DATE	JOB NO.	FIGURE NO.
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1.3 Report Organization

This report is divided into ten sections. Sections 1 to 5 comprise the introduction and the RI portion of the report. The FS part of the report is presented in Sections 6 to 8. A brief overview of these sections is discussed below.

Section 1 has been presented above and provides a background of this study, objectives of the RI/FS, and a description of the subject property. In addition, a brief history of operations conducted on the property and investigations completed prior to carrying out the RI/FS was discussed.

Section 2 describes the methodology and field activities implemented to characterize the site, including surface features, geology, site-specific soil and groundwater conditions, and contaminants distribution. The results of the physical site features investigations are provided in Section 3.

Section 4 describes the nature and extent of contamination on the subject property. This section presents the contaminants distribution in various media including soil and groundwater.

Section 5 presents a qualitative baseline risk assessment, including the identification of contaminants of concern, potential routes of exposure, and factors affecting the migration to the most sensitive receptors.

The FS portion of the report begins in Section 6. In this section, a description is provided for remedial action objectives, general response actions, and identification and screening of technology types and process options. Section 7 presents the development and preliminary screening of alternatives. The alternatives that pass the preliminary screening are then evaluated in detail and presented in Section 8.

Section 9 presents a summary of conclusions and limitations to this report. References used in carrying out the RI/FS are provided in Section 10.

2. STUDY AREA INVESTIGATION

This section provides a summary of the investigation and field methods used in the RI and during previous studies to characterize the physical and chemical features on the property. The findings were used to define potential contaminant transport pathways and receptors, and to support the development and screening of remedial alternatives. The results of the physical features are discussed in Section 3 while the extent of contamination is described in Section 4.

2.1 Surface Features

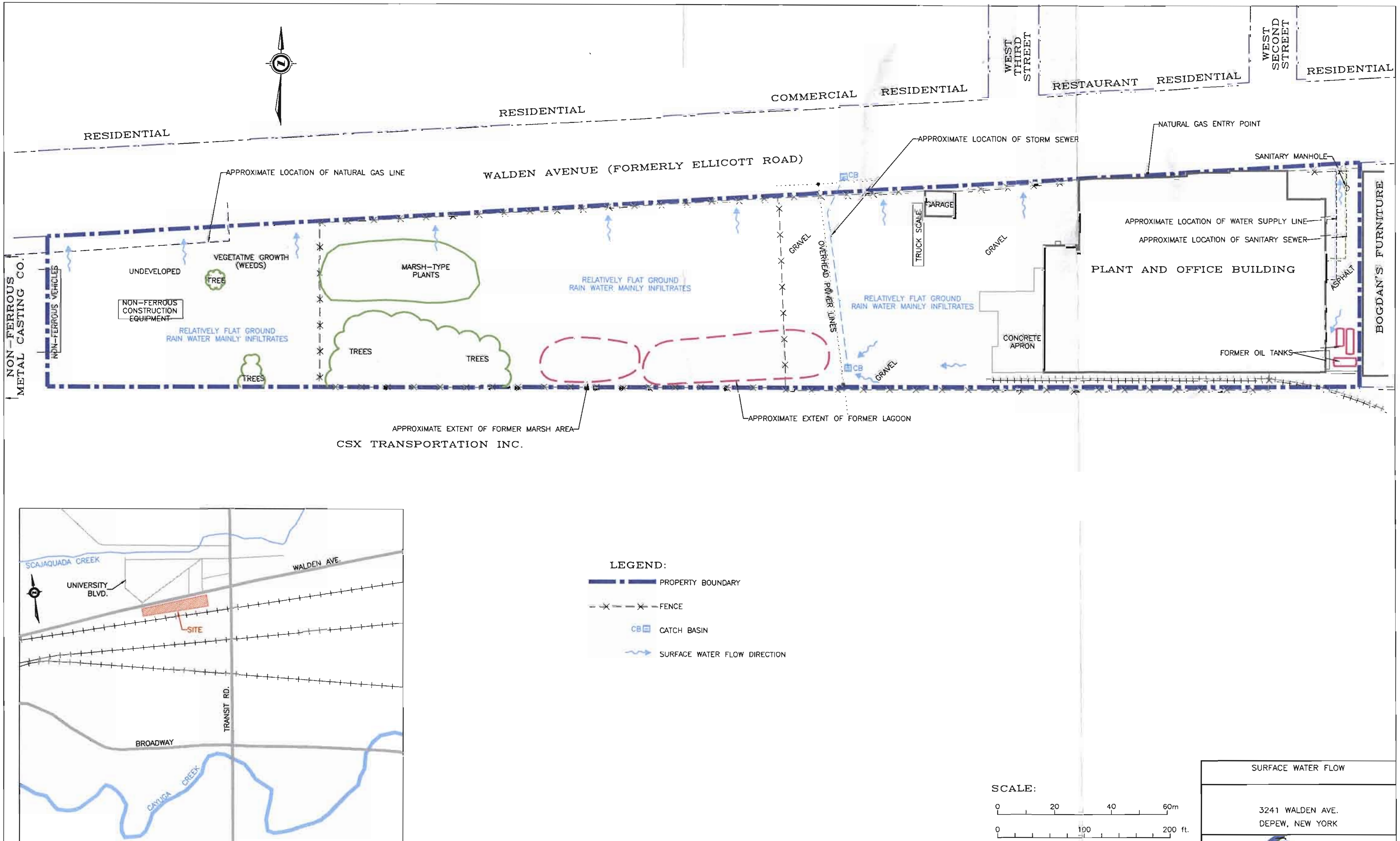
An assessment of the surface features was carried out to identify potential migration routes and possible end receptors that may be affected by the contaminants present on-site. These surface features included facility dimensions (e.g. building, tanks, etc.), aboveground and underground utilities, locations of fences, drainage ditches, surface water bodies, topography, and vegetation. In addition to on-site characteristics, off-site features such as locations of neighboring residences that could be affected or commercial/industrial properties that may have contributed to contamination on the subject property are identified.

The assessment of current surface features was primarily conducted from site reconnaissance. Supporting information was obtained from a 7.5 x 15 minute quadrangle topographic map produced by the U.S. Geological Survey (Lancaster, 1982). Any historical changes to the land features were determined by examining historical aerial photographs (1942, 1951, 1966, 1978, 1985, and 1990), Sanborn Fire Insurance Maps (1893, 1900, 1905, 1911, 1923, 1949, and 1959), and other historical plans obtained from the site. Figure 3 presents surface features and surface water flow patterns.

2.2 Geological Investigations

The geology of the site and surrounding area was assessed to identify features that could influence the fate and transport of the contaminants of concern. The geology of unconsolidated overburden soil and bedrock controls the depths and extent of water-bearing units or aquifers, and the movement of contaminants through these media. The geology of the site is also considered when evaluating potential in-situ and ex-situ remedial options.

The regional geology was determined by reviewing published soil maps at the Buffalo & Erie County Public Library. The information was obtained from a document prepared by the United States Department of Agriculture entitled "Soil Survey of Erie County, New York," dated December 1986. Site-specific geology was determined from the various borehole drilling programs implemented on the subject property.



KEYMAP (not to scale)

LEGEND:

- PROPERTY BOUNDARY
- FENCE
- CB CATCH BASIN
- SURFACE WATER FLOW DIRECTION

SCALE:

0 20 40 60m

0 100 200 ft.

DRAWING REFERENCE: Based on survey drawing by Norampac, Inc. (Millard & McKay)
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SURFACE WATER FLOW

3241 WALDEN AVE.
DEPEW, NEW YORK

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2.3 Soil Investigations

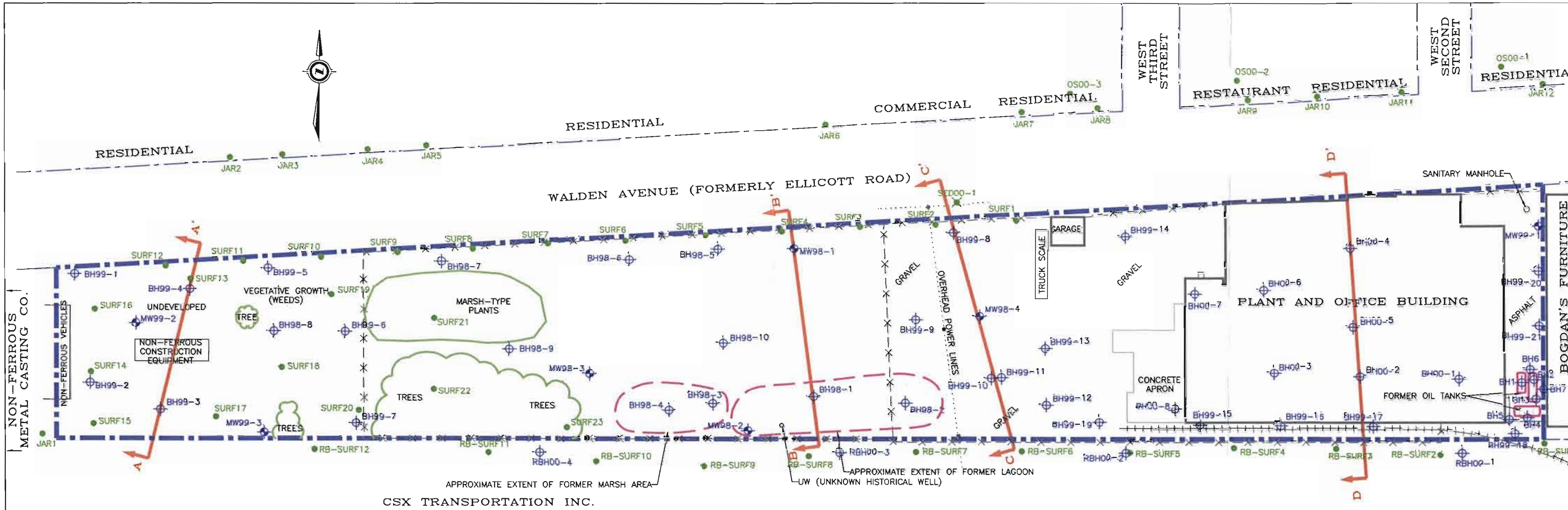
As noted above in Section 2.2, the site-specific geology was determined by carrying out an extensive borehole drilling and surficial sampling program. These investigations were implemented over several stages between 1998 and 2000, the last of which was completed as part of the RI. The initial subsurface investigations were carried out between October and December 1998. An additional subsurface investigation, which also included surficial soil sampling, was completed in April 1999. Further surficial soil sampling was conducted in June 1999. The last round of soil investigations was initiated in May 2000, and due to difficulties in obtaining access to residential properties, the program was completed in August 2000. The boreholes were placed at relatively even spaced locations at each investigated area, in order to properly define the site-specific geology and to delineate the extent of metals and residual petroleum impacts. A summary of all surface and subsurface soil investigations is provided as follows:

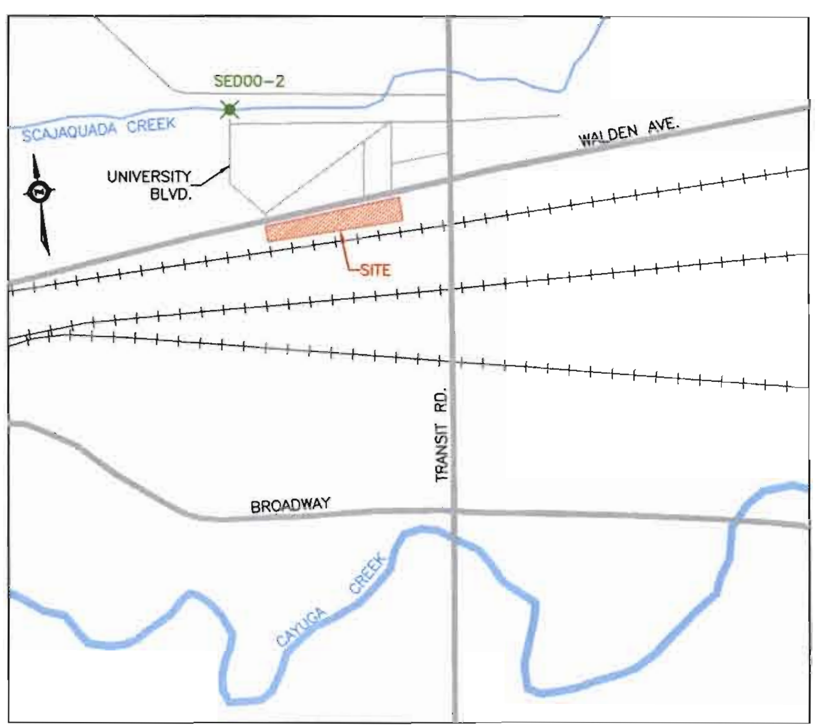
- Drilling 53 shallow and deeper boreholes over the entire subject property;
- Drilling 4 shallow boreholes on the off-site railway line to the south;
- Collecting surficial soil samples at 28 on-site locations;
- Collecting surficial soil samples from 27 off-site locations; and,
- Collecting 2 additional off-site soil samples from the catch basin on Walden Avenue in front of the subject property, and from the edge of Scajaquada Creek, where the storm sewere outfall is located.

Deeper boreholes, some of which were completed as monitoring wells, were installed using a truck-mounted CME-75 and an Acker Soilmax drilling rig. XCG subcontracted the drilling operations to Maxim Technologies, Inc. (Maxim) of Hamburg, New York. The drilling activities were completed under the full-time supervision of XCG personnel. The boreholes and surface sampling locations are shown on Figure 4, while the borehole logs are provided in Appendix A.

The shallow boreholes were advanced using a direct-push drilling rig (Geoprobe). XCG also retained Maxim to carry out these shallow drilling activities.

Borehole drilling with the truck-mounted drilling rigs was conducted with hollow-stem augers. Soil sampling was generally performed at continuous 2 feet (0.6 metre) intervals to a depth of at least 8 feet (2.4 metres) below ground surface. Beyond this depth, the soil samples were obtained less frequently as the boreholes had advanced beyond the fill material and native silty clay contact.





KEYMAP (not to scale)

LEGEND:

- PROPERTY BOUNDARY
- FENCE
- MW98-4 APPROXIMATE EXISTING MONITORING WELL LOCATION
- BH98-4 APPROXIMATE EXISTING BOREHOLE LOCATION
- SURF12 SURFACE GRAB SAMPLE LOCATION
- SED00-2 SEWER SEDIMENT SAMPLE
- A A' CROSS-SECTION LOCATION

SCALE:

0 20 40 60m

0 100 200 ft.

DRAWING REFERENCE: Based on survey drawing by Norampac, Inc. (Millard & McKay)
NOTE: Locations of buildings, underground utilities, etc. are for reference only and should not be relied upon for detail design, excavation, or construction purposes.

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BOREHOLE, MONITORING WELL, AND SURFACE SAMPLING LOCATIONS

3241 WALDEN AVE.
DEPEW, NEW YORK

XCG CONSULTANTS LTD.

DATE	JOB NO.	FIGURE NO.
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2-5

In this report, fill material is defined as the surficial soils overlying the native clay, and includes sand, gravel, silty sand and sandy silt. Further, fill material that has been contaminated with metals is referred to as metals-impacted fill, while soil containing mild hydrocarbon odours or residual concentrations is defined as hydrocarbon-impacted fill. This is discussed further in Section 3.3.

A 2 foot (0.6 metre) long, 2 inch (5 centimetre) diameter, stainless steel split-spoon sampler was used to collect the soil samples. A standard penetration test (SPT) was performed during the collection of each sample. The boreholes drilled with the truck-mounted rigs were advanced to depths ranging between approximately 8 to 26 feet (2.4 to 7.9 metres) below ground surface. For boreholes that were not completed as monitoring wells, the drilling was terminated just past the fill material and native silty clay interface, to minimize the potential vertical migration pathway.

Soil sampling with the Geoprobe was performed continuously with a 4 foot (1.2 metre) long, 2 inch (5 centimetre) diameter, stainless steel cylindrical sampler. The sampler's interior was lined with a plastic sleeve for soil collection. The Geoprobe boreholes were advanced to depths just beyond the fill material and native silty clay interface, to minimize the potential vertical migration pathway. These depths ranged from approximately 2 to 11.5 feet (0.6 to 3.5 metres) below grade.

Surface grab samples were collected manually. A stainless steel shovel was used to excavate a small hole at ground surface. The soil samples were then collected from the wall of the hole with a stainless steel trowel at a depth of 0 to 2 inches (0 to 5 centimetres).

Hollow-stem augers were decontaminated between borehole locations to prevent cross-contamination, and where required, a steam cleaner was used to assist in removing soil cuttings adhered to the augers. Further, the split-spoon samplers, Geoprobe sampler, shovel, and trowel were decontaminated between each sampling point with clean distilled water and detergent. A new plastic sleeve was used for each Geoprobe sampling point to further prevent cross-contamination.

Soil samples (i.e. fill material and silty clay) were visually classified and logged for stratigraphy, soil structure, and evidence of contamination. All soil samples were placed in labelled plastic sample bags. Headspace vapours in the sample bags were screened for TOV readings using a field photoionization detector (i.e. HNu meter). TOV readings in parts per million (ppm) for each soil sample are included in the borehole logs.

2.4 Groundwater Investigations

Groundwater investigations were conducted to determine the hydrogeology of the site. The depths to the shallow water-bearing zone and any perched lenses were identified. The purpose of this investigation was to determine if the groundwater has been impacted by contaminants situated in the fill material and to estimate the flow direction. The groundwater investigations were conducted in conjunction with the soil investigations. This consisted of the installation and sampling of 7 monitoring wells in the deeper boreholes advanced with the truck-mounted drilling rigs.

Monitoring well locations are shown on Figure 4 and construction details are presented on the borehole logs. In general, the monitoring wells were constructed with 2 inch (50 millimetre) diameter Schedule 40 PVC pipe. In MW99-1, the bottom 5 feet (1.5 metres) were screened with #10 slot PVC screen. A 10 foot (3.0 metre) screen was used for the remaining monitoring wells. The annulus between the borehole wall and screen was filled with #1 quartz sand to a depth of approximately 2 feet (0.6 metres) above the top of the screen. A 2 to 3 foot (0.6 to 0.9 metre) thick bentonite seal was placed above the sand. The remaining annular space was backfilled with hand-mixed concrete. A steel flush-mount protective casing was constructed at ground surface for MW98-1, MW98-4, MW99-1 and MW99-2 while a steel stick-up protective casing was used for MW98-2, MW98-3, and MW99-3. A J-plug and lock were provided for the monitoring wells equipped with flush-mount protective casings. The stick-up protective casing was locked on the outside of the casing.

Prior to groundwater sampling, the water levels in each new monitoring well were measured using an electronic water level tape. To prevent cross-contamination, the water level tape was cleaned with detergent and distilled water after each measurement. The new monitoring wells were then developed to:

- Remove fine material from the sand pack and create a good filter area around the well screen; and
- Ensure that a representative groundwater sample was obtained.

Monitoring well development was completed with dedicated WaTerra inertial lift tubing to prevent cross-contamination. The WaTerra system consists of a polyethylene foot valve installed in each well and connected to the surface with polyethylene tubing. Each monitoring well was developed by surging and purging the water in the well, using the dedicated WaTerra tubing. Three well volumes are typically removed during the well development process (a well volume is the amount of standing water in the pipe and surrounding sand backfill). However, due to the slow recovery, the wells were purged dry three times each before sampling.

In addition to the 7 monitoring wells installed by XCG, a historical well was located at the south side of the former lagoon. This well was constructed of steel. It was approximately 5 inches (13 centimetres) in diameter and was terminated at the south side wall of the former lagoon, approximately 3.7 feet (1.1 metres) below ground surface. Norampac staff was unaware of when the well was installed and who installed it. This well has been removed since XCG's initial investigation. A sample of the perched groundwater in the former lagoon was collected from this well and was identified as UW.

In order to obtain representative samples, a dedicated disposal bailer was used to collect the groundwater samples after well development, as this method minimized the agitation in the well. The goal was to reduce the turbidity in the sample. In accordance with the NYSDEC TAGM 4015 document entitled "Alteration of Groundwater Samples Collected for Metals," dated September 30, 1988, the groundwater samples were not field filtered and were immediately preserved with nitric acid (pH<2). In addition, TAGM 4015 indicates that the groundwater turbidity should be less than 50 nephelometric turbidity units (NTUs) during sampling.

A field water quality instrument was used to measure the changes in pH and turbidity in the groundwater during well development and at the time of sample collection. A Horiba Model U-10 Water Quality Checker was used for this purpose. The pH and turbidity readings are summarized in Table 1. The high turbidity readings during well development were likely a result of using WaTerra tubing, which causes a significant amount of agitation. As mentioned previously, a disposal bailer was used during sampling to minimize the amount of agitation. The results in Table 1 show a significant reduction in the turbidity at the time of sampling. XCG made its best efforts to reduce the turbidity to less than 50 NTUs; however, it was measured slightly above 50 NTUs on a few occasions. This is likely a result of the shallow groundwater-bearing zone existing in a silty clay stratum.

TABLE 1
GROUNDWATER pH AND TURBIDITY MEASUREMENTS

WELL #	DATE	PH DURING WELL DEVELOPMENT	PH AT SAMPLING	TURBIDITY DURING WELL DEVELOPMENT (NTUS)	TURBIDITY AT SAMPLING (NTUS)
MW99-1	April 14-15, 99	7.51-8.15	7.78	>800	45
MW99-2	April 14-15, 99	7.19-8.02	7.19	>800	73
MW99-3	April 14-15, 99	7.43-8.11	7.40	>800	30
MW99-1	May 10-11, 00	7.78	*	779	*
MW99-2	May 10-11, 00	6.87-7.19	7.27	>800	40
MW99-3	May 10-11, 00	6.63-7.50	7.49	>800	74
MW98-1	May 10-11, 00	7.69-7.76	7.9	151-289	11
MW98-2	May 10-11, 00	7.62-7.92	7.65	51-188	6
MW98-3	May 10-11, 00	7.42-7.67	7.75	358-467	100
MW98-4	May 10-11, 00	7.9-8.08	7.84	>800	31

NOTES:

* No readings since sampling conducted in the dark

2.5 Contaminants Investigations

XCG carried out an extensive soil and groundwater analytical testing program to delineate the extent of metals and hydrocarbon impacts on the subject property. The investigations were conducted in a phased approach to obtain a greater insight of the subsurface environmental conditions with each step, which was used to develop the scope of work for subsequent sampling. Soil samples submitted for laboratory analyses were collected from relatively equal spaced locations throughout the entire subject property to determine the lateral distribution of soil contamination. Soil samples were also collected from off-site properties.

The vertical extent of contamination was determined by analytical testing in both the fill material and native silty clay. Fill material samples from the boreholes were comprised of a composite of the full length of soil recovered in the stainless-steel sampler. Surficial samples were collected from a more discrete point on the top of the fill material (i.e. 0 to 2 inches). The native silty clay samples submitted for laboratory analyses ranged from just below the contact with the fill material to deeper locations.

The total on-site and off-site analytical program conducted by XCG between 1998 and 2000 is briefly summarized as follows:

- Laboratory analyses of 134 soil samples for metals, from both the fill material and native silty clay;
- Laboratory analyses of 14 soil samples from the fill material for Total Characteristic Leachate Procedure (TCLP) metals;
- Laboratory analyses of 24 soil samples, from both the fill material and silty clay, for polycyclic aromatic hydrocarbons (PAHs);
- Laboratory analyses of 18 soil samples, from both the fill material and silty clay, for volatile organic compounds (VOCs);
- Laboratory analyses of 1 fill material soil sample for PCBs;
- Laboratory analyses of 1 stagnant surface water sample for metals, PAHs, and anions;
- Laboratory analyses of 18 groundwater samples for metals;
- Laboratory analyses of 5 groundwater samples for PAHs;
- Laboratory analyses of 6 groundwater samples for VOCs;
- Laboratory analyses of 4 groundwater samples for semi-VOCs;
- Laboratory analyses of 4 groundwater samples for pesticides and PCBs; and,

- Laboratory analyses of 5 groundwater samples for anions.

Selection of soil samples from the fill material for laboratory analyses was based on visual and olfactory evidence, sample depth, and TOV measurements in an effort to identify "worst case" samples (i.e. fill material). Analyses of the silty clay samples were obtained from varying depths to determine the vertical distribution of metals. In addition, the analytical results of total metals in the fill material were used to determine which samples to analyze for TCLP metals, in order to provide a range of leachate results (i.e. TCLP analyses for low to high concentrations of total lead). The analytical program of all soil and groundwater samples is summarized in Table 2.

The selected soil samples were stored in sample laboratory-prepared glass jars with teflon-lined lids. The samples were placed in coolers (containing ice/cooler packs) and picked-up by Philip Analytical Services Corp. (PASC) of Burlington, Ontario, within approximately 24 to 48 hours of sample collection. Chain-of-custody forms were completed and maintained to ensure proper handling. PASC's Burlington laboratory is certified with the New York State Department of Health (ELAP Certification, ID#10756). The first two rounds of groundwater samples were also analyzed by PASC. As requested by NYSDEC, the third round of groundwater sampling, which was conducted as part of the RI, was analyzed by a laboratory that was both Contract Laboratory Program (CLP) and Environmental Laboratory Approval Program (ELAP) certified. XCG retained Ecology and Environment, Inc. (ELAP ID#10486) of Lancaster, New York to carry out this testing.

TABLE 2
SUMMARY OF SOIL AND GROUNDWATER SAMPLING PROGRAM

LOCATION	DEPTH		SOIL TYPE	PARAMETERS	
	(METRES)	(FEET)		SOIL	GROUNDWATER
West Undeveloped Area					
BH98-8	0-0.6	0-2	fill material	Metals	N/A
MW99-2	N/A	N/A	N/A	N/A	2 Metals, VOCs, semi-VOCs, PCBs, pesticides
MW99-3	N/A	N/A	N/A	N/A	2 Metals
BH99-1	0-0.9	0-3	fill material	Metals, TCLP metals	N/A
BH99-1	1.2-1.8	4-6	silty clay	Metals	N/A
BH99-2	0-1.1	0-3.5	fill material	Metals	N/A
BH99-3	0-1.2	0-4	fill material	Metals, TCLP metals	N/A
BH99-3	1.2-1.8	4-6	silty clay	Metals	N/A
BH99-4	0-0.9	0-3	fill material	Metals	N/A
BH99-4	0.9-1.2	3-4	silty clay	Metals	N/A

TABLE 2
SUMMARY OF SOIL AND GROUNDWATER SAMPLING PROGRAM

LOCATION	DEPTH		SOIL TYPE	PARAMETERS	
	(METRES)	(FEET)		SOIL	GROUNDWATER
BH99-6	0-0.9	0-3	fill material	Metals, TCLP metals	N/A
BH99-7	0-0.9	0-3	fill material	Metals, TCLP metals	N/A
BW1 (BH99-7 dup)	0-0.9	0-3	fill material	Metals	N/A
BH99-7	0.9-1.2	3-4	silty clay	Metals	N/A
SURF10	0-0.05	0-0.17	fill material	Metals	N/A
SURF11	0-0.05	0-0.17	fill material	Metals	N/A
SURF12	0-0.05	0-0.17	fill material	Metals	N/A
SURF13	0-0.05	0-0.17	fill material	Metals	N/A
SURF14	0-0.05	0-0.17	fill material	Metals	N/A
SURF15	0-0.05	0-0.17	fill material	Metals	N/A
SURF16	0-0.05	0-0.17	fill material	Metals	N/A
SURF17	0-0.05	0-0.17	fill material	Metals	N/A
SURF18	0-0.05	0-0.17	fill material	Metals	N/A
SURF19	0-0.05	0-0.17	fill material	Metals	N/A
SURF20	0-0.05	0-0.17	fill material	Metals	N/A
Central Undeveloped Area					
MW98-1	0-0.6	0-2	fill material	Metals, TCLP metals	2 Metals, PAHs, anions
MW98-1	2.4-3.0	8-10	Silty clay	Metals	N/A
MW98-2	0.6-1.2	2-4	fill material	Metals, TCLP metals, PAHs	2 Metals, 2 VOCs, semi-VOCs, PAHs, PCBs, pesticides, anions
MWBW00-1 (MW98-2 dup)	N/A	N/A	N/A	N/A	Metals, VOCs, semi-VOCs, PCBs, pesticides
MW98-2	1.8-2.4	6-8	Silty clay	Metals	N/A
MW98-3	0-0.6	0-2	fill material	Metals, TCLP metals	2 Metals, PAHs, anions
MW98-3	4.3-4.9	14-16	Silty clay	Metals	N/A
BH98-1	1.8-2.4	6-8	fill material	Metals, TCLP metals, VOCs, PAHs	N/A
BH98-1	3.0-3.6	10-12	Silty clay	Metals	N/A
BH98-3	0.6-1.2	2-4	fill material	Metals, PAHs	N/A
BH98-3	1.8-2.4	6-8	Silty clay	Metals	N/A
BH98-4	0.6-1.2	2-4	fill material	Metals, PAHs	N/A

TABLE 2
SUMMARY OF SOIL AND GROUNDWATER SAMPLING PROGRAM

LOCATION	DEPTH		SOIL TYPE	PARAMETERS	
	(METRES)	(FEET)		SOIL	GROUNDWATER
BH98-5	0-0.6	0-2	fill material	Metals	N/A
BH98-6	0-0.6	0-2	fill material	Metals	N/A
BH98-7	0-0.15	0-0.5	fill material	Metals	N/A
BH98-9	0-0.9	0-3	fill material	Metals	N/A
BH98-10	0-0.6	0-2	fill material	Metals	N/A
SURF3	0-0.05	0-0.17	fill material	Metals	N/A
SURF4	0-0.05	0-0.17	fill material	Metals	N/A
BW3 (SURF 4 dup)	0-0.05	0-0.17	fill material	Metals	N/A
SURF5	0-0.05	0-0.17	fill material	Metals	N/A
SURF6	0-0.05	0-0.17	fill material	Metals	N/A
SURF7	0-0.05	0-0.17	fill material	Metals	N/A
SURF8	0-0.05	0-0.17	fill material	Metals	N/A
SURF9	0-0.05	0-0.17	fill material	Metals	N/A
SURF21	0-0.05	0-0.17	fill material	Metals	N/A
SURF22	0-0.05	0-0.17	fill material	Metals	N/A
SURF23	0-0.05	0-0.17	fill material	Metals	N/A
BERM1	0-0.05	0-0.17	fill material	Metals	N/A
BERM2	0-0.05	0-0.17	fill material	Metals	N/A
BERM3	0-0.05	0-0.17	fill material	Metals	N/A
UW	N/A	N/A	N/A	N/A	Metals, VOCs, PAHs, anions
Surface Water	N/A	N/A	N/A	N/A	Metals
Trucking Yard					
MW98-4	N/A	N/A	N/A	N/A	2 Metals, VOCs, semi-VOCs, PCBs, pesticides, anions
BH98-2	1.2-1.8	4-6	fill material	Metals, PAHs	N/A
BH98-2	2.4-3.0	8-10	fill material	Metals, PAHs	N/A
BH98-2	3.7-4.3	12-14	Silty clay	Metals	N/A
BW2 (BH98-2 dup)	3.7-4.3	12-14	Silty clay	Metals	N/A
BH99-8	0-1.2	0-4	fill material	Metals, TCLP metals	N/A
BH99-8	1.5-2.4	5-8	silty clay	Metals	N/A
BH99-9	0-1.2	0-4	fill material	Metals	N/A
BW2 (BH99-9 dup)	0-1.2	0-4	fill material	Metals	N/A
BH99-9	2.1-2.4	7-8	silty clay	Metals	N/A
BH99-10	0-0.9	0-3	fill material	Metals, TCLP metals, VOCs, PAHs	N/A

TABLE 2
SUMMARY OF SOIL AND GROUNDWATER SAMPLING PROGRAM

LOCATION	DEPTH (METRES)	DEPTH (FEET)	SOIL TYPE	PARAMETERS SOIL	PARAMETERS GROUNDWATER
BH99-11	1.2-1.8	4-6	silty clay	Metals	N/A
BH99-13	0-0.6	0-2	fill material	Metals	N/A
BH99-14	0-0.6	0-2	fill material	Metals, TCLP metals	N/A
BH99-19	0-1.2	0-4	fill material	Metals, VOCs, PAHs	N/A
BH99-19	1.2-2.4	4-8	silty clay	Metals	N/A
SURF1	0-0.05	0-0.17	fill material	Metals	N/A
SURF2	0-0.05	0-0.17	fill material	Metals	N/A
BH00-8	0.6-0.9	2.0-3.0	fill material	Metals	N/A
Rail Siding					
BH99-15	0-1.2	0-4	fill	Metals, VOCs, PAHs	N/A
BH99-15	1.2-2.1	4-7	silty clay	Metals	N/A
BH99-17	0-1.2	0-4	fill material	Metals, TCLP metals, VOCs, PAHs	N/A
BH99-17	1.2-1.8	4-6	silty clay	Metals	N/A
BH99-18	0-1.2	0-4	fill material	Metals, TCLP metals, VOCs, PAHs	N/A
BH99-18	1.2-1.8	4-8	silty clay	Metals	N/A
Parking Lot					
BH1	0-1.2	0-4	fill material	Metals, VOCs, PAHs	N/A
BH3	1.2-2.4	4-8	fill material	Metals, VOCs, PAHs	N/A
BH4	0-0.75	0-2.5	fill material	Metals, VOCs, PAHs	N/A
BH5	0-0.75	0-2.5	fill material	Metals, VOCs, PAHs, PCBs	N/A
BW1 (BH5 dup)	0-0.75	0-2.5	fill material	PAHs	N/A
BH6	1.2-1.8	4-6	Silty clay	Metals, VOCs, PAHs	N/A
BH99-20	0-0.9	0-3	fill material	Metals	N/A
BH99-20	0.9-1.2	3-4	silty clay	Metals	N/A
BH99-21	0-0.8	0-2.5	fill material	Metals, TCLP metals	N/A
BH99-21	0.8-1.2	2.5-4	silty clay	Metals	N/A
MW99-1	N/A	N/A	N/A	N/A	2 Metals

TABLE 2
SUMMARY OF SOIL AND GROUNDWATER SAMPLING PROGRAM

LOCATION	DEPTH		SOIL TYPE	PARAMETERS	
	(METRES)	(FEET)		SOIL	GROUNDWATER
BW4 (MW99-1 dup)	N/A	N/A	N/A	N/A	Metals
Building					
BH00-1	0.4-0.75	1.5-2.5	fill material	Metals	N/A
BH00-2	1.4-1.7	4.5-5.5	fill material	Metals, VOCs, PAHs	N/A
BH00-2	1.7-2.0	5.5-6.5	Silty clay	Metals, VOCs, PAHs	N/A
BH00-3	1.4-2.0	4.5-6.5	fill material	Metals, VOCs, PAHs	N/A
BH00-4	2.0-2.3	6.5-7.5	fill material	Metals, VOCs, PAHs	N/A
BH00-4	2.3-3.6	7.5-8.5	Silty clay	Metals, VOCs, PAHs	N/A
BH00-5	0.3-0.45	1.0-1.5	fill material	Metals	N/A
BH00-6	1.4-1.5	4.5-5.0	fill material	Metals, VOCs, PAHs	N/A
BW00-1 (BH00-6 dup)	1.4-1.5	4.5-5.0	fill material	Metals, VOCs, PAHs	N/A
BH00-7	0.15-1.4	0.5-4.5	fill material	Metals	N/A
Off-Site Walden Avenue					
JAR1	0-0.05	0-0.17	fill material	Metals	N/A
JAR2	0-0.05	0-0.17	fill material	Metals	N/A
JAR3	0-0.05	0-0.17	fill material	Metals	N/A
JAR4	0-0.05	0-0.17	fill material	Metals	N/A
JAR5	0-0.05	0-0.17	fill material	Metals	N/A
JAR6	0-0.05	0-0.17	fill material	Metals	N/A
JAR7	0-0.05	0-0.17	fill material	Metals	N/A
JAR8	0-0.05	0-0.17	fill material	Metals	N/A
JAR9	0-0.05	0-0.17	fill material	Metals	N/A
JAR10	0-0.05	0-0.17	fill material	Metals	N/A
JAR11	0-0.05	0-0.17	fill material	Metals	N/A
JAR12	0-0.05	0-0.17	fill material	Metals	N/A
OS00-1 (3242 Walden Ave., # 4)	0-0.05	0-0.17	fill material	Metals	N/A
OS00-2 (3232 Walden Ave.)	0-0.05	0-0.17	fill material	Metals	N/A
OS00-3 (3224 Walden Ave., #2/3)	0-0.05	0-0.17	fill material	Metals	N/A

TABLE 2
SUMMARY OF SOIL AND GROUNDWATER SAMPLING PROGRAM

LOCATION	DEPTH		SOIL TYPE	PARAMETERS	
	(METRES)	(FEET)		SOIL	GROUNDWATER
SED00-1	Sewer	Sewer	Accumulated soil particles	Metals	N/A
SED00-2	0-0.05, edge of creek, on land	0-0.17	soil	Metals	N/A
Off-Site Railway Berm					
RB-SURF1	0-0.05	0-0.17	fill material	Metals	N/A
RB-SURF2	0-0.05	0-0.17	fill material	Metals	N/A
RB-SURF3	0-0.05	0-0.17	fill material	Metals	N/A
RB-SURF4	0-0.05	0-0.17	fill material	Metals	N/A
RB-SURF5	0-0.05	0-0.17	fill material	Metals	N/A
RB-SURF6	0-0.05	0-0.17	fill material	Metals	N/A
RB-SURF7	0-0.05	0-0.17	fill material	Metals	N/A
RB-SURF8	0-0.05	0-0.17	fill material	Metals	N/A
RB-BW1 (RB-SURF8 dup)	0-0.05	0-0.17	fill material	Metals	N/A
RB-SURF9	0-0.05	0-0.17	fill material	Metals	N/A
RB-SURF10	0-0.05	0-0.17	fill material	Metals	N/A
RB-SURF11	0-0.05	0-0.17	fill material	Metals	N/A
RB-SURF12	0-0.05	0-0.17	fill material	Metals	N/A
RBH00-1	0.1-0.45	0.5-1.5	fill material	Metals	N/A
RBW00-1 (RBH00-2 dup)	0.1-0.45	0.5-1.5	fill material	Metals	N/A
RBH00-2	1.2-1.4	4.0-4.5	fill material	Metals	N/A
RBH00-3	1.7-2.1	5.5-7.0	fill material	Metals	N/A
RBH00-4	0.1-0.3	0.5-1.0	fill material	Metals	N/A

NOTES:

N/A – Not analyzed or not applicable

dup – blind field duplicate

BH98-8 and BH1 – Boreholes drilled in 1998

MW98-1 – Monitoring well installed in 1998

UW – Groundwater from historical unknown well in 1998

BH99-1 – Borehole drilled in 1999

MW99-3 – Monitoring well installed in 1999

SURF10 – Surficial soil sample collected in 1999

BERM1 – Soil sample from berm in central area in 1999

JAR2 – Off-site surficial soil samples on Walden Avenue in 1999

RB-SURF3 – Off-site surficial soil samples on railway berm in 1999

BH00-1 – Borehole drilled in 2000

RBH00-2 – Railway berm borehole in 2000

OS00-1 – Off-site soil sample on Walden Avenue residential property in 2000

SED00-1 – soil sample in 2000 (soil particles accumulated in catch basin and soil on land at edge of creek)

Table 2 presented above summarizes the analytical program conducted by XCG between 1998 and 2000. This data was used to prepare the draft RI/FS report dated July 5, 2001. Subsequent to this submission, XCG carried out three additional soils investigations. Additional soil samples were analyzed for total lead and TCLP lead to provide supplementary data to assist in better identifying the correlation between total lead and TCLP lead concentrations at the subject property. The findings are summarized in XCG's letter report entitled "Total Lead and TCLP Lead Testing, 3241 Walden Avenue, Depew, New York," dated January 14, 2002 (see Appendix G). The other two studies consisted of off-site sampling on the residential properties to the north of the subject property. The first study was conducted by XCG for Norampac, and was entitled "Off-Site Surficial Soil Investigation, Residential Properties Near 3241 Walden Avenue, Depew, New York," dated December 21, 2001. The second off-site study was conducted for NL and was entitled "Supplemental Off-Site Surficial Soil Investigation, Residential Properties Near 3241 Walden Avenue, Depew, New York," dated July 29, 2002. Details of these separate studies can be found in the three stand-alone reports, which have been submitted to NYSDEC.

3. PHYSICAL CHARACTERISTICS OF STUDY AREA

3.1 Surface Features

The subject property is approximately rectangular in shape, with the east side slightly wider than the west side. The property is located in a mixed commercial/industrial and residential area. Commercial/industrial properties adjoin the east and west sides of the subject property. The properties located across the street, on the north side of Walden Avenue, is a mixture of residential and some commercial sites. Given their close proximity, the people living on these residential properties were considered potential receptors to the contaminants on the subject property. The south side of the property is bordered by railway tracks. The topography of the subject property and immediate surrounding area has a generally flat grade. There are no surface water bodies on or adjacent to the subject property. Surface features and surface water flow patterns are presented in Figure 3.

The property has one main building located at the east side of the property. Based on measurements obtained from historical site drawings, the building is estimated to occupy an area of approximately 5,890 m^2 (63,400 ft^2) and is primarily one floor. There is an open yard, approximately 790 m^2 (8,500 ft^2) in size, located at the north side of the building, near the east end. A brick wall encloses the north side of this concrete-paved yard. The natural gas line enters the property at the north end of the building. Offices, washrooms/change rooms, lunchroom, maintenance room, and a compressor room are located at the east side of the building. This part of the building contains a second floor, which is used for offices and a conference room. The remainder of the building is primarily used for paper fibre recycling activities. The entire building floor is concrete, which prevents any direct exposure to impacted fill situated below the building. The building has undergone numerous expansions since it was originally constructed in 1892. This may explain the presence of impacted fill below the building floor. Waste containing metals was likely placed on-site during operations in the earlier part of the century and was left in-place at the time of the building expansions.

The east side of the property, adjacent to the site building, is paved with asphalt and is used for parking. The asphalt is acting as a surface barrier and is mitigating any direct exposure to metals and hydrocarbon-impacted fill in this area. There is a concrete wall, approximately 4 feet (1.2 metres) high, with a locked gate at the south end of the parking lot. The east property line is bordered by a commercial/industrial building, which was most recently occupied by Bogdan's Furniture. The grade of the parking is relatively flat. Stormwater in this area flows off-site at the north and south ends. The public water supply line and sanitary sewer are located below the parking lot and enter the east side of the building. These underground utilities are not expected to be a significant pathway for migration since the saturated water-bearing zone is situated at a greater depth, in the silty clay.

Three former oil tanks were located at the south end of the parking lot and were removed in 1981. The oil was used to operate the boilers located at the southeast corner of the building. Two of these tanks were located below grade in a concrete-lined basement and had capacities of 28,457 litres (7,517 US gallons) and 42,717 litres (11,284 US gallons). The third tank, which had a capacity of 55,607 litres (14,689 US gallons), was situated at ground level to the south of the first two tanks. A wood-framed, corrugated metal-clad building, enclosed all three of these tanks. This metal-clad building has been removed from the property. The dimensions of the basement were approximately 30 x 40 x 10 feet (9.1 x 12.2 x 3.0 metres) deep. The basement was backfilled after the tanks were removed in 1981..

A rail siding exists to the south of the building, adjacent to the south property line. This area is surfaced with rail ballasts (crushed rock), which provides some protection to direct contact with the underlying metal and hydrocarbon-impacted fill. A chain-link fence, with a locked gate at the east end, borders the south side of the rail siding. This provides further protection to potential off-site receptors by limiting access to the property in this area. The rail siding is connected to the main rail tracks bordering the south of the subject property. These tracks are situated on a berm approximately 4 to 5 feet (1.2 to 1.5 metres) higher than the ground surface on the subject property. The rail tracks have existed since at least 1893 and are currently owned by CSX Transportation, Inc.

A truck loading/unloading and trailer parking yard is located west of the building. A small garage and weigh scale is situated at the north side of this trucking yard. The area was surfaced with gravel during the various field investigations and at the time of completion of the final draft RIFS report, and is surrounded by a chain-link fence with gates. These features assist in preventing access to the trucking yard by potential off-site receptors. In November 1999, approximately 400 tons of gravel was imported to the site to place a minimum cover of approximately 3 inches (8 centimetres). The new gravel cover provided a temporary measure to potential exposure to impacted fill in this area. In December 2004, Metro Waste paved the trucking yard to provide a better driving surface for the daily trucks that enter the property to load and unload shipments. The existing granular surface was considered a sufficient subbase and was graded prior to installing the asphalt, which consisted of 4.5 inches of binder and 1.5 inches of asphalt topcoat. In addition to the asphalt, a new concrete apron, approximately 6 inches thick, was constructed adjacent to the the west side of the building. The paving of the trucking yard was primarily conducted to provide a better driving surface, but it has also resulted in eliminating direct contact with the underlying impacted fill. An overhead electrical power line aligned in the north-south direction is situated near the west side of the trucking yard.

Prior to the recent asphalt paving work, stormwater in the trucking yard had infiltrated into the ground, as this area is relatively flat. In addition, a catch basin was located near the southwest corner of the trucking yard. Surface water collected in this catch basin was conveyed to the municipal storm sewer located on Walden Avenue. This was originally considered a potential off-site migration pathway for surficial metals-impacted soil. The sewer discharges the stormwater to Scajaquada Creek, which is situated approximately 0.25 miles (0.4 kilometres) to the north. The outfall of the storm sewer is located northwest of the property, at the north end of University Boulevard. NYSDEC considered the potential migration of soil particles from the property to this outfall as a possible concern, as there are children playing in this area. Therefore, XCG collected a soil sample on dry land near the edge of Scajaquada Creek, near the outfall, for laboratory analyses. It should be noted re-iterated that the trucking yard was recently paved with asphalt, with some concrete near the building. As such, the migration pathway via the storm sewer has now been eliminated as rain water is diverted directly to the on-site catch basins, which is then conveyed to the municipal storm sewer on Walden Avenue (i.e. rain water in the trucking yard no longer contacts any soil before leaving the site).

The central undeveloped area is flat and is currently covered with a 4 to 5 inches (10 to 13 centimetre) layer of imported topsoil, which has been hydro-seeded. This area is secured with a chain-link fence and locked-gates. The construction of the cover and fence was implemented in the summer of 1999 as part of the IRM. These temporary measures were designed to mitigate any direct exposure to the metals-impacted fill in this area, until final remedial actions are undertaken. Based on historical aerial photographs and site plans, the central area has never been developed, other than the creation of the former lagoon. There is a tree-covered area situated at the southwest corner of the central undeveloped area. As mentioned previously, the former lagoon is located at the south end of the central undeveloped area, with a small portion situated in the trucking yard. The bottom of the former lagoon is approximately 10 to 12 feet (3.0 to 3.7 metres) below grade, at its deepest location, and has been filled to ground level after its use was discontinued (likely with the accumulated sediments). Due to the relatively flat grade, stormwater in the central undeveloped area is expected to primarily infiltrate into the ground. As such, overland flow of surface water, and possible transport of metal-impacted fill, to Walden Avenue is expected to be minimal. This is supported by the results of the accumulated soil particles sampling in a catch basin on Walden Avenue and the soil near the outfall at Scajaquada Creek.

The west undeveloped area is not used by Metro Waste and is covered with imported fill, including construction debris (i.e. brick and large concrete fragments). Similar to the central area, stormwater in the west undeveloped area mainly infiltrates into the ground and any potential off-site migration of metal-impacted fill is expected to be minimal, due to the flat ground surface. Further, the results of the surficial soil sampling indicate that the lead concentrations at surface are below the applicable guideline values in this area of the property. Historically, this area has always been vacant and was not used for any on-site operations. The neighbouring business to the west (Non-Ferrous Metal Casting Company) is currently storing some heavy equipment and miscellaneous items on the west side of the property. There is a natural gas line that traverses along the north property line in the west undeveloped area. Although this is not considered a potential significant migration pathway for impacted soil, it is a potential safety concern that will need to be considered when assessing remedial options.

3.2 Regional Geology

The regional geology of the study area was provided by a published soil survey document prepared by the United States Department of Agriculture (USDA). The subject property is located in Erie County, which is comprised of two physiographic provinces. The northern half and western edge of Erie County is situated in the Erie-Ontario lake plain province while the southern portion is comprised of the Allegheny Plateau province. The study area is located in the Erie-Ontario lake plain province.

With the exception of areas near the major drainageways, the Erie-Ontario Plain has little significant relief and its topography is typical of an abandoned lakebed. The elevation slopes upwards to the south to southeast, starting from approximately 569 feet (173 metres) above mean sea level at the Lake Erie shoreline. The study area is situated at approximately 676 feet (206 metres) above mean sea level.

Erie County is underlain by bedrock of the Upper Silurian and the Middle and Upper Devonian periods. The bedrock formations are in bands with an east-west alignment. The oldest formations are located in the northern section of Erie County and become younger towards the south. Bedrock underlying the county is relatively flat, but dips approximately 50 feet per mile (25 metres per kilometre) to the southwest.

The City of Buffalo is underlain by the Onondaga Limestone, which is the lowest formation of the Devonian period in this area. The Hamilton Group is situated above and to the south of the Onondaga Limestone. This formation consists of shales and limestones in a band approximately 4 miles (6.4 kilometres) wide. Depew, which is a suburb to the east of Buffalo, is located near the border of the Onondaga Limestone and Hamilton Group.

The overburden soil is comprised of the Odessa silt loam, which is nearly level (0 to 3 percent slope) and is somewhat poorly drained. This soil contains a high clay content. The surficial layer is typically very dark greyish-brown silt loam less than 1 foot (3 centimetres) thick. The subsoil is a mottled pinkish-grey silty clay in the upper portion and mottled reddish-brown silty clay in the lower part. The substratum consists of a varved reddish-brown, grey, or reddish-grey silty clay. This silty clay acts as a vertical migration barrier of contaminants present at surface.

The USDA document indicates that there is a perched water table in the upper part of the subsoil from December to May. The permeability in the subsoil and substratum is slow to very slow. This low permeability will hinder the lateral movement of any contaminants in the shallow groundwater flow direction. Groundwater in the area is not used for drinking purposes. The Village of Depew is serviced by municipal water, which is drawn from Lake Erie.

3.3 Site Geology

The site-specific geology was determined from the various Phase 2 ESAs conducted at the subject property, including the subsurface investigation carried out as part of the RI. The site geology is shown in four cross-sections at various parts of the property (see Figures 5 to 8). The location of each cross-section is identified in Figure 4. The subsurface conditions at the various portions of the subject property are briefly summarized in this section. In general, the shallow soils across the site consist of varying types of soil overyling a native silty clay stratum. Bedrock was not encountered in any of the deep boreholes drilled across the entire site (26 feet was the deepest borehole). In this report, fill material is defined as surficial soils of varying grades, such as sand, gravel, silty sand, and sandy silt. Further, fill material that has been mixed with metal waste (e.g. foundry sands, smelting residues, babbitt residues, process water residues, etc.) produced from decades of historical on-site industrial operations is referred to as metal-impacted fill. In addition, soil containing mild hydrocarbon odors or residual concentrations is defined as hydrocarbon-impacted fill. Details of historical site operations are provided in Section 4.1. In brief, these industrial activities included foundry operations, smelting operations, and processing of babbitt. The metal waste produced by these operations, including the dredged material from the former settling lagoon and foundry sands, was apparently mixed and spread throughout the property. As a result, the fill material across the site, which was originally clean, became metal-impacted fill. The metal and hydrocarbon-impacted fill at the various parts of the property is discussed below.

The metal-impacted fill encountered at the west side of the property consisted of sand and gravel fill mixed with silty clay, and the metal waste produced by the historical site operations. Brick and concrete fragments were also encountered in the metal-impacted fill. The depth of the metal-impacted fill at the west side of the site was generally between approximately 2 to 3 feet (0.6 and 0.9 metres) below grade, and was present to as deep as 4 feet (1.2 metres) at one of the drilling locations. The metal-impacted fill is underlain by a native silty clay stratum. Occasional pebbles and gravel are present in the silty clay. The consistency of this soil unit increased from very stiff to hard with depth, and became less hard as the depth approached the shallow water-bearing zone. The native silty clay was generally the same throughout the remaining parts of the property.

The metal-impacted fill at the central portion of the property consisted of silty and sandy grades of soil mixed with occasional gravel, and the metal waste from past on-site industrial operations. The depth of the metal-impacted fill typically ranged between approximately 2 to 3 feet (0.6 and 0.9 metres) below grade. The metal-impacted fill in the former lagoon consisted of saturated and very soft silty and sandy type of material. This material was likely the remaining accumulated sediment from the former lagoon, which was used as a settling basin for the past industrial process water. The bottom of the former lagoon extended to as deep as approximately 10 to 12 feet (3.0 to 3.7 metres) below ground surface. In the former marsh area, the metal-impacted fill was encountered to 4 feet (1.2 metres) below grade in both boreholes drilled. In addition to the metal impact, mild hydrocarbon odours were detected in the fill in the former marsh and lagoon. Both of these areas were saturated with perched water.

In the trucking yard, the metal-impacted fill encountered during the drilling programs consisted of sand and gravel at the surface. The metal-impacted fill became a mixture of sand, gravel, and silty clay with depth and was saturated with perched water. The depth of the metal-impacted fill in this area generally ranged between approximately 4 and 5 feet (1.2 and 1.5 metres) below grade, and was encountered as deep as 6 feet (1.8 metres). As mentioned previously in Section 3.1, the trucking yard was re-surfaced in November 1999 with a new gravel cover, approximately 3 inches (8 centimetres) thick. Mild hydrocarbon odours were detected in the metal-impacted fill at the south side of the trucking yard. Also as noted previously, the trucking yard was paved with asphalt, with some concrete adjacent to the building, in December 2004.

The parking lot at the east side of the property is surfaced with asphalt, approximately 3 inches (8 centimetres) thick on average. The depth of the underlying metal-impacted fill, which was comprised of coarse sand with gravel, ranged between approximately 1.5 and 2.5 feet (0.5 and 0.75 metres) below grade. The metal-impacted fill in the former basement used to store the oil tanks was present to approximately 10.5 to 11.5 feet (3.2 to 3.5 metres) below ground surface, where refusal was encountered. Mild hydrocarbon odours were detected in the metal-impacted fill within the former basement and the immediate surrounding area.

The overburden material along the rail siding consisted of rail ballast underlain by metal-impacted fill, which was comprised of sand and gravel, and silty clay mixed with metal waste from past on-site industrial operations. The metal-impacted fill was dark brown to black in colour and was saturated with perched water. A mild to moderate hydrocarbon odour and oily sheen was present in the metal-impacted fill all boreholes advanced along the rail siding. The metal-impacted fill in the rail siding area was encountered at a depth ranging between approximately 3 to 4 feet (0.9 to 1.2 metres). The underlying silty clay stratum did not exhibit any visual or olfactory evidence of petroleum hydrocarbons.

The concrete floor slab was approximately 6 inches (15 centimetres) thick in most of the boreholes drilled inside the building. The underlying metal-impacted fill consisted of different grades of soil, including medium to coarse sand, with some silt and gravel, mixed with metal waste from historical on-site industrial activities. Hydrocarbon odours and an oily sheen were encountered in four boreholes. The metal-impacted fill thickness below the building ranged between 4 and 8 feet (1.2 and 2.4 metres). The native silty clay below the metal-impacted fill was similar to the conditions found elsewhere on the property.

3.4 Site Hydrogeology

The hydrogeology at the site was determined by the installation of seven groundwater monitoring wells throughout the property. There are two different groundwater layers present beneath the site, and are separated by the top of the stiff native silty clay layer. Perched water was encountered in the fill material at various drilling locations; however, the natural shallow groundwater-bearing zone is situated in the native silty clay. The low hydraulic conductivity of the silty clay causes infiltrated surface water to remain "perched" in the fill layer. As shown on the borehole logs, the perched water is not present in a continuous layer throughout the property. Rather, it is present at selected drilling locations. The upper portions of the silty clay is damp to moist and the consistency is stiff to hard (i.e. not saturated). This soil unit becomes soft and saturated at a greater depth (approximately 15 feet).

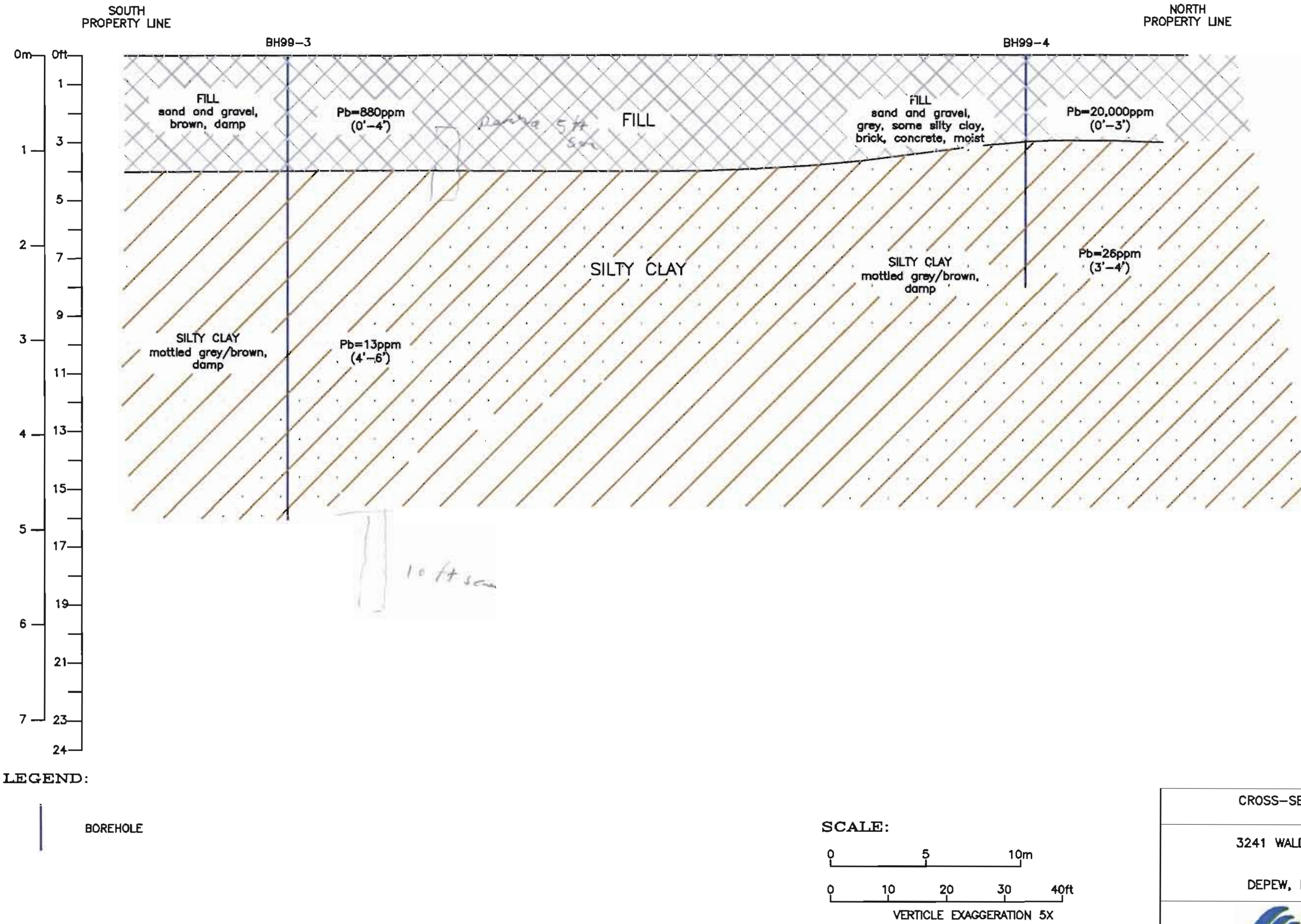
The monitoring wells were surveyed to a geodetic benchmark, which was provided by the New York State Department of Transportation. The static groundwater depths and elevations in the monitoring wells are summarized in Table 3. This data consists of water level measurements collected during two wet periods (i.e. April 1999 and May 2000). Based on these measurements, the shallow groundwater is estimated to flow in a northwesterly direction. Scajaquada Creek is located approximately 0.25 miles (0.4 kilometres) to the north of the subject site while Cayuaga Creek is situated approximately 0.62 miles (1.0 kilometres) to the south. The inferred shallow groundwater flow direction is shown on Figure 9.

TABLE 3
GROUNDWATER MEASUREMENTS

WELL #	DEPTH TO WATER APR 14, 99		ELEVATION APR 14, 99		DEPTH TO WATER APR 15, 99		ELEVATION APR 15, 99		DEPTH TO WATER MAY 10, 00		ELEVATION MAY 10, 00	
	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)
MW99-1 (flush)	1.26	4.13	205.72	674.94	1.10	3.01	205.88	675.47	1.12	3.67	205.86	675.39
MW99-2 (flush)	2.73	8.96	203.60	667.97	2.94	9.65	203.39	667.28	2.65	8.69	203.68	668.23
MW99-3 (stick-up)	N/M	N/M	N/M	N/M	2.685	8.81	204.52	670.98	2.94	9.65	204.26	670.14
MW98-1 (stick-up)	N/M	N/M	N/M	N/M	0.645	2.12	205.40	673.89	0.72	2.36	206.33	676.93
MW98-2 (stick-up)	N/M	N/M	N/M	N/M	0.88	2.89	206.37	677.08	0.80	2.62	206.45	677.34
MW98-3 (stick-up)	N/M	N/M	N/M	N/M	2.48	8.14	204.75	671.74	2.55	8.37	204.68	671.50
MW98-4 (flush)	N/M	N/M	N/M	N/M	0.55	1.80	206.18	676.46	0.6	1.97	204.76	671.8

NOTE:

N/M not measured



Cross-Section based on XCG borehole logs.

NOTE: Locations of buildings, underground utilities, etc. are for reference only and should not be relied upon for detail design, excavation, or construction purposes.

(file: P:\STREETSVILLE\ACAD DATA\5-997-02-03 NORAMPAC\FIGURE 5 SECTION A-A'.DWG)

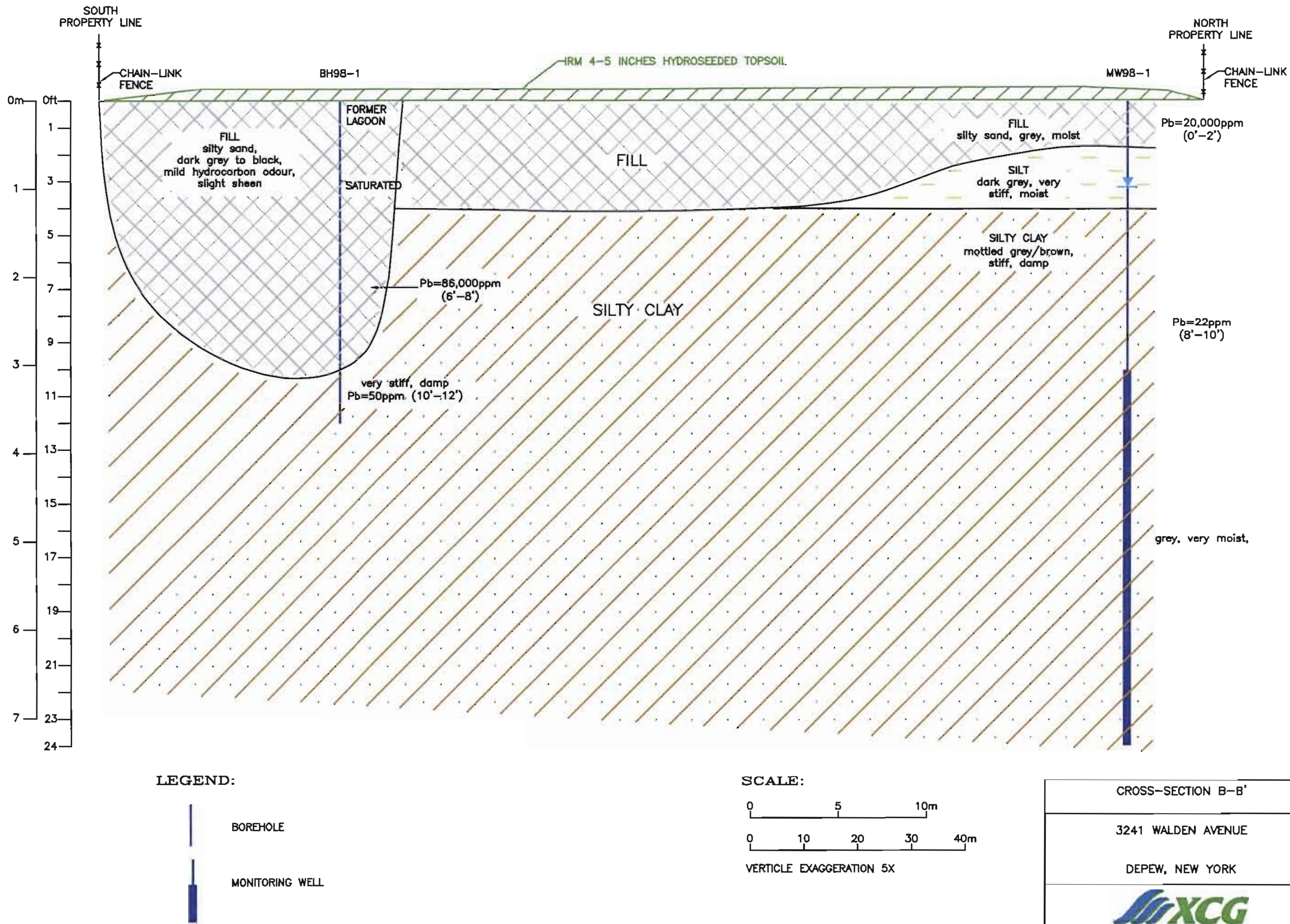
CROSS-SECTION A-A'

3241 WALDEN AVENUE

DEPEW, NEW YORK

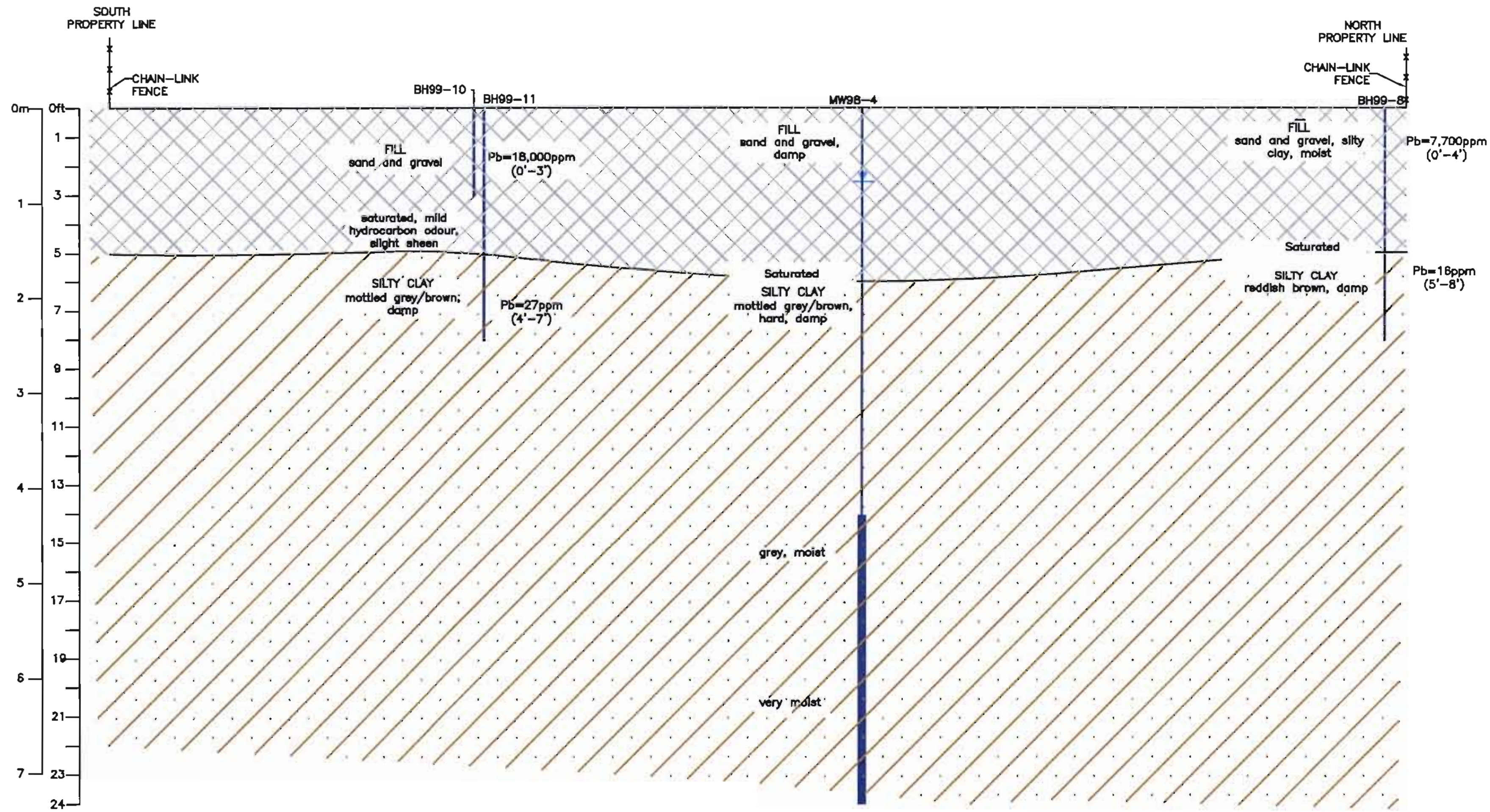
XCG CONSULTANTS LTD.

DATE	JOB NO.	FIGURE NO.
JUNE 2001	5-997-02-03	5



Cross-Section based on XCG borehole logs.
NOTE: Locations of buildings, underground utilities, etc. are for reference only and should not be relied upon for detail design, excavation, or construction purposes. (file: P:\STREETSVILLE\ACAD DATA\5-997-02-03 NORAMPAC\FIGURE 6 SECTION B-B'.DWG)

CROSS-SECTION B-B'		
3241 WALDEN AVENUE		
DEPEW, NEW YORK		
XCG CONSULTANTS LTD.		
DATE	JOB NO.	FIGURE NO.
JUNE 2001	5-997-02-03	6



LEGEND:

- BOREHOLE
- MONITORING WELL

SCALE:

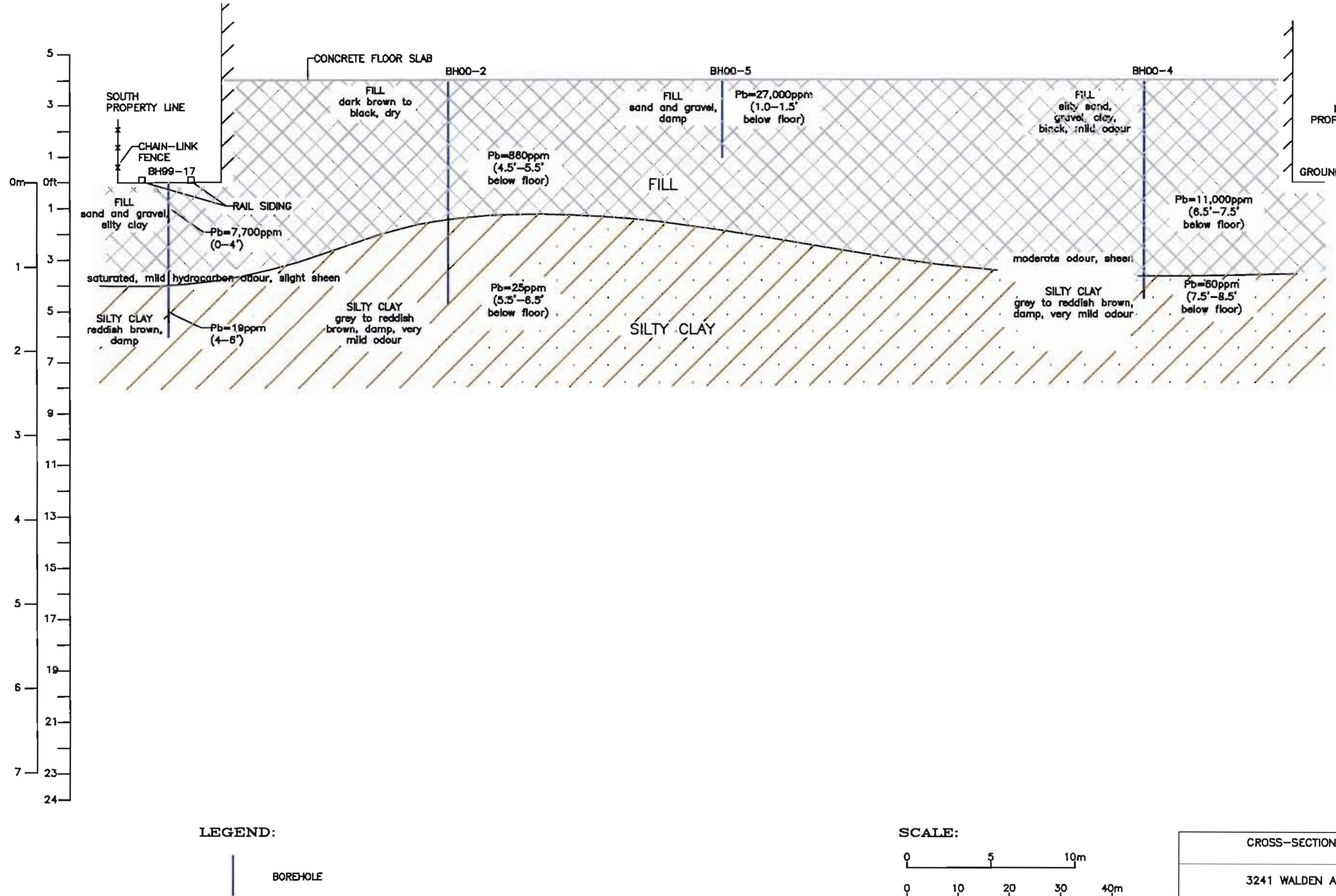
0 5 10m

0 10 20 30 40m

VERTICLE EXAGGERATION 5X

Cross-Section based on XCG borehole logs.
NOTE: Locations of buildings, underground utilities, etc. are for reference only and should not be relied upon for detail design, excavation, or construction purposes. (file: P:\STREETSVILLE\ACAD DATA\5-997-02-03 NORAMPAC\FIGURE 6 SECTION B-B'.DWG)

CROSS-SECTION C-C'		
3241 WALDEN AVENUE		
DEPEW, NEW YORK		
XCG CONSULTANTS LTD.		
DATE	JOB NO.	FIGURE NO.
JUNE 2001	5-997-02-03	7

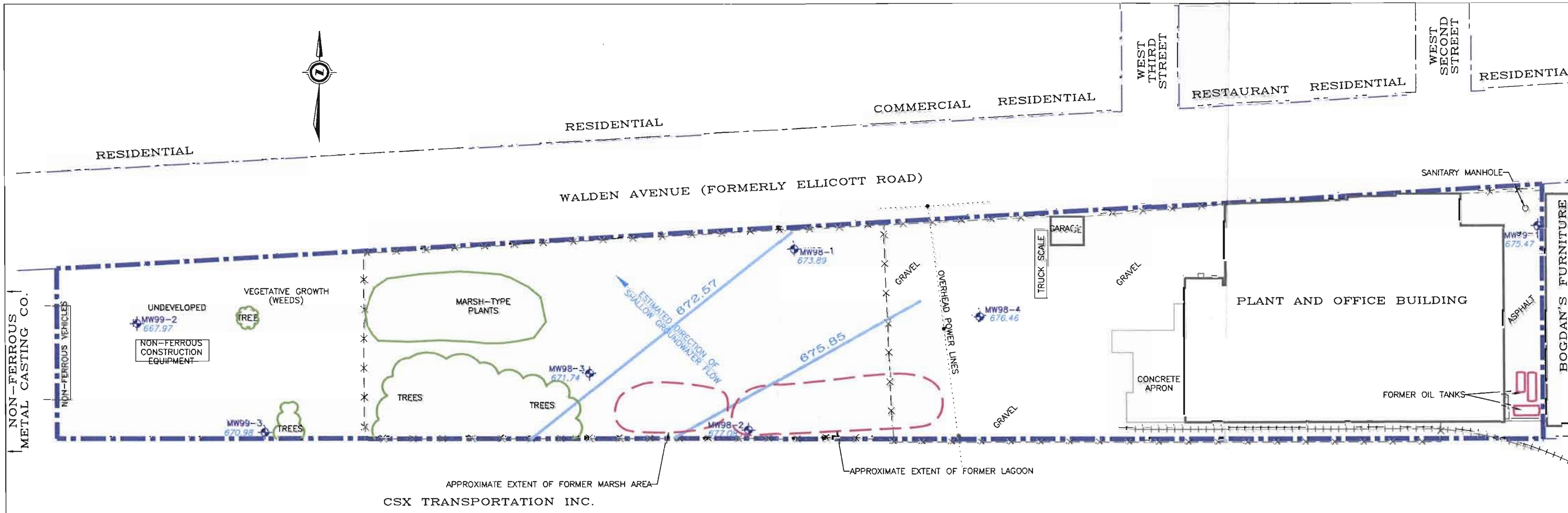


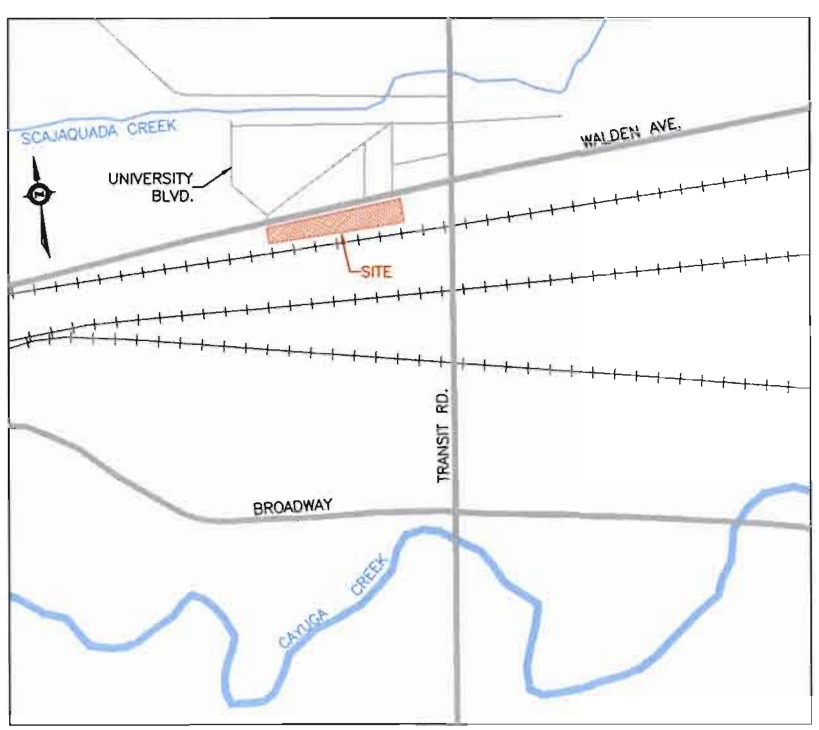
CROSS-SECTION D-D'
3241 WALDEN AVENUE
DEPEW, NEW YORK
XCG CONSULTANTS LTD.

DATE	JOB NO.	FIGURE NO.
JUNE 2001	5-997-02-03	8

Cross-Section based on XCG borehole logs.
NOTE: Locations of buildings, underground utilities, etc. are for reference only and should not be relied upon for detail design, excavation, or construction purposes.

(file: P:\STREETSVILLE\ACAD DATA\5-997-02-03 NORAMPAC\FIGURE 6 SECTION B-B'.DWG)





KEYMAP (not to scale)

LEGEND:

- PROPERTY BOUNDARY
- FENCE
- MW98-4 APPROXIMATE EXISTING MONITORING WELL LOCATION
- 671.74 GEODETIC GROUNDWATER ELEVATION (ft) (APRIL 14&15, 1999)
- 672.57 GEODETIC GROUNDWATER ELEVATION CONTOURS (ft) (APRIL 14&15, 1999)

SCALE:

0 20 40 60m

0 100 200 ft.

DRAWING REFERENCE: Based on survey drawing by Norampac, Inc. (Millard & McKay)
NOTE: Locations of buildings, underground utilities, etc. are for reference only and should not be relied upon for detail design, excavation, or construction purposes.

(file: 5997\02\5997-0203_SITE2.DWG)

GROUNDWATER CONTOUR MAP

3241 WALDEN AVE.
DEPEW, NEW YORK

XCG CONSULTANTS LTD.

DATE	JOB NO.	FIGURE NO.
JUNE 2001	5-997-02-03	9

4. NATURE AND EXTENT OF CONTAMINATION

4.1 Sources of Contamination

As described in the following sections, the fill material throughout the subject property has been impacted by metals, primarily lead, copper, and zinc. The historical foundry operations carried out by Buffalo Brass Company, Magnus Metal Corporation, Empire Smelting Company, and NL Industries Inc. resulted in the deposition of waste containing heavy metals in the fill material.

The east side of the subject property was first developed for industrial purposes in 1892 by Buffalo Brass Co. (Buffalo Brass), which conducted brass foundry operations. Buffalo Brass operated at this part of the property until 1899, at which time Magnus Metal Co. (Magnus) acquired this portion of the property and continued the brass foundry operations until 1936. In the early 1900s, Empire Smelting Co. (Empire) conducted operations in the area of the current trucking yard while Magnus occupied the east area. A structure identified as the "Concentrator" building was located at the south side of Empire's operational area. A 1911 Sanborn Map shows two dashed lines extending westwards from the Concentrator building (later renamed the Reclamation Building), which may have been the supply and return pipes connected to the former on-site lagoon. A 1923 Sanborn Map indicates that Empire had added a foundry building near the southeast portion of its operational area. However, the Empire part of the subject property was conveyed to Magnus in 1923.

National Lead Company acquired the entire property from Magnus in 1936 and continued the brass foundry operations until 1972, when it vacated the site. The name Magnus remained with the company, and was called Magnus Metal, a Division of National Lead Company. National Lead Company eventually changed its name to NL Industries Inc.

Some details of the on-site foundry operations were provided by a retired employee with approximately 24 years of service to NL. This retired employee, who did not provide permission to identify his name, worked for NL from approximately 1950 to 1972. The former employee indicated that waste metal was processed and sorted by scrap dealers before arriving at the subject site. A major percentage of waste metal products received consisted of used brass railway bearings, which contained a lining of babbit. This material was "sweated out" at the subject facility. Crushed dross produced on-site was washed in the Reclamation Building with water obtained from both the former lagoon and a former supply well located in the immediate area. The wash water was returned to the lagoon and recycled via two aboveground portable 5 inch (13 centimetre) diameter pipes. Sediments in the wash water would accumulate in the lagoon and it required dredging every two to three years. The former employee believed that the dredged material accumulated on the property and does not recall it ever being transported off-site.

The historical brass foundry operations, which were conducted between 1892 and 1972 (i.e. 80 years), smelting operations conducted in the early part of the century, and the processing of babbitt explains the elevated levels of lead, zinc, and copper in the fill material. Brass is an alloy of copper and zinc, and babbitt is formed from an alloy of various metals including lead and copper. Waste produced by these operations, including the dredged material from the former lagoon, was apparently spread throughout the site. In addition, there is the potential that foundry sands were disposed of on-site.

The source of residual petroleum in the former lagoon/marsh area was from a reported historical oil spill. In the spring of 1986, oil was detected in the former lagoon's intake pipe. Analysis conducted by NYSDEC indicated that the liquid was non-PCB, No. 2 fuel oil. This oil may have either been dumped by unknown parties or the result of an unspecified past activity. Prior to acquiring the property, Norampac retained Environmental Data Resources (EDR) to review regulatory database information on the subject property. On November 7, 1997, EDR prepared a report entitled "Domtar Fibre Products, 3241 Walden Avenue, Depew, NY, 14043, Inquiry Number: 209751.2S." A summary letter prepared by EDR, dated November 14, 1997, stated that the spill was assigned a New York Spills number (No. 8600427). EDR indicated that the spill was cleaned up to standard and no penalty was recommended. The spill incident was closed as of November 17, 1987. Residual petroleum hydrocarbons at the southeast corner of the property are likely a result of leakage in the three former heating oil storage tanks located in this area.

4.2 Applicable Guideline Criteria

To determine the level and extent of metal and hydrocarbon impacts in the soil and groundwater, the analytical data were compared to the applicable guideline criteria used in New York State. There are two documents developed by the NYSDEC that are currently used to compare and assess analytical soil and groundwater data. These documents are summarized as follows:

1. NYSDEC Division of Technical and Administrative Guidance Memorandum (TAGM) 4046 under the title "Determination of Soil Cleanup Objectives and Cleanup Levels," dated January 24, 1994, as revised (in draft) dated October 13, 1995, and NYSDEC Memorandum on Determination of Soil Cleanup Levels, dated December 20, 2000; and

2. NYSDEC's Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1 under the title "Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations," dated October 22, 1993 (reissued June 1998).

In addition to the above, the Spill Technology and Remediation Series Memo #1 (STARS1) entitled "Petroleum-Contaminated Soil Guidance Policy," dated August 1992 (reprinted July 1993) was used for the assessment of petroleum impacts in the various subsurface investigations conducted at the site since the fall of 1998.

However, NYSDEC recently ceased using the STARS1 manual for the assessment and clean-up of petroleum impacted sites in New York State. In this manual, there were four criteria that must be satisfied, in order to consider a soil to be not sufficiently contaminated. These are summarized as follows:

- Protection of the groundwater;
- Protection of human health;
- Protection of fish and wildlife (not applicable at this site); and
- Protection against objectionable nuisance characteristics.

Regional Spills Investigators of NYSDEC indicated to XCG that the department's main focus is the protection of groundwater. This may be accomplished by comparing the analytical results of select VOCs and semi-volatile organic compounds (i.e. SVOCs, PAHs) in leachate extract, using the Toxicity Characteristic Leaching Procedure (TCLP), to the TCLP Guidance Values in either Table 1 (gasoline contaminated soil) or Table 2 (fuel oil contaminated soil) of the STARS1 document. Alternatively, the analytical soil results can be compared to the TCLP Alternative Guidance Values. The alternative method was adopted in this study to assess the soil quality with respect to petroleum contaminants. In the initial subsurface investigations, the VOC and SVOC analytical results were compared to the TCLP Alternative Guidance Values, since the protection of groundwater was the main focus. As more data was collected, the analytical results indicated that groundwater was not impacted by petroleum products. As such, the results were also assessed against the STARS1 Human Health Guidance Values (i.e. protection of human health). Since the STARS1 manual is no longer used by NYSDEC, the VOCs and SVOCs were then compared only to the Recommended Soil Cleanup Objectives in TAGM 4046.

The TAGM 4046 Recommended Soil Cleanup Objectives for certain metals provide the option of using either the specified value or using site background values. There are no site background values available for the study area. As such, the analytical metal results were compared to the specified Cleanup Objectives or the Eastern USA/New York State Background Values (where Cleanup Objectives have not been developed). A range of Eastern USA and New York State Background Values for most metals are provided in TAGM 4046. Background values at the subject property and surrounding area are probably very high as it is located in an industrial area and is adjacent to a railway corridor. Therefore, the high end of the range of Background Values was used in this assessment. For example, the Background Values for lead is 200 ppm to 500 ppm. The results of lead were therefore compared to a Background Value of 500 ppm.

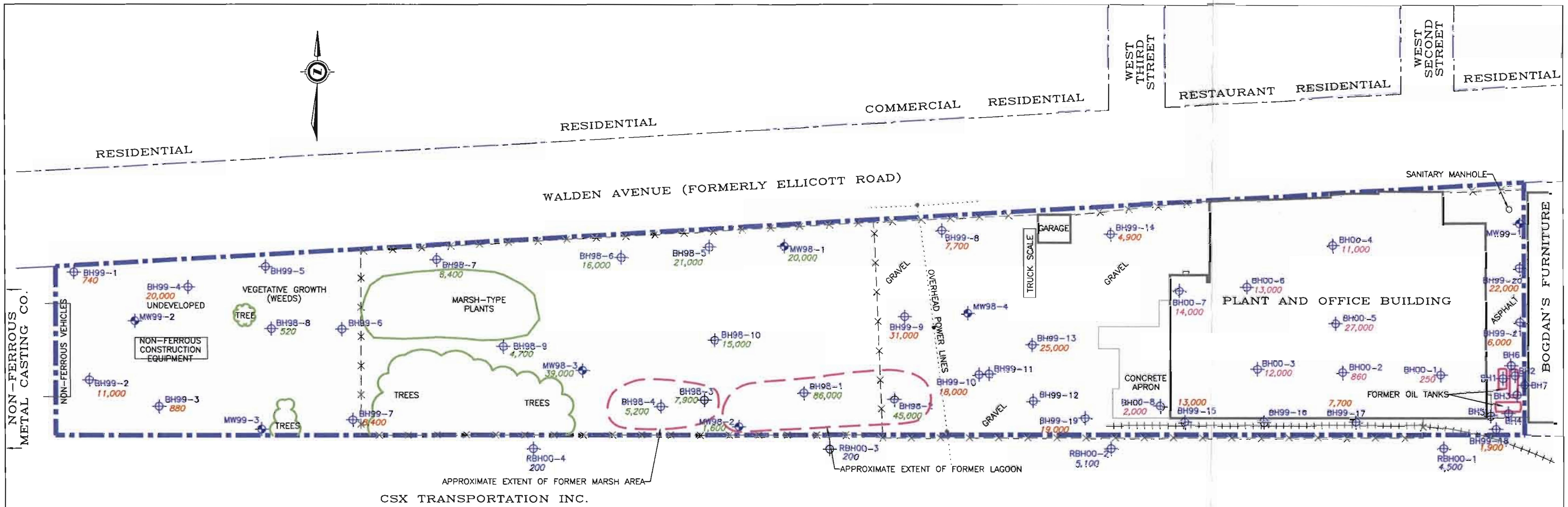
The TOGS 1.1.1 was used for comparison of the groundwater analytical results. TOGS 1.1.1 does not have Standards or Guidance Values for groundwater that is not used for potable purposes. A Standard is a value that has been promulgated and placed into regulation. Guidance Values are used where a Standard has not been established. The subject property and surrounding area is serviced by a municipal water supply, which draws its water from a surface water body (i.e. Lake Erie).

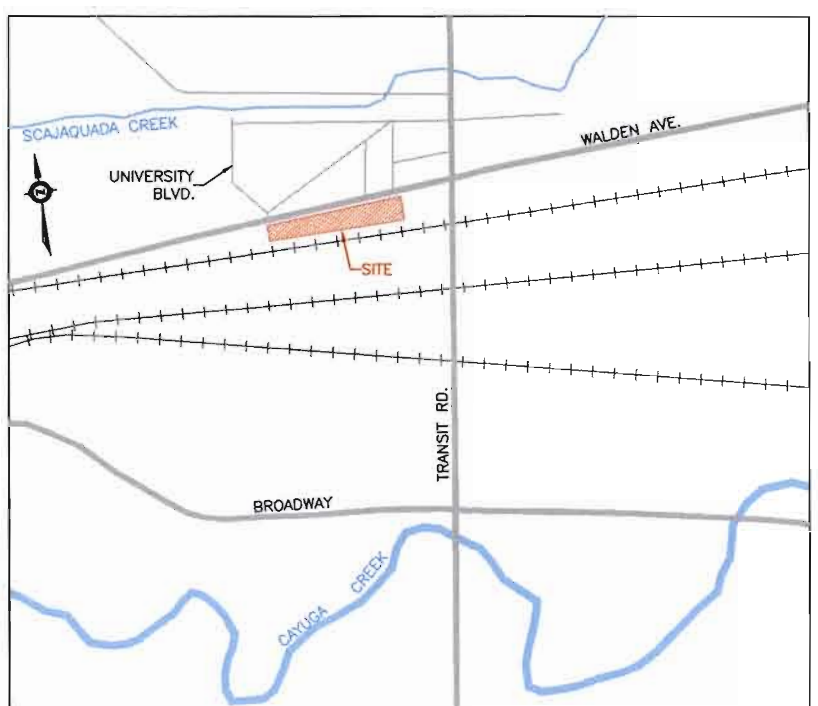
Since there are no criteria for non-potable groundwater, the Standards and Guidance Values for potable groundwater were used for assessment in this report.

4.3 Soil

This section describes the analytical results of the soil investigations conducted on the subject property while the findings from the testing at nearby off-site properties are provided in Section 4.5. The on-site soil investigation consisted of laboratory analysis of 97 samples, of which 74 were collected from the fill material and 23 were from the underlying native silty clay. All soil samples were analyzed for metals and some were tested for VOCs and PAHs. The summary tables for the analytical results are presented in Appendix B while the laboratory certificates of analyses are provided in Appendix C. The analytical results have been organized into separate tables for fill material and native silty clay samples, and for three separate sections of the property: 1) west and central undeveloped areas, 2) trucking yard and rail siding, and 3) building and parking lot. The property was divided into these three main areas since they are used for different purposes and the assessment of a specific remedial technology will need to take this into consideration.

The analytical results of this extensive testing program have provided a clear indication of the lateral and vertical extent of metal impacts throughout the subject property. The hydrocarbon impacts, which are present to a lesser extent, were also clearly defined by the analytical results. A majority of the fill material at the property contains metals, and lead in particular, at concentrations that exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values. The TCLP results indicate that much of the metal-impacted fill exceeds the regulatory limit for lead in leachate. Although there are a number of metals that exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values, the primary contaminant of concern is lead in soil. The concentrations of lead in the fill material at depth throughout the subject property are presented in Figure 10. The concentrations of lead at surface, both on-site and off-site, are shown in Figure 11. In general, soil samples that contained elevated levels of lead also had high copper and zinc concentrations, which were the other two metals historically handled on-site. The analytical results of copper and zinc will be discussed below for a few samples, to provide a general indication of their concentrations in the fill material and native silty clay. The discussion of metals results will focus mainly on lead since this is the primary contaminant of concern on the subject property.





KEYMAP (not to scale)

LEGEND:

- PROPERTY BOUNDARY
- —x— —x— FENCE
- MW98-4 APPROXIMATE EXISTING MONITORING WELL LOCATION
- BH98-4 APPROXIMATE EXISTING BOREHOLE LOCATION
- 1,600 LEAD CONCENTRATION (ppm) IN FILL MATERIAL (OCTOBER & DECEMBER 1998)
- 7,700 LEAD CONCENTRATION (ppm) IN FILL MATERIAL (APRIL & JUNE 1999)
- 27,000 LEAD CONCENTRATION (ppm) IN FILL MATERIAL (MAY 2000)
- 2,000 LEAD CONCENTRATION (ppm) IN OFF-SITE MATERIAL (JUNE & JULY 1999; MAY & AUGUST 2000)

SCALE: 0 20 40 60m; 0 100 200 ft.

LEAD CONCENTRATIONS IN FILL AT DEPTH

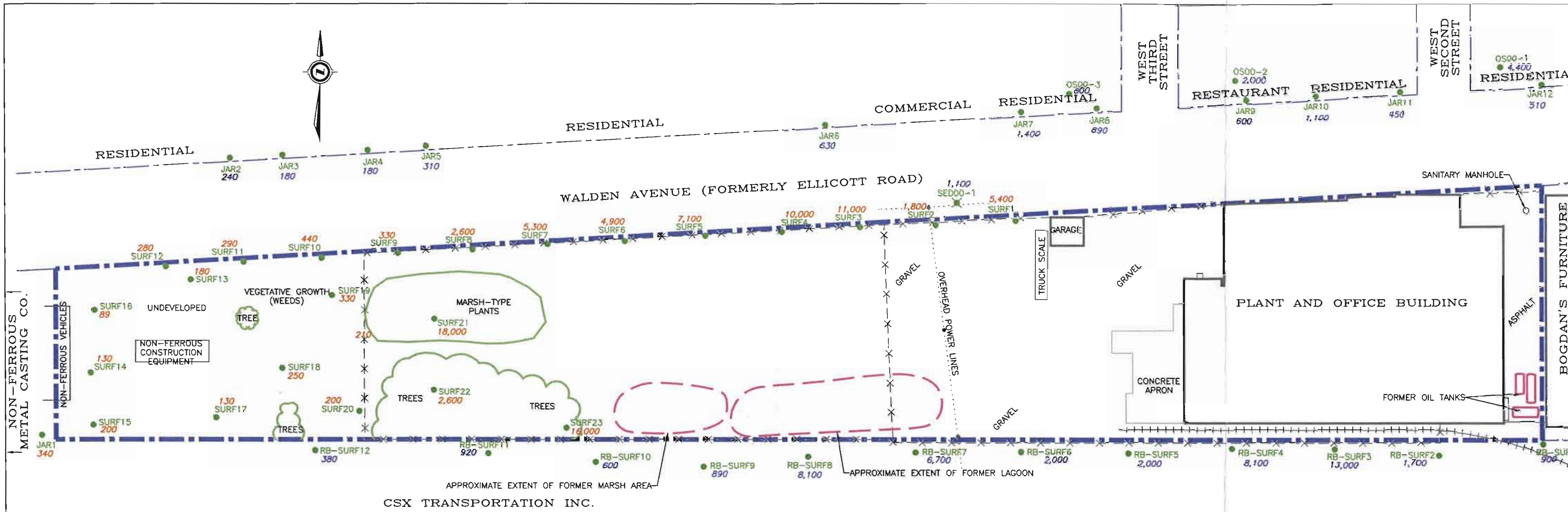
3241 WALDEN AVE.
DEPEW, NEW YORK

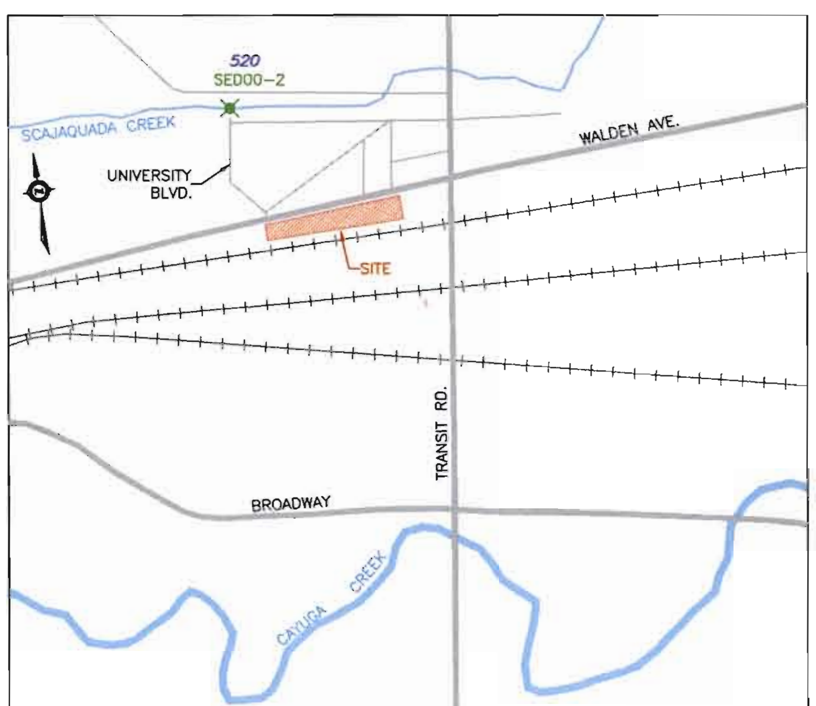
XCG CONSULTANTS LTD.

DATE	JOB NO.	FIGURE NO.
JUNE 2001	5-997-02-03	10

(file: 5997\02\5997-0203_SITE2.DWG)

DRAWING REFERENCE: Based on survey drawing by Norampac, Inc. (Millard & McKay)
NOTE: Locations of buildings, underground utilities, etc. are for reference only and should not be relied upon for detail design, excavation, or construction purposes.





KEYMAP (not to scale)

LEGEND:

PROPERTY BOUNDARY

FENCE

SURF12 — SURFACE GRAB SAMPLE LOCATION

SED00-2 — SEWER SEDIMENT SAMPLE

7,700 — LEAD CONCENTRATION (ppm) IN FILL MATERIAL (APRIL & JUNE 1999)

2,000 — LEAD CONCENTRATION (ppm) IN OFF-SITE MATERIAL (JUNE & JULY 1999; MAY & AUGUST 2000)

SCALE:

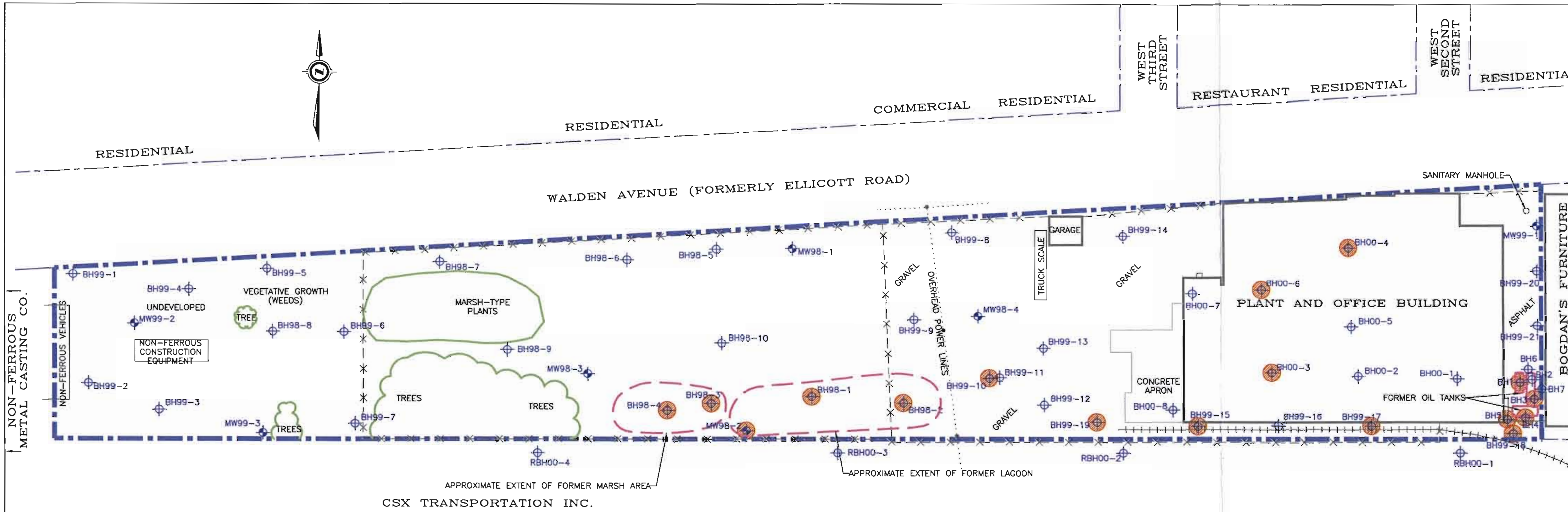
0 20 40 60m

0 100 200 ft.

LEAD CONCENTRATIONS AT SURFACE		
3241 WALDEN AVE. DEPEW, NEW YORK		
XCG CONSULTANTS LTD.		
DATE	JOB NO.	FIGURE NO.
JUNE 2001	5-997-02-03	11

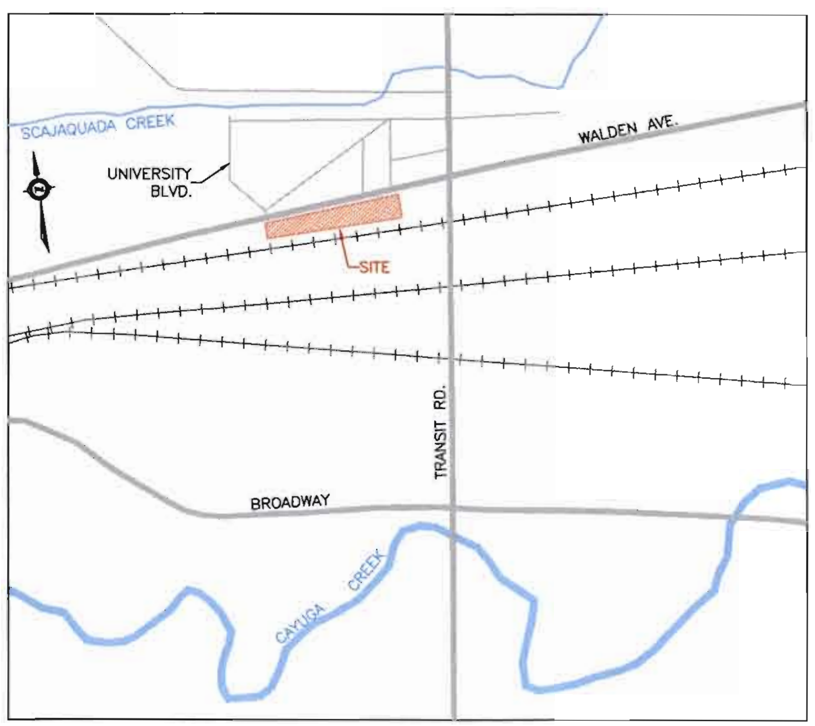
DRAWING REFERENCE: Based on survey drawing by Norampac, Inc. (Millard & McKay)
NOTE: Locations of buildings, underground utilities, etc. are for reference only and should not be relied upon for detail design, excavation, or construction purposes.

(file: 5997\02\5997-0203_SITE2.DWG)



LEGEND:

- PROPERTY BOUNDARY
- FENCE
- MW98-4 APPROXIMATE EXISTING MONITORING WELL LOCATION
- BH98-4 APPROXIMATE EXISTING BOREHOLE LOCATION
- FILL SAMPLES WITH VOCs OR PAHs ABOVE TAGM4046 CLEANUP OBJECTIVES



KEYMAP (not to scale)

SCALE: 0 20 40 60m; 0 100 200 ft.

DRAWING REFERENCE: Based on survey drawing by Norampac, Inc. (Millard & McKay)
NOTE: Locations of buildings, underground utilities, etc. are for reference only and should not be relied upon for detail design, excavation, or construction purposes.

(file: 5997\02\5997-0203_SITE2.DWG)

FILL MATERIAL WITH DETECTABLE HYDROCARBONS

3241 WALDEN AVE.
DEPEW, NEW YORK

XCG CONSULTANTS LTD.

DATE	JOB NO.	FIGURE NO.
JUNE 2001	5-997-02-03	12

Residual petroleum hydrocarbon impacts were detected in the fill material, but to a much lesser extent than the metals. Although select VOC and PAH parameters exceeded the STARS1 TCLP Alternative Guidance Values, they were considered to be low concentrations, as most of the results were below the STARS1 Human Health Protection Guidance Values and TAGM 4046 Cleanup Objectives. Petroleum impacts were limited to the south end of the parking lot, rail siding, south part of the trucking yard, and former lagoon/marsh area. The residual petroleum hydrocarbons were situated within the same medium (i.e. fill material) and lateral extent, as the elevated metals and are considered to be co-contaminants. The locations where fill material contained residual petroleum parameters that were above the TAGM 4046 cleanup objectives are presented in Figure 12.

The underlying very stiff to hard silty clay is acting as an effective barrier to vertical migration of contaminants. This is supported by the analytical results of the native soil.

The following sections provide a summary of the lateral and vertical extent of metal and hydrocarbon impacts at the three sections of the subject property. Based on this delineation, XCG estimated the volumes of metal and hydrocarbon-impacted fill. The development of remedial alternatives for the site as a whole focussed on the most applicable technologies for each area, giving consideration to its current and future use. The remedial alternative development is presented in Sections 6 to 8.

4.3.1 West and Central Undeveloped Areas

Central Undeveloped Area

The central undeveloped area consists of an open field with no structures. The former lagoon and marsh is located at the south side of this area. A small portion of the former lagoon is located in the trucking yard, but will be discussed in this section. In the summer of 1999, a surface cap consisting of imported topsoil and hydro-seed was placed over the central area as part of the IRM. In addition, a chain-link fence was placed around the perimeter to limit access to this area. For the purpose of this report, this fenced-in area is defined as the central undeveloped area.

Five boreholes were drilled within the former lagoon and marsh area. The results of the testing in this area are discussed first, followed by a summary of the findings in the general central undeveloped area (i.e. beyond the lagoon and marsh).

Soil samples from MW98-2 [2 to 4 feet (0.6 to 1.2 metres)], BH98-1 [6 to 8 feet (1.8 to 2.4 metres)], BH98-2 [4 to 6 feet (1.2 to 1.8 metres)], and BH98-2 [8 to 10 feet (2.4 to 3.0 metres)] were collected from the fill material in the former lagoon. Although BH98-2 is located in the trucking yard, it is included in this discussion as it was drilled in the former lagoon. In each of these samples, the concentration of a number of metals exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background values (where no Cleanup Objectives or Site Background values exist), including arsenic, beryllium, mercury, cadmium, chromium, copper, iron, lead, nickel, and zinc. Of greatest concern are the significantly high concentrations of lead, and to a lesser extent copper and zinc, compared to the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values. The concentrations of copper in MW98-2 [2 to 4 feet (0.6 to 1.2 metres)], BH98-1 [6 to 8 feet (1.8 to 2.4 metres)], BH98-2 [4 to 6 feet (1.2 to 1.8 metres)], and BH98-2 [8 to 10 feet (2.4 to 3.0 metres)] were 1,900 parts per million (ppm or mg/kg), 54,000 ppm, 37,000 ppm, and 36,000 ppm, respectively. The Cleanup Objective for this parameter is 25 ppm, while the Eastern USA Background values range from 1 to 50 ppm. The concentrations of zinc were 1,700 ppm, 89,000 ppm, 63,000 ppm, and 48,000 ppm, respectively. The Cleanup Objective of zinc is 20 ppm while the Eastern USA Background values range from 9 to 50 ppm. For these same samples, the concentrations of lead were 1,600 ppm, 86,000 ppm, 45,000 ppm and 45,000 ppm, respectively, compared to a typical range of 200 to 500 ppm in metropolitan areas (as identified in TAGM 4046). The high end typical value of 500 ppm was used as the Background Value for assessment.

Soil samples from the underlying native silty clay at these three borehole locations were analyzed to determine if the metals were migrating vertically downwards. In MW98-2 [6 to 8 feet (1.8 to 2.4 metres)], BH98-1 [10 to 12 feet (3.0 to 3.6 metres)], and BH98-2 [12 to 14 feet (3.7 to 4.3 metres)], the concentrations of copper, lead, and zinc in the underlying native silty clay were significantly lower than the analytical results of the fill material. The copper and zinc concentrations ranged from 30 to 48 ppm, and 74 to 120 ppm, respectively. Although these concentrations exceeded the Cleanup Objectives, the values were much more comparable to typical Eastern USA Background Values than the results of the fill material. The concentrations of lead in these three silty clay samples ranged between 18 ppm and 50 ppm, which were well below the Background Values found in metropolitan areas (as identified in TAGM 4046).

Samples of the fill material from BH98-3 [2 to 4 feet (0.6 to 1.2 metres)] and BH98-4 [2 to 4 feet (0.6 to 1.2 metres)] were collected from the former marsh area, which is adjacent to the west of the former lagoon. These samples also contained a number of metals that exceeded the Cleanup Objectives or Eastern USA/New York State Background values, including significantly high concentrations of copper, lead, and zinc. In BH98-3 [2 to 4 feet (0.6 to 1.2 metres)], the concentrations of copper, lead, and zinc were 11,000 ppm, 7,900 ppm, and 15,000 ppm, respectively. In BH98-4 [2 to 4 feet (0.6 to 1.2 metres)], the concentrations of these three metals were 6,500 ppm, 5,200 ppm, and 9,600 ppm, respectively.

A soil sample from the underlying native silty clay unit in BH98-3 [6 to 8 feet (1.8 to 2.4 metres)] was analyzed to determine if metals were migrating vertically downwards. The concentrations of copper (45 ppm) and zinc (90 ppm) exceeded the Cleanup Objectives. However, these concentrations were significantly lower than those detected in the overlying fill material and were more comparable to the typical Eastern USA background values noted in TAGM 4046. The concentration of lead (41 ppm) in the silty clay was well below the TAGM 4046 Background Value of 500 ppm.

Samples of the fill material from the former lagoon and marsh were also analyzed for VOCs and PAHs to address the reported historical #2 fuel oil release located in this area. A sample from BH98-1 [6 to 8 feet (1.8 to 2.4 metres)], which contained a mild hydrocarbon odour and sheen, was analyzed for VOCs. The concentration of acetone (0.32 ppm) slightly exceeded the TAGM 4046 Cleanup Objective of 0.2 ppm. However, this might be a laboratory artifact as acetone is commonly used for extraction purposes. The method blank analyzed with this sample contained a detectable concentration of acetone. A majority of the other VOC parameters, including those listed in STARS1, were below the laboratory's method detection limits (MDLs).

Although the historical #2 fuel oil release was reportedly remediated, the PAH results indicate that some low level residual fuel related impacts still remain in the former lagoon and marsh areas. In all samples tested, the concentrations of at least three of the PAH parameters exceeded the STARS1 TCLP Alternative Guidance Values. However, many of the results were below the STARS1 Human Health Guidance Values or TAGM 4046 Cleanup Objectives. These samples were analyzed from the same fill material samples which contained elevated metals concentrations.

Soil samples were collected from 7 boreholes and 10 surface sampling locations in the general central undeveloped area (i.e. beyond the former lagoon and marsh). Fill material samples from the boreholes were comprised of a composite of the full length recovered in the stainless-steel sampler, whereas the surficial samples were collected from a more discrete point [i.e. 0 to 2 inches (0 to 5 centimetres)]. Analytical results of the fill material in the general central undeveloped area indicated lead concentrations ranging from 4,700 ppm to 39,000 ppm, which exceed the TAGM 4046 Background Value (500 ppm). In 9 of the 10 surficial soil samples, the lead concentrations (2,600 ppm to 18,000 ppm) exceeded the Background Value.

Two native silty clay samples in the general central undeveloped area were analyzed for metals. The concentrations of lead ranged between 22 and 51 ppm, which is well below the Background Value of 500 ppm. These results further indicate that the native silty clay is acting as an effective barrier to vertical migration of metals.

Based on the relatively high concentrations of certain metals, and lead in particular, XCG submitted 4 fill material samples from the central undeveloped area for TCLP metals analysis to determine the soil waste classification. Part 371, Section 371.3, of Title 6 of the New York Codes, Rules, and Regulations (6NYCRR) states that solid waste is a hazardous waste if it exhibits any of the characteristics identified in that section. One of these characteristics is the leachate toxicity characteristic. The concentration of lead in the leachate extracted from each sample exceeded the regulatory level of 5 mg/L (or ppm). The sample with the lowest total lead concentration, MW98-2 (2 to 4 feet, 1,600 ppm) had a leachate concentration of 8.7 mg/L. Soil sample BH98-1 (6 to 8 feet) had a total lead concentration of 86,000 ppm and a leachate concentration of 210 mg/L.

In summary, soil sampling at 21 locations in the central undeveloped area has shown that lead in the fill material is present at concentrations exceeding the TAGM 4046 Background Values (except for one surface sample at 330 ppm) throughout this area, from boundary to boundary. These elevated lead concentrations ranged between 1,600 ppm to 86,000 ppm. The concentrations of lead in the underlying native silty clay (18 to 51 ppm) were significantly lower than the fill and were well below the TAGM 4046 Background Value. As such, the silty clay is acting as an effective barrier to vertical migration of metals. The metal-impacted fill in the central undeveloped area exhibits lead concentrations in leachate exceeding the regulatory level (6NYCRR Part 371, Section 371.3).

West Undeveloped Area

The west undeveloped area is defined as the land extending from the fenced-in central area to the west property line. This area is essentially vacant with the exception of the storage of some heavy and miscellaneous equipment by the neighbouring business to the west.

Soil was collected from 10 boreholes and 11 surface sampling locations. The soil quality in the west undeveloped area is somewhat different than in the central undeveloped area, as the lead concentrations in the fill varied throughout this section of the property. In fill material samples from BH99-2 [0 to 3.5 feet (0 to 1.1 metres)], BH99-4 [0 to 3 feet (0 to 0.9 metres)], and BH99-7 [0 to 3 feet (0 to 0.9 metres)], the lead concentrations were 11,000 ppm, 20,000 ppm, 8,400 ppm, respectively. These concentrations are significantly higher than the TAGM 4046 Background Value 500 ppm. In contrast, the lead levels in the fill material from boreholes BH98-8 (520 ppm), BH99-1 (740 ppm), BH99-3 (880 ppm), and BH99-6 (210 ppm) were much lower. The low and high concentrations of lead are not located in clearly defined areas. Rather, the elevated lead concentrations in the fill material are scattered sporadically throughout the west undeveloped area. This may be a result of random historical placement or grading of metal wastes. At ground surface, the lead concentrations are consistently below the TAGM 4046 Background Value and ranged between 89 ppm and 440 ppm.

The fill material samples from BH99-1, BH99-3, BH99-6, and BH99-7 were analyzed for TCLP metals to determine the soil waste classification. The concentration of lead in the leachate extracted from BH99-7 was 17 mg/L (ppm), which exceeds the regulatory level of 5 mg/L (6NYCRR Part 371, Section 371.3). The total lead detected in this fill sample was 8,400 ppm. Considering that the total lead concentrations in the fill material from BH99-2 and BH99-4 were higher than BH99-7, the soil at these locations are also likely to be hazardous. The lead concentrations in leachate from fill material samples BH99-1, BH99-3, and BH99-6 were all below the laboratory MDL of 0.022 mg/L. These samples had total lead concentrations of 740 ppm, 880 ppm, and 210 ppm. The TCLP analytical results indicate that the metal-impacted fill at the west undeveloped area exhibits both hazardous and non-hazardous characteristics. However, the fill material in the entire area is considered to be characterisically hazardous, given that the high lead concentrations in the fill material are present in a scattered pattern in this part of the property.

Samples of the native silty clay from BH99-1 [4 to 6 feet (1.2 to 1.8 metres)], BH99-3 [6 to 8 feet (1.2 to 1.8 metres)], BH99-4 [3 to 4 feet (0.9 to 1.2 metres)], and BH99-7 [3 to 4 feet (0.9 to 1.2 metres)] were analyzed to determine the vertical extent of metals impacts. The concentrations of lead were much lower than the overlying fill material and significantly lower than the TAGM 4046 Background Value of 500 ppm. The lead concentrations in the native silty clay ranged from 13 to 28 ppm.

In summary, the analytical results in the west undeveloped area has shown that lead in the fill material is present at concentrations exceeding the TAGM 4046 Background Values in sporadically distributed locations. The elevated lead concentrations in the fill ranged between 8,400 ppm to 20,000 ppm, while those results that were more closer to the TAGM 4046 Background Value ranged between 210 ppm and 880 ppm. The lead concentrations in the surface layer of the fill material are below the Background Value, and therefore, is mitigating any direct exposure in the interim until remedial actions are undertaken. The concentrations of lead in the underlying native silty clay (18 to 51 ppm) were significantly lower than the fill material and were well below the TAGM 4046 Background Value. This provides further support that the silty clay is acting as an effective barrier to vertical migration of metals. Conservatively, the metal-impacted fill in the west undeveloped area is considered to be characteristically hazardous as the lead concentration in leachate in one of the samples exceeded the regulatory level (6NYCRR Part 371, Section 371.3).

4.3.2 Trucking Yard and Rail Siding

The exterior operational area of the property is comprised of the trucking yard located adjacent to the west of the building and the rail siding situated along the south side. These two areas are connected and surrounded by a chain-link fence with gates. Trucks conduct loading and unloading activities along the west building wall, while trailers are regularly parked at the west side adjacent to the chain-link fence. Shipping and receiving activities are also carried out by railway containers on the siding at the south side of the building. The subsurface conditions in the trucking yard and rail siding were evaluated separately from the undeveloped areas since the remedial options for this part of the property would need to consider the impact on the daily operation of the business.

The analytical results of fill material collected from the trucking yard were similar to those found in the central undeveloped area. Fill material samples from BH99-8 [0 to 4 feet (0 to 1.2 metres)], BH99-9 [0 to 4 feet (0 to 1.2 metres)], BH99-10 [0 to 3 feet (0 to 0.9 metres)], BH99-13 [0 to 2 feet (0 to 0.6 metres)], BH99-14 [0 to 2 feet (0 to 0.6 metres)], BH99-19 [0 to 4 feet (0 to 1.2 metres)], and BH00-8 [2 to 3 feet (0.6 to 0.9 metres)] contained a number of metals which exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values. The concentrations of copper, lead, and zinc exceeded the TAGM 4046 values in all seven of these fill samples. The copper concentrations ranged from 2,700 ppm in BH99-14 to 60,000 ppm in BH99-19, which exceeds the TAGM 4046 Cleanup Objective of 25 ppm. The zinc concentrations ranged from 1,700 ppm in BH99-14 to 55,000 ppm in BW1 (field duplicate of BH99-9). The TAGM 4046 Cleanup Objective for zinc is 20 ppm. The lead concentrations in the fill from BH99-8 (7,700 ppm), BH99-9 (31,000 ppm), BH99-10 (18,000 ppm), BH99-13 (25,000 ppm), BH99-14 (4,900 ppm), BH99-19 (19,000 ppm), and BH00-8 (2,300 ppm) were well above the typical high end value of 500 ppm found in metropolitan areas (as identified in TAGM 4046). Two surface samples were collected at the north side of the trucking yard in April 1999. The lead concentrations for these two samples were 1,800 ppm and 5,400 ppm. However, it should be noted that in November 1999, imported gravel was brought to the site to provide a minimum cover of 3 inches (8 centimetres) over the trucking yard.

Petroleum hydrocarbon odours were detected in the fill material at boreholes BH99-10 [0 to 3 feet (0 to 0.9 metres)] and BH99-19 [0 to 4 feet (0 to 1.2 metres)]. These two boreholes were located near the south side of the trucking yard. Samples of the fill material from these locations were analyzed for VOCs and PAHs. The concentrations of benzene and 1,2,4-trimethylbenzene in BH99-10 were 0.018 ppm and 0.11 ppm, respectively. These levels marginally exceeded the STARS1 TCLP Alternative Guidance Values of 0.014 ppm and 0.1 ppm, respectively. The benzene concentration was, however, below the STARS 1 Human Health Guidance Values and the TAGM 4046 Cleanup Objectives. In this sample, the concentrations of acetone (1.7 ppm) and methylene chloride (0.47 ppm) slightly exceeded the TAGM 4046 Cleanup Objectives of 0.2 ppm and 0.1 ppm, respectively. In BH99-19, the concentrations of benzene (0.026 ppm), methylene chloride (0.71 ppm), and xylenes (0.145 ppm) slightly exceeded either the STARS1 TCLP Alternative Guidance Values or TAGM 4046 Cleanup Objectives. However, for both benzene and xylenes, the results were below the STARS1 human health protection Guidance Values. In both of these fill material samples, nine of the PAH parameters slightly exceeded the STARS1 TCLP Alternative Guidance Values, but in many cases were lower than the STARS1 Human Health Guidance Values and/or TAGM 4046 Cleanup Objectives.

The fill material from BH99-8, BH99-10, and BH99-14 were analyzed for TCLP metals to determine the soil waste classification in the trucking area. The concentrations of lead in the leachate were 21 mg/L (total lead was 7,700 ppm), 89 mg/L (total lead was 18,000 ppm), and 25 mg/L (total lead was 4,900 ppm), respectively. These concentrations exceeded the New York State regulatory level of 5 mg/L (6NYCRR Part 371). Considering the high total lead concentrations in the other boreholes, all the fill material in the trucking yard is considered characteristically hazardous.

Similar to the undeveloped portions of the property, the analytical results of the underlying native silty clay in the trucking yard showed a significant decrease in the metal concentrations. Although a number of metals exceeded the TAGM 4046

Cleanup Objectives, the concentrations in the silty clay were more comparable to typical Eastern USA/New York State Background Values. For instance, the concentrations of copper ranged between 30 ppm in BH99-7 and 76 ppm in BH99-19, which exceeds the TAGM 4046 Cleanup Objective of 25 ppm. The high end of the range of typical Eastern USA Background Values is 50 ppm. The lead concentrations in the silty clay were significantly lower than the fill material, and were well below the typical high end value of 500 ppm found in metropolitan areas (as identified in TAGM 4046). The concentrations of lead ranged from 16 ppm in BH99-8 to 32 ppm in BH99-9.

In the rail siding area, samples of the fill material from BH99-15 [0 to 4 feet (0 to 1.2 metres)], BH99-17 [0 to 4 feet (0 to 1.2 metres)], and BH99-18 [0 to 4 feet (0 to 1.2 metres)] contained concentrations of a number of metals which exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values. The concentrations of copper ranged from 2,600 ppm at the east end of the rail siding to 24,000 ppm to the west. These values are well above the TAGM 4046 Cleanup Objective of 25 ppm. The concentrations of zinc ranged between 1,800 ppm in BH99-18 to 12,000 ppm in BH99-15, compared to the TAGM Cleanup Objective of 20 ppm. The concentrations of lead in the fill material in BH99-15 (13,000 ppm), BH99-17 (7,700 ppm), and BH99-18 (1,900 ppm) were well above the TAGM 4046 Background Value of 500 ppm.

Petroleum hydrocarbon odours and an oily sheen were observed in the fill material under the rail siding. Soil samples from BH99-15 [0 to 4 feet (0 to 1.2 metres)], BH99-17 [0 to 4 feet (0 to 1.2 metres)], and BH99-18 [0 to 4 feet (0 to 1.2 metres)] were analyzed for VOCs and PAHs. In BH99-15 and BH99-17, the concentrations of benzene, xylenes, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene exceeded the STARS1 TCLP Alternative Guidance Values. The concentration of toluene in BH99-15 also exceeded the STARS1 TCLP Alternative Guidance Value. However, the benzene, xylenes, and toluene concentrations were all lower than both the STARS1 Human Health Guidance Values and TAGM 4046 Cleanup Objectives. In BH99-18, the concentrations of xylenes and 1,2,4-trimethylbenzene were above the STARS1 TCLP Alternative Guidance Values, but were lower than the Human Health Guidance Value and TAGM 4046 Cleanup Objective for xylenes. The concentrations of methylene chloride in all three of these fill material samples were above the TAGM 4046 Cleanup Objectives. In addition, at least twelve PAH parameters exceeded the STARS1 TCLP Alternative Guidance Values; however, many of these concentrations were below the STARS1 Human Health Guidance Values and/or TAGM 4046 Cleanup Objectives.

The fill material samples from BH99-17 and BH99-18 were analyzed for TCLP metals to determine the waste classification in the rail siding area. The concentration of lead in the leachate from BH99-17 was 100 mg/L (total lead was 7,700 ppm), which exceeds the regulatory level of 5 mg/L. As such, the fill material in this area is characteristically hazardous. In BH99-18, the lead concentration in leachate was 1.1 mg/L (total lead was 1,900 ppm). Considering the relatively high total lead concentration in BH99-15 (13,000 ppm), a majority of the fill material along the rail siding is expected to be characteristically hazardous.

The analytical results of the underlying silty clay samples along the rail siding were similar to those detected in other areas of the property, except for BH99-15. The concentrations of copper and zinc in BH99-17 and BH99-18 slightly exceeded the TAGM 4046 Cleanup Objectives, but were more comparable to the typical Eastern USA Background Values than the fill results. The lead concentrations in these two silty clay samples were 19 ppm and 15 ppm, respectively, which is well below the typical high end Background Value of 500 ppm found in metropolitan areas. The concentration of lead in the silty clay sample from BH99-15 was 6,500 ppm. This was the only native silty clay sample of the 23 analyzed on the property that exceeded the TAGM 4046 Background Value. This one exceedance may simply represent contamination at the upper zone of the silty clay unit (i.e. at the fill and silty clay interface).

In summary, the concentrations of lead in the fill material exceeded the TAGM 4046 Background Value at all tested locations throughout the trucking yard and the rail siding. The lead concentrations in the fill ranged between 1,900 ppm and 31,000 ppm. A layer of gravel was placed over the trucking yard in November 1999, which is mitigating any direct exposure in the interim until remedial actions are undertaken. Excluding a small portion at the east side of the rail siding, the metal-impacted fill in the trucking yard and rail siding is characteristically hazardous, as the lead concentration in leachate exceeded the regulatory level (6NYCRR Part 371, Section 371.3). With the exception of one sample, the concentrations of lead in the underlying native silty clay (16 ppm to 32 ppm) in the trucking yard and rail siding were significantly lower than the fill material and were well below the TAGM 4046 Background Value. This provides further support that the silty clay is acting as an effective barrier to vertical migration of metals.

4.3.3 Building and Parking Lot

The subsurface conditions under the building and parking lot located at the east side of the property were evaluated separately since the contaminants in these areas are already covered by concrete and asphalt, respectively. As such, the existing conditions were taken into consideration during assessment of the most practical and cost-effective remedial options for these two areas.

Parking Lot

Sampling in the parking lot was conducted to address two areas. The initial testing focussed on the south side of the parking lot. Three oil tanks were formerly stored in this area, two of which were located below grade in a concrete-lined basement. The second investigation was carried out from the centre to the north end of the parking lot to determine the general quality of the fill material underlying the asphalt.

Soil samples from BH1 [0 to 4 feet (0 to 1.2 metres)] and BH3 [4 to 8 feet (1.2 to 2.4 metres)] were collected from the material used to backfill the former oil tanks basement. The concentrations of copper, zinc, and lead were much lower in this fill than the fill located elsewhere on the property. Copper was detected in BH1 [0 to 4 feet (0 to 1.2 metres)] and BH3 [4 to 8 feet (1.2 to 2.4 metres)] at 99 ppm and 58 ppm, respectively, compared to the TAGM 4046 Cleanup Objective of 25 ppm. The concentration of zinc in the BH1 sample (26 ppm) marginally exceeded the Cleanup Objective of 20 ppm while the value in BH2 (18 ppm) was below the Cleanup Objective. Lead was detected in these two samples at 18 ppm and 8 ppm, respectively. These values were well below the typical high end Background Value found in metropolitan areas (500 ppm), as identified in TAGM 4046.

Boreholes BH4 and BH5 were located to the south-central and southwest of the former tank area, respectively. Soil samples from the fill material in BH4 [0 to 2.5 feet (0 to 0.75 metres)] and BH5 [0 to 2.5 feet (0 to 0.75 metres)] contained a number of metals that exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values. The concentrations of copper in BH4 and BH5 were detected at 360 and 1,500 ppm, respectively, which exceeded the Cleanup Objective of 25 ppm. The concentrations of zinc in the fill material in BH4 (330 ppm) and BH5 (760 ppm) also exceeded the TAGM 4046 Cleanup Objective of 20 ppm. Lead was analyzed in these two samples at 1,500 ppm and 1,200 ppm, respectively, compared to the TAGM 4046 Background Value of 500 ppm typically found in metropolitan areas.

Borehole BH6 was located just north of the former oil tanks basement. The soil sample submitted for analysis was collected from the native silty clay stratum [4 to 6 feet (1.2 to 1.8 metres)]. The concentrations of copper (36 ppm) and zinc (62 ppm) slightly exceeded the Cleanup Objectives. The concentration of lead in this sample (24 ppm) was well below the TAGM 4046 Background Value.

The fill material and native silty clay samples were also analyzed for VOCs and PAHs to address the reported, historical oil tank leaks. The samples of the fill material from BH1 [0 to 4 feet (0 to 1.2 metres)] and BH3 [4 to 6 feet (1.2 to 1.8 metres)] were collected from within the former tank basement. Acetone was detected in these two samples at 0.4 and 0.24 ppm, respectively. In soil samples from BH4 [0 to 2.5 feet (0 to 0.75 metres)], BH5 [0 to 2.5 feet (0 to 0.75 metres)], and BH6 [4 to 6 feet (1.2 to 1.8 metres)], which were collected from beyond the former basement perimeter, the concentration of acetone was detected at 0.32 ppm, 0.28 ppm, and 0.74 ppm, respectively. The concentrations of acetone in these five samples slightly exceeded the TAGM 4046 Cleanup Objective of 0.2 ppm. However, this might be a laboratory artifact as acetone is commonly used for extraction purposes. The method blank analyzed with these samples contained a detectable concentration of acetone. In all soil samples tested, a number of other VOC parameters were analyzed at concentrations above the laboratory's MDL, but at levels well below either the STARS1 TCLP Alternative Guidance Values or TAGM 4046 Cleanup Objectives.

In all samples tested from the fill material, both from within and beyond the perimeter of the former oil tank basement, the concentrations of at least two of the

PAH parameters exceeded the STARS1 TCLP Alternative Guidance Values; however, many of the results were below the STARS1 Human Health Guidance Values and/or TAGM 4046 Cleanup Objectives. These samples were analyzed from the same fill material samples which contained elevated metals concentrations. The sample from BH6 [4 to 6 feet (1.2 to 1.8 metres)] was collected from the native silty clay stratum. The concentrations of PAH parameters in this sample were either detectable (but below the STARS1 TCLP Alternative Guidance Values) or below the laboratories MDLs.

The fill material sample from BH5 [0 to 2.5 feet (0 to 0.75 metres)] contained a slight sheen and mild hydrocarbon odour. Based on field observations, this sample was considered the worst case sample of all samples collected, with respect to petroleum impacts. As such, this sample was also analyzed for PCBs. The results indicate that total PCBs were below the laboratory's MDL of 0.076 ppm.

TCLP testing was not conducted at the south side of the parking lot. The highest total lead concentration was 1,500 ppm. The TCLP results of samples collected elsewhere on the property, with total lead concentrations slightly higher than 1,500 ppm, produced different results. In MW98-2, the total lead concentration was 1,600 ppm and the leachate level was 8.7 mg/L. In BH99-18, the total lead concentration of 1,900 ppm produced a leachate level of 1.1 mg/L. Therefore, it is inferred that a total lead concentration of 1,500 ppm would pass the TCLP test. As requested by NYSDEC, additional soil samples will be collected in this area for TCLP testing to verify the waste classification, if required for disposal purposes.

Boreholes BH99-20 and BH99-21 were drilled in the north to central portions of the parking lot. Similar to the fill material collected from other areas of the site, samples of the fill material from BH99-20 [0 to 3 feet (0 to 0.9 metres)] and BH99-21 [0 to 2.6 feet (0 to 0.8 metres)] exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values for a number of metals. The concentrations of select metals, including copper, lead, and zinc suggest that metals bearing material has been historically placed in this area. The concentrations of copper in BH99-20 (38,000 ppm) and BH99-21 (7,500 ppm) were well above the TAGM 4046 Cleanup Objective of 25 ppm. The zinc concentrations in these two samples were 30,000 ppm and 3,400 ppm, respectively, compared to the TAGM 4046 Cleanup Objective of 20 ppm. Lead was detected in the fill material in BH99-20 at 22,000 ppm and at 6,000 ppm in BH99-21.

One of these fill material samples (BH99-21) was analyzed for TCLP metals to determine the waste classification in this area. The concentration of lead in leachate in this sample was 7.0 mg/L (total lead was 6,000 ppm), which slightly exceeds the regulatory level of 5 mg/L.

The underlying native silty clay samples from BH99-20 and BH99-21 were analyzed to determine the vertical extent of metals impacts. The concentrations of a number of metals exceeded the Cleanup Objectives, but were more comparable to the Eastern USA/New York State Background Values. Lead was detected in these two samples at 110 and 16 ppm, respectively. These concentrations were well below the typical high end Background Value of 500 ppm found in metropolitan areas (as identified in TAGM 4046).

In summary, the general fill material in the parking lot contains elevated concentrations of lead above the TAGM 4046 Background Values. However, the lead concentrations in the fill material used to backfill the former tank basement were well below the Background Value. The concentrations of lead in the underlying native silty clay (16 ppm to 110 ppm) were significantly lower than the fill material and were well below the TAGM 4046 Background Value. This provides further support that the silty clay is acting as an effective barrier to vertical migration of metals. Based on a TCLP result and the total lead concentrations, it is inferred that the fill material in the northern two-thirds of the parking lot is characteristically hazardous while the southern one-third is non-hazardous.

Building

Borehole drilling through the building floor slab was the last phase of field investigations and was conducted as part of the RI to fill-in the data gap in this area of the property. The boreholes were placed at different sections of the building in an effort to develop a good understanding of the subsurface conditions beneath the structure.

Metals analyses were conducted in the fill material at 7 locations. BH00-1 was located in the southeast area of the building. The fill material from this location [1.5 feet to 2.5 feet (0.45 to 0.75 metres)] contained a lead concentration of 250 ppm, which is below the TAGM 4046 Background Value of 500 ppm. However, the lead concentrations in the fill material at the other locations all exceeded the TAGM 4046 Background Value. The analytical results of these samples ranged between 860 ppm and 27,000 ppm. Based on these results, a majority of the fill material beneath the floor slab is expected to contain elevated concentrations of lead above the TAGM 4046 Background Value.

Two native silty clay samples from beneath the building were chemically analyzed to determine if the metals were migrating vertically downwards. Similar to the results elsewhere on the property, the lead concentrations in the silty clay in BH00-2 (25 ppm) and BH00-4 (60 ppm) were well below the TAGM 4046 Background Value.

Trace hydrocarbon odours and a slight oily sheen were detected in four of the boreholes drilled through the floor slab. Samples of the fill material from these boreholes were analyzed for VOCs and PAHs. At two of these locations, BH00-3 [4.5 to 6.5 feet (1.4 to 1.7 metres)] and BH00-4 [6.5 to 7.5 feet (2.0 to 2.3 metres)], the concentrations of acetone were 0.23 and 0.25 ppm, respectively. These values marginally exceed the TAGM 4046 Cleanup Objective of 0.2 ppm. The sample from BH00-3 also contained concentrations of 1,2,4-trimethylbenzene (0.33 ppm) and 1,3,5-trimethylbenzene (0.14) that slightly exceeded the STARS1 TCLP

Alternative Guidance Value (0.1 ppm for both parameters). In all four fill material samples, at least three PAH parameters were detected at concentrations above the STARS1 TCLP Alternative Guidance Values, but most results were below the STARS1 Human Health Guidance Values and/or TAGM 4046 Cleanup Objectives. Those organic parameters that did exceed the TAGM 4046 Cleanup Objectives were only slightly above the objectives. As such, the presence of residual petroleum nuisance characteristics beneath the building is not considered a significant concern and does not warrant any action.

Two native silty clay samples situated directly below the fill material were also analyzed for VOCS and PAHs. The concentration of acetone in BH00-2 [5.5 to 6.5 feet (1.7 to 2.0 metres)] was 0.28 ppm, which marginally exceeded the TAGM 4046 Cleanup Objective. The concentration of benzene in this sample (0.019 ppm) slightly exceeded the STARS1 TCLP Alternative Guidance Value (0.014 ppm), but was below both the Human Health Guidance Value (24 ppm) and TAGM 4046 Cleanup Objective (0.06 ppm). The concentrations of PAH parameters were either below the laboratory's MDLs or detectable but well below the STARS1 TCLP Alternative Guidance Value.

4.3.4 Contaminated Soil Volumes

The analytical results described above have provided a clear indication of the lateral and vertical extent of metals and residual petroleum impacts. Based on this data, XCG conducted volume calculations for each area, which was used for estimating remediation costs. A brief description of the assumptions used to carry out the calculations in each area is provided below. The volume estimates are summarized in Table 4.

Based on the results of the initial fourteen soil samples analyzed for TCLP metals, the volumes estimated for each area of the property would be characteristically hazardous. The total lead and TCLP lead concentrations were plotted on a graph to determine a correlation or a value of total lead where the soil would fail TCLP. This curve is presented with the analytical result tables in Appendix B. The results clearly show that total lead concentrations above 10,000 ppm would produce TCLP lead results well over the criteria of 5.0 mg/L. As such, a best-fit curve was made for the ten samples that contained total lead concentrations below 10,000 ppm. This curve indicates that a total lead concentration of approximately 1,700 ppm would produce a TCLP lead value of 5.0 mg/L. As discussed previously, additional TCLP analyses was conducted after the draft RI/FS report (July 5, 2001) was submitted to NYSDEC. Based on the supplementary data, the total lead concentration where the soil can be expected to exceed the TCLP criteria (5.0 mg/L) was estimated to be 4,900 ppm. This concentration is now considered the cut-off concentration for TCLP failure. Details of this study are provided in XCG's letter report (see Appendix G).

In the central undeveloped area, trucking yard, rail siding, parking lot, and building, the concentrations of total lead in almost every soil sample were above this "cut-off" value, and in most cases well above it. As such, the metals-impacted fill in these areas was considered characteristically hazardous. In the west undeveloped area, the concentrations of total lead were more sporadic. However, in practical terms with respect to excavation/soil handling during remediation, the fill material in the west undeveloped area was considered to be hazardous, given that the high lead concentrations in the fill material are present in a scattered pattern in this part of the property.

West Undeveloped Area

The fill material in the west undeveloped area contains a mixture of very high lead concentrations (8,400 ppm to 20,000 ppm), and much lower concentrations (210 ppm to 880 ppm) that are more typical of background concentrations in a developed urban industrial area. These varying concentrations are sporadically located throughout this area with no distinguishable pattern. This was likely the result of historical random placement and grading of metal waste generated from the past industrial operations. Because of this inconsistent pattern of high lead concentrations, the lateral extent of metal-impacted fill was considered to cover the entire west undeveloped area, from boundary to boundary. The vertical limit of metal-impacted fill was inferred to extend the full depth of the fill zone to the contact with the native silty clay. The analytical results of silty clay samples indicated that this soil unit was not impacted by lead. The depth of metals-impacted fill encountered ranged between 2 to 3 feet (0.6 to 0.9 metres). This depth variance was used to estimate a range of volumes.

Central Undeveloped Area

Unlike the west area, the central undeveloped area showed a more consistent pattern of high lead concentrations in the fill material throughout this portion of the property (1,600 ppm to 86,000 ppm). As such, the metal-impacted fill is considered to cover the entire area, from boundary to boundary. The depth of metals-impacted fill in the central undeveloped area varied. A conservative depth range of 4 to 6 feet (1.2 to 1.8 metres) below grade was used to estimate the volume of metals-impacted fill in the general area (i.e. beyond the limits of the lagoon and marsh). In the lagoon, the deepest fill material locations were 10 to 12 feet (3.0 to 3.6 metres) below ground surface. The depth of fill material encountered in the former marsh area was approximately 4 feet (1.2 metres) below grade. These varying depths were used to estimate a volume range of impacted soil.

In addition to the elevated metals, the fill material in the former lagoon and marsh also contained low levels of residual petroleum hydrocarbons. The residual hydrocarbons are considered co-contaminants with the metals. A separate volume for these two areas was calculated, and was included in the total volume (see Table 4). Further, the volumes in the central undeveloped area included approximately 1,300 m^3 (1,700 yd^3) of imported topsoil used in the IRM. Although it is not contaminated, it would be very difficult to scrape this thin layer of topsoil [4 to 5 inches (13 centimetres)] during remediation without it becoming mixed with the underlying impacted fill.

Trucking Yard

The results of the fill material samples from the trucking yard also showed a consistent pattern of elevated lead metals. These boreholes were located at relatively equal spaced locations, and therefore, metals-impacted fill is inferred to cover the entire lateral area of the trucking yard. Analytical results of the underlying silty clay in this area also confirmed that this soil unit has not been impacted. As such, the vertical extent of metals-impacts extends the full depth of the fill material, to the contact with the native silty clay. The depth of fill material in the trucking yard ranged between 4 and 6 feet (1.2 and 1.8 metres) below ground surface.

Low levels of residual petroleum hydrocarbons were encountered in the fill material along the south property line. The residual hydrocarbons are considered co-contaminants with the metals. The volume estimate for this area was included in the total volume for the trucking yard, and is also shown separately in Table 4.

Rail Siding

The concentrations of lead in all boreholes drilled along the rail siding were above the applicable criteria (1,900 ppm to 13,000 ppm). As such, the entire rail siding was considered to be impacted by metals. The vertical limit in this area was also inferred to extend the full depth of the fill material to the native silty clay contact. The depth of fill material encountered along the rail siding ranged between 3 and 4 feet (0.9 and 1.2 metres). The fill material in this area also contained low levels of residual petroleum hydrocarbons, which are considered to be co-contaminants with the metals.

Parking Lot

Based on the analytical results of lead, the fill below the entire parking lot area was inferred to be impacted to the contact with the native silty clay. The depth of fill generally ranged between 1.5 and 2.5 feet (0.5 and 0.75 metres) below grade. The depth of the former tank storage basement located at the south end was approximately 11 feet (3.35 metres) below grade. This area also contained some low level residual petroleum hydrocarbons. Similar to the other areas containing residual petroleum hydrocarbons, these compounds are considered to be co-contaminants with metals.

Building

Volumes of metals-impacted fill below the building were estimated; however, this material is not expected to be removed at this time, as it would require demolishing the building. As such, this volume is shown separately on Table 4. Based on the high lead concentrations, the metals-impacted fill is assumed to be present over the entire footprint of the building, to the bottom of the fill material. The fill material thickness encountered below the floor slab during borehole drilling ranged between 1.2 and 2.4 feet (4 to 8 feet).

TABLE 4
CONTAMINATED SOIL VOLUMES

AREA	VOLUME (M^3)	VOLUME (YD^3)
West Undeveloped Area	3,135 - 4,700	4,100 - 6,150
Central Undeveloped Area [1]	15,936 – 22,097	20,842 – 28,900
Trucking Yard [2]	8,060 – 12,088	10,540 – 15,810
Rail Siding [3]	610 – 815	800 – 1,065
Parking Lot [4]	460 – 690	600- 900
Total	28,201 – 40,390	36,882 – 52,825
Building	7,070 – 14,135	9,245 – 18,490

NOTES:

1. 3,985 to 4,816 m^3 (5,215 to 6,300 yd^3) contains residual petroleum in lagoon/marsh
2. 610 to 810 m^3 (795 to 1,060 yd^3) contains residual petroleum at south side
3. Most of rail siding contains residual petroleum
4. 380 m^3 (500 yd^3) contains residual petroleum at south end of the parking lot

4.4 Groundwater

Groundwater testing was conducted over three sampling events. In October 1998, four monitoring wells were installed in the central undeveloped area (MW98-1 to MW98-3) and trucking yard (MW98-4). The second round of groundwater testing was conducted in three new monitoring wells installed in April 1999, one of which was located in the parking lot (MW99-1) and the other two in the west undeveloped area (MW99-2 and MW99-3). The third round of testing was carried out in May 2000, as part of this RI, and consisted of re-sampling all seven monitoring wells.

In 1998, a total of 6 water samples were submitted to PASC for analyses of various parameters including metals, PAHs, VOCs, and anions. One of these samples was collected from a historical well installed by an unknown party (identified as UW). This well was installed within the fill material of the former lagoon and has since been removed. In addition, a sample of standing surface water in the area of the former lagoon was analyzed for metals. The sample identified as BW1 was a blind field duplicate of MW98-2.

The samples from MW98-1 to MW98-4 were collected from the shallow water-bearing zone in the native silty clay layer. In all samples, the concentrations of magnesium exceeded the TOGS 1.1.1 Guidance Value while sodium exceeded the TOGS 1.1.1 Standard. Considering that the site is located in an urbanized area, the high concentrations of sodium may be attributed to road salting during the winter season. In MW98-3, the concentration of lead was 30 parts per billion (ppb), which slightly exceeded the TOGS 1.1.1 Standard of 25 ppb.

The groundwater sample from UW was collected from perched water in the former lagoon. The concentration of copper (220 ppb) slightly exceeded the TOGS 1.1.1 Standard of 200 ppb. Manganese was detected at 1,100 ppb, which exceeded the TOGS 1.1.1 Standard of 300 ppb. The concentration of lead (73 ppb) in the stagnant surface water sample exceeded the TOGS 1.1.1 Standard of 25 ppb.

Other than acetone (13 ppb) in MW98-2, the concentrations of VOCs in this groundwater sample as well as the sample collected from UW were below the laboratory's MDLs. The detectable concentration of acetone may be a laboratory artifact. The PAH analytical results in MW98-1, MW98-2, and BW1 were all below the laboratory's MDLs. Although there was no visual or olfactory evidence of petroleum impact in the groundwater sample from MW98-3, a number of PAH parameters, including benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene, exceeded the TOGS 1.1.1 Guidance Values.

The concentration of all anions, with the exception of bromide in MW98-4, were below the TOGS 1.1.1 Standards. Bromide in MW98-4 (2,600 ppb) slightly exceeded the TOGS 1.1.1 Guidance Value of 2,000 ppb.

In April 1999, a total of 4 groundwater samples from MW99-1 to MW99-3 were submitted to PASC for analyses of metals. One of these samples was a blind field duplicate of MW99-1 (identified as BW4).

The monitoring wells were installed in the native silty clay stratum. The concentrations of iron in the groundwater from MW99-1 and MW99-2 were 390 ppb and 320 ppb, respectively. These values exceed the TOGS 1.1.1 Aesthetic Standard of 300 ppb. The concentrations of magnesium in the three monitoring wells ranged between 78,000 ppb and 130,000 ppb, which exceeds the TOGS 1.1.1 Guidance Value of 35,000 ppb. The concentrations of sodium (25,000 to 70,000 ppb) also exceeded the TOGS 1.1.1 Guidance Value of 20,000 ppb. Given that the site is located in an urbanized area, the high concentrations of sodium may be attributed to road salting during the winter season. The concentrations of lead in MW99-1 (26 ppb) and MW99-3 (27 ppb) marginally exceeded the TOGS 1.1.1 Standard of 25 μg/L. The concentration in MW99-2 was below the laboratory's method detection limit.

In the third round of groundwater sampling, a total of 8 groundwater samples were collected from the 7 monitoring wells. One of these samples was a field duplicate of MW98-2 (identified as MWBW00-1). As requested by NYSDEC, four of these samples were analyzed for a full scan Target Compound List (TCL)/Target Analyte List (TAL) analysis. The TCL/TAL parameters included metals, VOCs, semi-VOCs, pesticides, and PCBs. The third round of groundwater analyses was conducted by an ELAP and CLP approved laboratory.

The analytical results of metals indicated elevated concentrations of iron, magnesium, and sodium. The concentrations of lead in all groundwater samples were below the TOGS 1.1.1 Standard, except for MW98-3 (765 ppb). This elevated concentration may have been a result of excessive amounts of suspended solids in the water, as the turbidity at the time of sampling was relatively high (100 NTUs). XCG made its best efforts to reduce the turbidity; however, the shallow water-bearing zone is situated in a silty clay soil. In any event, this elevated concentration of lead in the groundwater appears to be an isolated occurrence, based on the results of other testing throughout the property.

Groundwater from monitoring wells MW98-2 (including MWBW00-1), MW98-4, and MW99-2 were also analyzed for VOCs, semi-VOCs, pesticides, and PCBs. The analytical results were either below the laboratory's detection limit or detectable but below the TOGS 1.1.1 Standards or Guidance Values.

Although there are some exceedances of the TOGS 1.1.1 Standards or Guidance Values, with respect to bromide, metals, and PAHs, these values were developed for groundwater that is used as a source of drinking water. The subject property and surrounding area is serviced by a municipal drinking water supply, which draws its water from a surface water body. The Erie County Water Authority indicated to XCG that Lake Erie is the water source for water supplied to the Village of Depew. Since the subject property and surrounding land is situated in a well developed urbanized area, the use of water supply wells are not expected to exist in the study area. Mr. Brian Hourigan of the NYSDEC, Division of Water, indicated that its agency does not have a database of water supply wells installed in this area of New York State. Given that the minor exceedances of a few select compounds are based on drinking water standards and the subject property area does not use groundwater for potable purposes, these elevated concentrations are not considered to be a significant concern.

As such, groundwater remediation is not considered warranted. The media of concern on the subject property is the impacted fill and any remediation should focus on this area only.

4.5 Off-Site Contamination

In addition to the subsurface investigations conducted on the subject property, XCG also carried out a number of investigations on nearby off-site properties. In 1999, surficial soil samples were collected for laboratory analyses from the adjacent property to the west, grass boulevard on the north side of Walden Avenue, and adjacent railway berm to the south. This was followed by a borehole drilling program on the railway berm and additional surficial sampling in 2000. The off-site sampling program conducted by XCG is briefly summarized as follows:

- Collecting 1 surficial soil sample from the adjacent property to the west, Non-Ferrous Metal Casting Co.

- Collecting 11 surficical soil samples from the grass boulevard and 3 surficial soil samples from the residential properties on the north side of Walden Avenue.
- Collecting 12 surficial soil samples from the adjacent railway berm to the south of the subject property.
- Drilling 4 boreholes on the railway berm.
- Collecting 2 soil samples from a catch basin located north of the trucking yard and the storm sewer outfall at Scajaquada Creek.
- Laboratory analyses of 35 soil samples for metals, including two duplicate samples for QA/QC.

One surficial soil sample (JAR1) was obtained from the southeast corner of the adjacent property to the west. Sample JAR1 contained concentrations of a number of metals that exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values. However, the concentration of lead in this sample (340 ppm) was below the TAGM 4046 typical Background Value found in metropolitan areas (500 ppm).

Surficial soil samples JAR2 to JAR12 were collected from the grass boulevard located along the north side of Walden Avenue. The analytical results indicate that a number of metals in these eleven samples exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values. The concentration of lead in samples JAR 6 (630 ppm), JAR 7 (1,400 ppm), JAR 8 (890 ppm), JAR 9 (600 ppm), JAR 10 (1,100 ppm), and JAR 12 (510 ppm) exceeded the typical high end concentration of 500 ppm found in metropolitan areas (as identified in TAGM 4046). These six samples were located across the east half of the subject property.

The three surficial soil samples collected from the residential properties contained similar analytical results, and in two cases, the lead concentrations were higher than on the grass boulevard. The lead concentrations for OS00-1 (3242 Walden Avenue, Unit #4), OS00-2 (3232 Walden Avenue), and OS00-3 (3224 Walden Avenue, between Units 2 and 3) 4,400 ppm, 2,000 ppm, and 800 ppm, respectively. It should be noted that although the TAGM 4046 Background Value for lead is 500 ppm (high end of range), NYSDEC has indicated that the target concentration for residential properties is 400 ppm.

Similar to the other off-site soil samples, the surficial samples collected from the railway berm (RB-SURF1 to RB-SURF12) contained a number of metals, such as copper, lead, and zinc that exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values. The concentrations of lead in all twelve sampling locations, except for RB-SURF12 (380 ppm), exceeded the TAGM 4046 Background Value of 500 ppm found in metropolitan areas. The highest lead concentrations were found along the east half of the railway berm, from the former lagoon to the east side of the subject property. The concentrations in this area ranged from 900 ppm in RB-SURF1 to 13,000 ppm in RB-SURF3.

The analytical results of the fill material from the boreholes drilled on the railway berm showed a similar pattern to the results of the surficial sampling conducted on the berm. The highest lead concentrations were detected in RBH00-1 (4,500 ppm) and RBH00-2 (5,100 ppm), which were located across from the east half of the subject property. Borehole RBH00-3 was situated across from the former lagoon while RBH00-4 was located near the tree-covered area. The lead concentration in the fill material at both these locations was 200 ppm.

A concern was raised by NYSDEC regarding the potential off-site migration of surface soil particles to the storm water sewer system. As such, XCG collected accumulated soil particle samples from a catch basin located on the south side of Walden Avenue, in front of the trucking yard. A second soil sample was obtained from the ground surface adjacent to Scajaquada Creek, near the outfall of the storm sewer. This outfall is located to the northwest of the subject property, at the north end of University Boulevard (see key map on Figure 11). It should be noted that these samples are considered soil samples and not sediment samples. NYSDEC's document entitled "Technical Guidance for Screening Contaminated Sediments," dated November 1993 defines sediments as a collection of fine, medium, and coarse-grained minerals and organic particles found at the bottom of lakes (and ponds), rivers (and streams), bays, estuaries, and oceans. Neither one of the samples (SED00-1 or SED00-2) are considered sediment samples, according to this NYSDEC definition.

The lead concentration in the soil sample from the catch basin (SED00-1) was 1,100 ppm, which exceeds the TAGM 4046 Background Value of 500 ppm. The source of the lead may be from rainwater carrying impacted surface soil particles to the catch basin in the trucking yard, which is connected to the storm sewer. Surface run-off from the undeveloped areas may also be a source, but likely to a lesser degree since the ground surface is flat in this area. Although the lead concentration in this sample is elevated, the results suggest that there has not been significant off-site migration to the storm sewer, given that the concentration was not exceedingly high when compared to the on-site values.

The lead concentration in the soil sample near the outfall (SED00-2) was 520 ppm, which is marginally above the TAGM 4046 Background Value. Since this soil sample was located in an industrial area with other potential sources, it cannot be concluded that this lead concentration originated solely from the subject property. Regardless, NYSDEC requested that the storm sewer pipe be cleaned from the subject property to the outfall. Norampac has agreed that this cleaning work will be conducted as part of the selected remedial alternative for the impacted soil on the subject property.

Following the submission of this report in draft form to NYSDEC on July 5, 2001, XCG conducted two additional off-site soil investigations on the residential properties to the north of the subject property. The first study, which was carried out for Norampac, is summarized in XCG's report entitled "Off-Site Surficial Soil Investigation, Residential Properties Near 3241 Walden Avenue, Depew, New York," dated December 21, 2001. This study consisted of collecting surficial soil samples from twelve residential properties, one sample from the road allowance, and two samples from public properties away from the subject property. A total of thirty soil samples were submitted for laboratory analyses of metals. The findings of this study identified additional properties that contained elevated lead concentrations in the surface soil.

As a result, a second off-site soil investigation was conducted to define the lateral and vertical extent of the lead impacts on the residential properties near the subject site. This consisted of collecting samples from surface (0 to 2 inches) and at depth (6 to 8 inches). A total of 103 soil samples were submitted for laboratory analyses of metals. Based on the findings of these two off-site studies and previous data, it was concluded that twenty-four of the residential properties investigated contained lead concentrations above the NYSDEC residential target value of 400 ppm.

Details of the findings in these studies are provided in the two aforementioned reports, which have been submitted to NYSDEC.

5. BASELINE RISK ASSESSMENT

As part of the RI, a qualitative baseline risk assessment was completed to evaluate the potential threat to human health and the environment in the absence of any remedial actions. Risk assessment is the technical, scientific examination of the nature and magnitude of risk, using a factual base to define the health effects of exposure of individuals or human and ecological populations to contaminants in different exposure situations. Risk assessment involves estimating the likelihood and expected severity of effects on potential human and ecological receptors, taking into account receptor characteristics, the nature of the identified hazards, exposure pathways, and mitigating circumstances. Since the subject property is located in a well developed industrial and residential area, this study focussed primarily on human receptors with some discussions on ecological receptors. Considering the setting of the study area, threatened or endangered species are not expected to exist nearby.

XCG contacted staff at NYSDEC's Wildlife Bureau to obtain any information available on threatened or endangered species in the subject property area. Representatives of the Wildlife Bureau were unable to provide any site-specific information. XCG also consulted NYSDEC's web-site regarding endangered and threatened fish and wildlife in New York State. The categories reviewed included land animals, such as mammals, insects, reptiles, and birds. Although there are no surface water bodies on or adjacent to the subject property, there are nearby creeks that may contain endangered or threatened species (i.e. Scajaquada Creek). Therefore, the list of water animals such as molluscs, fishes, and amphibians was reviewed.

The information provided in the NYSDEC web-site indicated no endangered species inhabit the subject property area. Golden eagle sightings occur every year in New York, including Western New York; however, most are during migration and no active nests are currently known. Threatened bird species noted in the Western New York area include the northern harrier and common tern. The northern harrier is present in this area for breeding purposes. This species is not expected to be present in the study area as breeding occurs in marshes, grasslands, meadows, and cultivated fields. Furthermore, breeding is preferred in coastal areas. The common tern nest predominantly on Long Island in New York State, but are also known to breed in Western New York, including Lake Erie and Lake Ontario. However, this species is not expected to be present near the subject property area, as it breeds on small and artificial islands (i.e. power cribs, piers, navigation sites, etc.).

XCG completed this study using guidance from the USEPA document entitled "Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final," dated July 1989.

The findings of the baseline risk assessment were used to determine whether remedial action is necessary. Since this study was qualitative in nature, detailed exposure and risk calculations were not conducted (i.e. excess lifetime cancer risk or hazard quotients). The goals of the qualitative baseline risk assessment were to:

- Assess the environmental conditions of the media to be remediated (i.e. soil);
- Provide a qualitative assessment of human health risks under the current and future site conditions;
- Identify the qualitative potential impacts to the environment (i.e. non-human receptors entering the site) posed by the type of contaminants at the site; and,
- Provide assistance in determining which remedial alternative is best suited for the site.

Because operations are still ongoing at the site and the usage varies, the human health and environmental risk for different areas of the property was evaluated individually. The subject property was divided into the following three distinct areas or operable units:

- West and Central Undeveloped Areas;
- Trucking Yard and Rail Siding; and,
- Building and Parking Lot.

A risk assessment is comprised of the following four components:

- Contaminant Identification - This step consists of developing a list of contaminants of concern;
- Toxicity Assessment - This step consists of conducting a literature review to identify what are the potential adverse effects on the receptors associated with exposure to the identified contaminants;
- Exposure Assessment – This step involves identifying actual or potential exposure pathways, to characterize the potentially exposed populations, and to determine the extent of the exposure; and,
- Risk Characterization - In this step the information collected in Steps 1 to 3 is combined to quantitatively characterize the risk associated with the current and future conditions on the site.

Since this baseline risk assessment is qualitative in nature, risk characterization (i.e. quantitative component) was not carried out. The risks to potential receptors were evaluated qualitatively.

5.1 Identification of Contaminants of Concern

5.1.1 Groundwater and Surface Water

The analytical groundwater results presented in Section 4 indicated the concentrations of a few selected parameters were detected above the TOGS 1.1.1 Standards. However, these Standards are for groundwater used for drinking purposes. The shallow groundwater beneath the subject property and surrounding area is not used for potable purposes. The subject property and surrounding community receives potable water from a municipal source, which draws its water from Lake Erie. Therefore, the potential risks to human receptors are extremely low, considering that humans are unlikely to contact the groundwater.

Potential ecological receptors to the minor constituents present in groundwater at the site could include fish communities or waterfowl residing in Scajaquada Creek, which is located approximately 0.25 miles (0.4 kilometres) to the north of the subject site. Shallow groundwater is inferred to flow northwesterly and discharge into this creek. However, the risks to ecological receptors from groundwater are expected to be low, considering the geological setting of the subject property area and the relatively low concentrations of contaminants in the groundwater. The true shallow groundwater-bearing zone (i.e. not the perched water zone) is situated in the native silty clay. The migration of any contaminants present in the groundwater towards Scajaquada Creek would be significantly mitigated by the silty clay, given that its consistency is stiff to hard. Furthermore, the concentrations at the point of groundwater discharge, if it has migrated this far, would likely be very low, since the concentrations at the subject property are already relatively low.

There is the potential for risks to ecological receptors in Scajaquada Creek via stormwater migrating from the site. Rain water on-site primarily infiltrates into the ground, due to the relatively flat grade. Some water is also collected in the catchbasin located in the trucking yard. The water in the catchbasin is conveyed to the storm sewer on Walden Avenue, and it is ultimately discharged at Scajaquada Creek. One soil sample collected on land near the outfall contained a lead concentration of 520 ppm, which is comparable to the range of background values identified in TAGM 4046. Since this soil sample was located in an industrial area with other potential sources, it cannot be concluded that this lead concentration originated solely from the subject property. There has not been any surface water sampling conducted at Scajaquada Creek to date. However, given the distance from the subject property, the fact that rain water primarily infiltrates into the ground, and the assimilative capacity of the creek, the risks from contaminants carried by stormwater is likely low.

5.1.2 Soil

As discussed in Section 4, the media of concern on the subject property is impacted soil in the fill material. As such, site remediation will be conducted for metals-impacted fill and the baseline risk assessment was completed for this specific medium. The three separate areas of the property have been identified to contain soils that exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values for selected metals. Considering that the subject property is situated in an area with a long history of industrial operations, the background values for metals would be expected to be high (as opposed to the lower TAGM 4046 Cleanup Objectives). As such, the initial review of potential contaminants of concern involved the identification of metals that exceeded the TAGM 4046 Background Values, which was used as a reference only. These parameters are summarized for the three separate areas (or operable units) in Tables 5 to 7. Low concentrations of residual petroleum hydrocarbons were also detected at selected areas of the property. Since this qualitative baseline risk assessment focussed on evaluating potential human health risks, the petroleum parameters that exceeded the STARS1 Human Health Guidance Values are also identified in Tables 5 to 7. Where Human Health Guidance Values were not available in STARS1, the parameters were assessed against the TAGM 4046 Cleanup Objectives

TABLE 5
CONTAMINANTS IN FILL MATERIAL – WEST AND CENTRAL UNDEVELOPED AREAS

PARAMETER	FREQUENCY OF DETECTION	CONCENTRATION RANGES ABOVE CLEANUP OBJECTIVES (PPM)	BACKGROUND VALUES (PPM)	CLEANUP OBJECTIVES (PPM)
Metals				
Arsenic	6/26	16-42	3-12	7.5 or SB
Mercury	23/26	0.26-29	0.001-0.2	0.1
Barium	9/46	330-1,300	15-600	300 or SB
Cadmium	35/46	1.1-33	0.1-1	1 or SB
Calcium	25/46	38,000-140,000	130-35,000	SB
Chromium	15/46	49-940	1.5-40	10 or SB
Copper	44/46	77-54,000	1-50	25 or SB
Lead	31/46	520-86,000	200-500	200-500 or SB
Magnesium	28/46	5,100-32,000	100-5,000	SB
Manganese	2/46	5,500-8,500	50-5,000	SB
Nickel	39/46	29-810	0.5-25	13 or SB
Zinc	46/46	180-89,000	9-50	20 or SB
VOCs				
Acetone	1/1	0.32	N/A	0.2
PAHs				
benzo(a)anthracene	4/4	0.29-2.1	N/A	0.224 or MDL
benzo(b)fluoranthene	1/4	2.1	N/A	1.1
benzo(k)fluoranthene	1/4	2.1	N/A	1.1
benzo(a)pyrene	3/4	0.33-2.1	N/A	0.061 or MDL
dibenzo(ah)anthracene	1/4	1.4	N/A	0.014 or MDL

NOTES:

Background Values (Eastern USA/New York State) and Cleanup Objectives are from TAGM 4046 "Determination of Soil Cleanup Objectives and Cleanup Levels". For frequency of metals detection, Background Values are used where Site Background (SB) values are the Cleanup Objective (i.e. SB values are not available).

Frequency of Detection – Number of samples detected above Cleanup Objectives or high end of Background Value

N/A Not available

TABLE 6
CONTAMINANTS IN FILL MATERIAL – TRUCKING YARD AND RAIL SIDING

PARAMETER	FREQUENCY OF DETECTION	CONCENTRATION RANGES ABOVE CLEANUP OBJECTIVES (PPM)	BACKGROUND VALUES (PPM)	CLEANUP OBJECTIVES (PPM)
Metals				
arsenic	4/14	13-21	3-12	7.5 or SB
mercury	12/14	0.6-3.3	0.001-0.2	0.1
cadmium	14/16	2.6-20	0.1-1	1 or SB
calcium	5/16	180,000-230,000	130-35,000	SB
chromium	1/16	50	1.5-40	10 or SB
copper	16/16	1,300-39,000	1-50	25 or SB
lead	16/16	1,800-46,000	200-500	200-500 or SB
magnesium	6/16	5,400-11,000	100-5,000	SB
nickel	16/16	40-860	0.5-25	13 or SB
zinc	16/16	1,700-63,000	9-50	20 or SB
VOCs				
acetone	1/5	1.7	N/A	0.2
methylene chloride	5/5	0.45-0.71	N/A	0.1
PAHs				
benzo(a)anthracene	6/7	0.42-4.6	N/A	0.224 or MDL
benzo(b)fluoranthene	5/7	0.61-7.3	N/A	1.1
benzo(k)fluoranthene	4/7	3.4-4.4	N/A	1.1
benzo(a)pyrene	6/7	0.15-6.0	N/A	0.061 or MDL
dibenzo(ah)anthracene	5/7	0.23-1.5	N/A	0.014 or MDL

NOTES:

Background Values (Eastern USA/New York State) and Cleanup Objectives are from TAGM 4046 "Determination of Soil Cleanup Objectives and Cleanup Levels". For frequency of metals detection, Background Values are used where Site Background (SB) values are the Cleanup Objective (i.e. SB values are not available).

Frequency of Detection – Number of samples detected above Cleanup Objectives or high end of Background Value

N/A Not available

TABLE 7
CONTAMINANTS IN FILL MATERIAL – BUILDING AND PARKING LOT

PARAMETER	FREQUENCY OF DETECTION	CONCENTRATION RANGES ABOVE CLEANUP OBJECTIVES (PPM)	BACKGROUND VALUES (PPM)	CLEANUP OBJECTIVES (PPM)
Metals				
arsenic	2/6	16-30	3-12	7.5 or SB
mercury	3/6	0.28-1.4	0.001-0.2	0.1
selenium	1/6	8.5	0.1-3.9	2 or SB
cadmium	12/15	1.2-23	0.1-1	1 or SB
calcium	3/15	99-200	130-35,000	SB
chromium	1/15	50	1.5-40	10 or SB
copper	15/15	58-38,000	1-50	25 or SB
lead	12/15	860-27,000	200-500	200-500 or SB
magnesium	3/15	6,300-26,000	100-5,000	SB
manganese	1/15	6,600	50-5,000	SB
nickel	10/15	26-160	0.5-25	13 or SB
zinc	13/15	330-30,000	9-50	20 or SB
VOCs				
acetone	6/9	0.23-0.4	N/A	0.2
PAHs				
benzo(a)anthracene	8/10	0.31-1.6	N/A	0.224 or MDL
benzo(b)fluoranthene	1/10	1.3	N/A	1.1
Benzo(a)pyrene	6/10	0.28-0.97	N/A	0.061 or MDL

NOTES:

Background Values (Eastern USA/New York State) and Cleanup Objectives are from TAGM 4046 "Determination of Soil Cleanup Objectives and Cleanup Levels". For frequency of metals detection, Background Values are used where Site Background (SB) values are the Cleanup Objective (i.e. SB values are not available).

Frequency of Detection – Number of samples detected above Cleanup Objectives or high end of Background Value

N/A Not available

Although the site has been divided into three operable units, the identification of contaminants of concern was conducted for the property as a whole, since the types of contaminants present are consistent throughout the site. The above tables present a list of parameters that exceeded typical Background Values (for metals) and Human Health Guidance Values (for organics). In carrying out a risk assessment, it is common to narrow the list of potential contaminants of concern to a more manageable number, such that the process can be completed in a focussed and streamlined manner. Indicator chemicals are often chosen to represent the most toxic, persistent, and/or mobile substances of a group that are likely to significantly contribute to the overall risk posed by the site. The history of the site and compounds that were generated from past operations were also taken into consideration when deciding on the contaminants of concern. Other factors considered when narrowing the list of parameters included the frequency of detection, compounds not detected at relatively high concentrations or in large areas, chemicals that have limited or no toxicological effects (e.g. calcium, magnesium), and input from NYSDEC over the last few years. Based on the above, the contaminants of greatest concern were:

- lead;
- copper; and,
- zinc.

All three of these metals were known to have been historically handled on site. The historical brass foundry operations, which were conducted between 1892 and 1972 (i.e. 80 years), smelting operations conducted in the early part of the century, and the processing of babbitt contributed to the elevated levels of lead, zinc, and copper in the fill material. Brass is an alloy of copper and zinc, and babbitt is formed from an alloy of various metals including lead and copper. Of these three metals, lead is considered to be the metal that would have the greatest potential to pose a threat to on-site and off-site receptors, due to the combination of its toxicity and its high on-site concentrations. Antimony is also a common metallurgical component of babbitt. However, investigations conducted to date have not tested for this particular metal. As such, antimony has not been included in the toxicity assessment, since its presence and concentrations have not yet been confirmed. Additional investigations in the future, such as treatability testing, will include analyses of antimony. If present at high concentrations, this parameter may be included in a future revision of the toxicity assessment.

5.2 Toxicity Assessment

As discussed above in Section 5.1, lead, and to a lesser extent copper and zinc, have been identified as the parameters of concern at the subject property with respect to potential to have a toxic effect on human receptors. Information pertaining to the chemical use, health effects, and environmental fate was obtained from various sources including the Agency for Toxic Substances and Disease Registry (ATSDR), Integrated Risk Information System (IRIS), Merck Index, and various USEPA documents. The ATSDR and IRIS information sheets obtained on-line are included in Appendix D.

Summary of Toxicity Information Pertaining to Lead. Lead can affect almost every organ and system in the human body, with the central nervous system being the most sensitive, particularly in children (ATSDR). The Merck Index states that lead may cause weight loss in children, weakness, and anemia, and may be acutely toxic to young children with history of anorexia, vomiting, malaise, or convulsions due to increased intracranial pressure. Lead poisoning in adults is usually occupational due to inhalation of lead dust or fumes. Symptoms would most often include gastrointestinal and central nervous system complaints. The EPA IRIS substance file for lead does not currently provide oral or inhalation reference doses for lead. IRIS classifies the carcinogenicity of lead as B2, a probable human carcinogen, and bases this on animal evidence. Human evidence is inadequate and lacks quantitative exposure information. IRIS does not provide a cancer slope factor for lead.

The mobility of lead, and metals in general, depends on a number factors, including the type and quantity of soil surfaces present, concentrations of metals, concentrations of competing ions and complexing organic and inorganic ligands, pH, and redox potential (EPA Engineering Bulletin EPA/540/S-97/500). As the soil conditions change (e.g. pH, redox, etc.), either by natural processes or human control, the mobility of the metals will potentially change. Under natural conditions, lead is present in cationic forms and generally tends to stay close to the areas of initial deposition.

Summary of Toxicity Information Pertaining to Copper. The Merck Index states that certain copper salts are strong irritants to the skin and mucous membranes, and that copper oxide fumes can cause metal fume fever. Also, a relationship between copper and hemochromatosis has been reported. The EPA IRIS substance file for copper does not currently provide oral or inhalation reference doses for copper. IRIS does not classify the carcinogenicity of copper, as there are no adequate human or animal data, and no unequivocal mutagenicity data.

Summary of Toxicity Information Pertaining to Zinc. The Merck Index states that inhalation of zinc fumes may result in a sweet taste, dry throat, cough, weakness, generalized aching, chills, fever, nausea, and vomiting. Zinc chloride fumes have caused injury to mucous membranes and skin irritation. Ingestion of soluble salts of zinc may cause nausea, vomiting, and purging. The EPA IRIS substance file for zinc provides an oral RfD of 0.3 mg/kg/day. No cancer risk slope factors are provided by IRIS.

5.3 Exposure Assessment

Section 3 provided a detailed description of the physical characteristics of the subject property and surrounding area, and site-specific geology and hydrogeology. This information was used to identify potential receptors, both on-site and off-site, and possible exposure migration pathways. The following is a discussion of all of the exposure pathways, and associated human receptors, that were considered for the subject property.

A hazardous chemical may pose a health risk to humans or the environment only if the human or non-human receptors have the potential to be exposed to the impacted media in sufficient quantity. There are various pathways by which a receptor can be exposed to the contaminants at an uncontrolled hazardous waste site including the following:

- Ingestion of groundwater or surface water containing the contaminants of concern in the dissolved phase;
- Ingestion of impacted soil;
- Ingestion of biota (e.g. fish) which have bioaccumulated a contaminant originating from the hazardous waste site;
- Inhalation of volatile contaminants or air-borne contaminants (i.e. impacted dust); and,
- Dermal absorption by direct contact with the impacted media.

There are four basic elements that must exist for an exposure pathway to be considered complete. These include the following:

1. A waste source and mechanism of chemical release (e.g. leaching, wind scour, surface runoff, and volatilization);
2. A retention or transport media (e.g. groundwater, surface water, air)
3. A potential receptor to contact the impacted medium (e.g. humans, animals); and,
4. An exposure and uptake route (e.g. ingestion, dermal absorption, and inhalation).

A risk to human health and the environment does not exist unless all four of these elements are present together. In the text below, potential receptors to the contaminants of concern are first identified, followed by a general description of for potential off-site exposure scenarios. A description is then provided for potential exposure pathways at each operable unit of the subject property.

In carrying out this qualitative risk assessment, the current and potential future land use of the subject property was taken into consideration when evaluating exposure scenarios. The property is currently zoned industrial and is used for operating paper fibre recycling activities. The property is expected to remain industrial in the future. Norampac does not have any plans to sell the property, or portions of it, for residential redevelopment. This is considered a reasonable assumption, given that the properties along the south side of Walden Avenue, adjacent to the railway corridor, are industrial for a number of miles in either direction. As such, potential current and future on-site receptors include the full-time staff working in the plant area and the truck drivers who routinely enter the site to drop off or pick up the recyclable paper products.

Potential off-site receptors include the adjacent commercial/industrial facilities, residential properties on the north side of Walden Avenue, and trespassers entering the property. A railway borders the south side of the property while a cement factory is located further to the south. A small industrial operation is located adjacent to the west of the property (i.e. Non-Ferrous Metal Casting Company). These two operations are unlikely to be exposed to significant amounts of air-borne contaminants since the prevailing wind direction for the Buffalo area is from the southwest to the northeast (The Buffalo New York National Weather Service web site). Although Non-Ferrous Metal Casting occasionally enters the west side of the property (i.e. its equipment was stored in this area until recently), any appreciable amount of dermal exposure is not expected since the lead concentrations in the surface of the fill material in this part of the site were below the typical background values (as identified in TAGM 4046).

The properties located on the north side of Walden Avenue are predominantly residential, with a mixture of houses and low-rise apartment buildings. Potential receptors consist of human and children in particular. Children are most susceptible to health affects of lead. Potential exposure pathways include inhalation of air-borne impacted dust, and ingestion and dermal absorption with impacted surficial soil on-site.

Ingestion of groundwater by either on-site or off-site receptors is not a pathway of concern, as groundwater is not used for potable purposes in the study area. The Village of Depew is serviced by a municipal water supply, which draws its water from Lake Erie. Furthermore, analytical testing has indicated that the groundwater on-site is not significantly impacted by the contaminants of concern. In addition, the analytical results of the silty clay indicated that the metals in the fill material are not migrating vertically into the very stiff to hard native soil, where the saturated water-bearing zone exists.

5.3.1 West and Central Undeveloped Area

In the central undeveloped area, high concentrations of lead were detected in the profile of the fill material, as well as at surface. Potential migration routes in this part of the property would include dust generated by wind, lateral movement off-site by rain run-off, and direct contact with the impacted soils. It appears that historical migration of wind-borne contaminants has taken place, based on the analytical results of soil samples on the north side of Walden Avenue. Any historical lateral movement of surface soil particles to Walden Avenue, and ultimately to the storm sewer, is expected to be minimal since rainwater primarily infiltrates into the ground due to the flat topography in the area. This notion is supported by the results of the soil sampling adjacent to Scajaquada Creek, which is located about 0.25 miles (0.4 kilometres) north of the subject site. All three of the above-mentioned migration pathways have been eliminated by the implementation of the IRM, which consisted of a hydro-seeded topsoil cover and chain-link fence.

The west undeveloped area contains elevated concentrations of lead in the fill material; however, analytical results of surficial soil samples indicated that the lead level at ground surface is below the TAGM 4046 Background Value. Therefore, the migration pathways of direct contact (i.e. ingestion and dermal absorption) dust transport by wind, and surface run-off are minimal on this portion of the property. There is the potential for some exposure to the neighbour to the west from movement of equipment, which may expose metals-impacted fill beneath the surface. However, the impacts of this potential exposure scenario are likely low, considering that it does not actually carry out any of its operations at this location. Rather, the neighbour is using this area for storage of non-functional equipment. In other words, any exposure would be for a very brief amount of time when the derelict equipment is permanently removed from the site, since no operations are conducted in this area.

Although the potential exposure routes in the west and central areas are currently mitigated, remedial actions will ultimately be required to manage the risks posed by the impacted soil. The objective of implementing the IRM was to temporarily mitigate the potential exposure pathways. The future use of these undeveloped areas has not yet been determined; however, it is anticipated that it will remain industrial.

The subject property is situated in a well-developed industrial/commercial and residential area. Therefore, threatened or endangered species would not likely be present. Animals in the area would be expected to consist of native and migratory birds, and mammals including raccoons, voles, burrowing animals, and possibly deer (tracks were observed on-site). There is a sparse growth of grass in the west undeveloped area. Grass and other shallow vegetation may uptake metals located near the root zone. However, the potential pathway of grazing animals (e.g. deer) ingesting grass in this area is likely insignificant, considering the sparse growth and the expected infrequency of the entry of deer to this area. Burrowing animals are present in the area of the subject property, as there was evidence of these animals in the former soil and debris piles located at the south side of the central undeveloped area. These piles were flattened during the implementation of the IRM. The burrowing animals may be exposed to dermal and ingestion uptake routes. Furthermore, bioaccumlation may occur with respect to predatory animals feeding on burrowing animals, which have been ingested or has come into dermal contact with contaminants. This potential scenario provides further support that remedial action in this area of the property will ultimately be required.

5.3.2 *Trucking Yard and Rail Siding*

Elevated lead concentrations were detected in the fill material in the trucking yard, including soils at surface. In the draft version of the RIFS report, a potential migration pathway considered for this part of the property was the generation of dust particulates in the air by wind scouring. Off-site movement of surface soil particles by rain run-off at the edge of the property was considered another potential migration pathway; however, it was expected to be minimal since the ground surface in this area is relatively flat. Surface run-off of particulates could also occur in the drainage system in the trucking yard, which consists of a catch basin located at the southwest corner connected to the storm sewer on Walden Avenue. The storm sewer empties its waters into Scajaquada Creek at the north end of University Boulevard. A new gravel cover was installed in the trucking yard in November 1999. As such, the above-noted pathways are considered to be historical migration routes and are currently eliminated as a consequence of the new gravel cover. Historical migration of surface soil particles to the storm water drainage system appears to be minimal, based on the analytical results of the soil sampling at Scajaquada Creek. However, historical migration of wind-borne contaminants appears to have taken place since elevated lead concentrations were detected in the surficial soil on the north side of Walden Avenue.

The above potential pathways were considered in the draft version of the RIFS since the trucking yard at that time was gravel-covered. In December 2004, Metro Waste paved the trucking yard to provide a better driving surface for the daily trucks that enter the property to load and unload shipments. The new asphalt pavement consisted of 4.5 inches of binder and 1.5 inches of asphalt topcoat. In addition to the asphalt, a new concrete apron, approximately 6 inches thick, was constructed adjacent to the the west side of the building. The newly installed asphalt pavement in the trucking yard not only provided a better driving surface, it also acts as a barrier to prevent wind scouring, rain water transport, and direct contact.

Metals-impacted fill is present beneath the rail siding located at the south side of the building. This material is covered by the rail ballast (crushed rock), and is therefore not susceptible to generation of impacted dust by wind scour or surface movement of soil particles by rain run-off.

5.3.3 Building and Parking Lot

The metals-impacted fill in the parking lot and beneath the building are currently covered by asphalt and concrete, respectively. As such, these protective measures are eliminating any potential migration routes such as impacted dust particles dispersed into the atmosphere by wind action. The existing covers are also preventing erosion and off-site migration of surface soil by wind and rain. Analytical results of the underlying silty clay and groundwater indicate that the contaminants of concern are not migrating vertically downwards, towards the saturated water-bearing zone. As long as the building remains intact and the integrity of the asphalt is maintained, there are no exposure pathways of concern expected in the near future for this part of the property. However, given the age of the building, there is the possibility that at some time in the future the building may be demolished, in whole or in part. If this takes place, potential exposure pathways could be created. The metals-impacted soil would then have to be properly managed during any demolition and construction work. The metals-impacted soil beneath the existing asphalt in the parking lot would also be managed at the same time as the soil beneath the building.

5.3.4 Off-Site Residential Properties

Surficial soil samples were obtained on the grass-boulevard and on several residential properties on the north side of Walden Avenue and the side streets further to the north. The boulevard samples across the west half of the subject property were comparable to typical background values, as identified in TAGM 4046. Elevated lead concentrations were detected in the samples collected from the residential properties, which were located across the east half of the site. Remediating the impacted areas on the residential properties would reduce exposure of the residents to contaminants.

5.4 Summary of Risks

In summary, the contaminants of concern identified at the subject property are lead and to a lesser extent, copper and zinc. The medium of concern containing these contaminants is the fill material. Given the current conditions on the property, the level of risk posed to human and non-human receptors on the subject property is considered minimal; however, remedial action will be required in the future to mitigate future risks that could arise due to displacement of the current cover materials through natural processes (e.g. erosion) or human activity. The risks to human receptors on the residential properties are likely higher than on the subject property, given that there are no measures in place to mitigate the exposure routes. The extent of residential properties that may be affected has been defined to a certain extent. The two off-site sampling programs have delineated the the lead impacts to the north; however, the eastern extent has not been completely defined, as the two most easterly properties sampled contained lead concentrations above the NYSDEC residential criteria of 400 ppm.

6. *Identification and Screening of Technologies*

6.1 *Introduction*

The first portion of this report (Sections 1 to 5) consisted of the Remedial Investigation (RI). The RI characterized the subsurface environmental conditions on the subject property and the potential risks posed by the contaminants of concern. The remainder of this report forms the Feasibility Study (FS). XCG carried out the FS using the guidance outlined in the USEPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," dated October 1988 and NYDSEC's TAGM 4030 entitled "Selection of Remedial Actions at Inactive Hazardous Waste Sites," dated May 15, 1990. The procedures outlined in these two documents are similar in nature.

The main objective of the FS is to identify potentially applicable remedial technologies and assembling them into various alternatives to provide a site-wide soil management program. The FS was completed in three primary phases: development of alternatives, preliminary screening of alternatives, and detailed analysis of alternatives.

As such, the FS part of this report is divided into three main sections. Section 6 describes the identification and screening of potential remedial technologies. This section presents the remedial action objectives and the technologies that may potentially be applicable to address these objectives. The development and preliminary screening of alternatives are summarized in Section 7. At this stage, the alternatives are assessed on their effectiveness and implementability, while costs are not used as a screening factor. The goal of the preliminary screening is to narrow the list of potential alternatives to a more manageable number that will be evaluated further in detail. Section 8 presents the detailed analysis of remedial alternatives, which passed the preliminary screening step. The relevant information and assessment of each alternative against the seven evaluation criteria outlined in TAGM 4030 are discussed in this section. The results of the detailed analyses of each alternative are compared against each other to select a preferred site remedy option.

6.2 *Remedial Action Objectives*

The remedial action objectives for each media where a complete exposure pathway may potentially pose a risk to human health and the environment are discussed below. The objectives are summarized in Table 8, which also includes the general response actions, remedial technology types, and process options potentially applicable to meet these objectives.

6.2.1 *Soil*

Given that different portions of the subject property is used for various purposes, it was divided into three main areas or operable units in developing alternatives to meet the remedial action objectives for soil. The first operable unit consists of the undeveloped west and central portions of the property. The second operable unit is the exterior operational area, which is comprised of the trucking yard and rail siding. The third operable unit consists of the existing covered ground surface areas, including the site building and the asphalt parking lot at the east side of the property.

The lateral and vertical extent of metals-impacted soil on the subject property was identified and delineated in Section 4.3. The analytical results indicated that a majority of the fill material contains various metals, and lead in particular, at concentrations that exceed the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values. Section 5 presented a qualitative baseline risk assessment, which identified the contaminants of concern, their toxicities, and potential exposure pathways that could pose a risk to on-site and off-site receptors. Although multiple metals are present at concentrations above the TAGM 4046 Cleanup Objectives or Background Values, the main metal of concern is lead, based on the elevated concentrations and its toxicity to human receptors. Copper and zinc were also identified as contaminants of concern as these two metals, in addition to lead, were historically handled and processed on-site. However, lead is much more toxic than copper and zinc, and is a characteristic hazardous parameter. As such, lead was chosen as the indicator parameter for the remediation of metals-impacted soil. Nonetheless, the soil remedy option selected to manage the lead needs to concurrently address copper, zinc, and other metals. For alternative technologies, such as chemical fixation, co-treatment of other metals can be verified by bench-scale treatability tests or field-scale pilot tests. Initial treatability tests were conducted to determine the leachability of lead after application of a chemical fixation compound, since this is the main metal of concern. The results are discussed in Section 8.

Typical Background Values for lead in metropolitan areas identified in TAGM 4046 ranges from 200 to 500 ppm. Considering that the subject property is located in an industrialized urban area and along a railway corridor, the background values for lead in the study area would be expected to be on the high end of this range. TCLP analyses conducted in the site characterization investigations indicated that leachable levels of lead exceed the regulatory criteria of 5.0 mg/L, thereby rendering the fill material to be characteristically hazardous, in accordance with 6 NYCRR Part 371. Based on the above, the remedial action objective for fill material is to prevent ingestion, dermal absorption, and inhalation of soil with total lead concentrations in excess of 500 ppm.

Considering that the property is located in a setting with a long industrial history, Norampac and NYSDEC have had past discussions on increasing the cleanup goal for total lead concentrations (e.g. 1,000 ppm), but there has been no agreement to date. As such, the target concentration for total lead at this time will be 500 ppm, and XCG understands that the possibility of increasing the number still remains. The cross-sections presented in Section 3.3 (see Figures 5 to 8) provide a good view of the change in lead concentrations with depth. The high lead concentrations are representative of the conditions throughout the profile of the fill material, since the samples analyzed were collected as a composite. The cross-sections clearly show that the lead concentrations drastically decrease, to levels well below the TAGM 4046 background values, near the top of the silty clay unit.

Residual petroleum hydrocarbon impacts were detected in the fill material at selected areas, but to a much lesser extent. Low levels of petroleum impacts were limited to the rail siding, former lagoon and marsh area, south part of the trucking yard, and south side of the parking lot. Residual petroleum compounds were also detected beneath the building; however, the analytical results were low and indicate that they are not at levels requiring any further actions. The petroleum impacts are situated within the same medium (i.e. fill material) as the elevated metals and are considered to be co-contaminants with the metals. The concentrations of selected VOCs and PAHs were considered to be relatively low, as some of these parameters slightly exceeded the STARS1 TCLP Alternative Guidance Values, but many were below the STARS1 TCLP Alternative Guidance Values or TAGM 4046 Cleanup Objectives. Considering the low concentrations and the fact that there are no exposure pathways to these organic parameters (i.e. below surface and contained by hard silty clay), the selection of a preferred remedial alternative focused on metals and cleanup goals were not identified for the low level residual petroleum.

The volumes of metals-impacted fill in the three operable units were estimated and discussed in Section 4.3.4.

6.2.2 Groundwater

A total of seven monitoring wells have been installed on the subject property. Groundwater samples from each of these wells have been collected on two separate occasions for laboratory analyses. Analytical results were compared with the TOGS 1.1.1 Standards. Of the 14 groundwater samples analyzed, there was only one sample that contained an elevated concentration of lead. However, the consideration of this sample as being elevated was based the TOGS 1.1.1 Standard, which was designed for groundwater used for potable purposes. The groundwater in the study area is not used for drinking purposes. Further, the shallow groundwater beneath the subject property is situated in low hydraulic conductivity soil formation (i.e. silty clay), which limits migration of any contaminants that may have migrated vertically to the watertable. Given that the contaminant concentrations are relatively low and migration is limited by the hard native soil, groundwater remediation is not considered necessary for the subject property. As such, groundwater remedial action goals were not developed.

6.3 Standards, Criteria, and Guidelines

In the USEPA RI/FS guidance document, applicable or relevant and appropriate requirements (ARARs) establishes a framework for the selection of a remedial alternative. New York State does not have ARARs in it statute. Rather, New York State Standards, Criteria, and Guidelines (SCGs) are used, in accordance with TAGM 4030 "Selection of Remedial Actions at Inactive Hazardous Waste Sites." An alternative should not be considered for further evaluation if it does not meet the SCGs and if a waiver to an SCG is not justifiable.

SCGs are site specific, and therefore, this section identifies those that are applicable to the remediation of the subject property. SCGs are commonly separated into three general types: chemical specific, action specific, and location specific. As identified by USEPA, chemical specific requirements are usually health or risk based numerical values, which establishes acceptable concentrations that may be found or discharged to the environment. Action specific requirements are usually technology or activity based requirements or limitations on actions taken at hazardous wastes. Location specific requirements restrict the concentrations of hazardous substances or the conduct of activities solely because they occur in special locations. NYSDEC provided an index to New York State SCGS, and those that are considered applicable for the remediation of the subject property are discussed in the following subsections.

6.3.1 Chemical Specific SCGs

Chemical specific SCGs are summarized as follows:

- TAGM 4046 – Determination of Soil Cleanup Objectives and Cleanup Levels;
- 6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes; and,
- 6 NYCRR Part 376 – Land Disposal Restrictions.

As discussed in the preceding section, the medium of concern on the property is metals-impacted fill. The preliminary cleanup goal for lead, which was chosen as the indicator parameter, is 500 ppm. This was based on the high number in the range of typical background values, as identified in TAGM 4046. The higher value was considered appropriate, given that the property is situated in an industrialized area adjacent to a railway corridor. The determination of whether a waste is considered hazardous is outlined in Title 6 of the New York Official Compilation of Codes, Rules, and Regulations (6 NYCRR) Part 371. A solid waste exhibits the characteristic of toxicity (i.e. hazardous) if, based on the Toxicity Characteristic Leachate Procedure (TCLP) test, it contains any contaminants at a concentration equal to or greater than the values listed in Section 371.3. The TCLP limit for lead (Hazardous Waste Number D008) is 5.0 mg/L. Hazardous soil, which has been treated to non-hazardous levels, must meet the more stringent UTS values (0.37 mg/L for TCLP lead) for off-site disposal at a permitted landfill.

6.3.2 Action Specific SCGs

Action specific SCGs are summarized as follows:

- 6 NYCRR Part 360 - Solid Waste Management Facilities;
- 6 NYCRR Part 370 – Hazardous Waste Management System: General;
- 6 NYCRR Part 372 – Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities;

- 6 NYCRR Subpart 373-1 – Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements;
- 6 NYCRR Part 375 – Inactive Hazardous Waste Disposal Site Remedial Program;
- TAGM 4030 – Selection of Remedial Actions at Inactive Hazardous Waste Sites;
- TAGM 4031 – Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites; and
- 29 CFR Part 1910.120 – Hazardous Waste Operations and Emergency Response.

TCLP testing conducted on numerous soil samples indicate that the metals-impacted fill on the subject property is characteristically hazardous. However, specific remedial technologies applied to the metals-impacted fill may render the soil a non-hazardous waste (e.g. soil washing, solidification/stabilization, etc.). Further, remedial alternatives may include the disposal of metals-impacted fill, either treated or not, both on-site or at off-site permitted facilities. The management, transportation, and disposal of metals-impacted fill, either hazardous or non-hazardous, are regulated by 6 NYCRR Part 360 and Parts 370 to 376.

As noted above in Section 6.1, TAGM 4030 was used as a guide in this FS to develop remedial alternatives and select a preferred site remedy option. In carrying out any remedial actions, generation of dust particles will likely occur, and the monitoring and suppression of fugitive dust should follow the guideline in TAGM 4031. Remedial activities must ensure the health and safety of all on-site workers and any potential off-site receptors encountered during the performance of such actions. Health and safety at hazardous waste sites is regulated by Title 6 of the Code of Federal Regulations (29 CFR) Part 1910.120, and is administered by the Occupational Safety and Health Administration (OSHA).

6.3.3 Location Specific SCGs

No location specific SCGs were identified for the remediation of the subject property. The property is not located adjacent to a surface water body and there are no wetlands on-site.

6.4 General Response Actions

General response actions are actions that will satisfy the remedial action objectives identified in Section 6.2. Similar to remedial action objectives, general response actions are medium-specific. The general response actions determined to be applicable to address these objectives included institutional actions, containment actions, and excavation/treatment actions. In accordance with the USEPA RI/FS guidance document, no action was also considered to provide a baseline alternative for comparison purposes. The general response actions are summarized in Table 8 and discussed below.

6.4.1 No Action

The No Action general response action does not include any specific technologies. Rather, it is used to describe the risks posed to human health and the environment if remedial actions are not conducted. No Action is required for consideration under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, see 40 CFR 300). It is typically carried through the alternative development and screening process, and is used as a basis for assessing other alternatives.

6.4.2 Institutional Actions

Institutional Actions are legal local or state restrictions that can be enacted to protect human health and the environment in the area of the subject property. Other Institutional Actions include access restrictions (e.g. fencing) to prevent direct contact with the contaminated media.

6.4.3 Containment Actions

Containment Actions include remedial technologies that prevent direct contact by isolating the metals-impacted fill. The objective is to prevent the migration of contaminants to the receptor such that exposure pathways are not completed.

TABLE 8
REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPE, AND PROCESS OPTIONS

MEDIA	REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS
Soil	Prevent ingestion/ dermal absorption/ inhalation with soil having lead in excess of 500 ppm	No Action	No Action	Groundwater monitoring
		Institutional Actions	Institutional Options Action Restrictions Access Restrictions	Land Use Restrictions, Deed Restrictions Fencing

TABLE 8 (CONT'D)
REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPE, AND PROCESS OPTIONS

MEDIA	REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS
Soil		Containment Actions	Containment Technologies: Capping	Clay/Soil, Asphalt, Concrete, Geosynthetic Liner
		Excavation/ Treatment Actions: Excavation/ Disposal	Removal Technologies: Excavation	Solids Excavation
		In-Situ Treatment Ex-Situ Treatment	In-Situ Physical/Chemical Treatment Technologies: Separation	Electrokinetic Separation, Soil Flushing
			Solidification/ Stabilization	In-Situ Cement-based S/S, In-Situ Vitrification
			Ex-Situ Physical/Chemical Treatment Technologies:	Soil Washing/Acid Leaching
			Separation	
			Solidification / Stabilization/ Chemical Fixation	Ex-Situ Cement-based S/S, Ex-Situ Vitrification, Enviro-Blend® (American Minerals Inc.), Molecular Bonding System (Solucorp Industries), Advanced Chemical Treatment (Marcor Remediation Inc.)
			Pyrometallurgical Technologies	Roasting/Retorting/ Smelting, High Temperature Extraction and Immobilization, Incinerators

6.4.4 Excavation/Disposal/Treatment Actions

Excavation/Disposal/Treatment Actions include technologies that reduce the toxicity, mobility, or volume of the contaminants. These actions can be achieved by excavation and ex-situ treatment, or treating the contaminated media in-situ. Treated or untreated soil can be disposed of at an off-site permitted landfill or backfilled on-site.

6.5 Technology Types and Process Options

As mentioned previously in Section 6.1, XCG carried out the FS using guidance from both the USEPA RI/FS document and NYSDEC's TAGM 4030. However, the latter document was primarily used in developing and selecting a preferred remedial alternative. NYSDEC concurs with the federal Superfund Amendment and Reauthorization Act's (SARA) position on remedial technologies, which gives preference to those "that, in whole or in part, will result in a permanent and significant decrease in the toxicity, mobility, or volume of hazardous substances, pollutants or contaminants," to the maximum extent practicable. TAGM 4030 sets a hierarchy of remedial technologies and considers only on-site or off-site destruction, or separation/treatment or solidification/chemical fixation of inorganic wastes as permanent remedies. This hierarchy is summarized as follows:

- Destruction;
- Separation/Treatment;
- Solidification/Chemical Fixation;
- Control and Isolation Technologies; and
- Off-Site Land Disposal.

Furthermore, NYSDEC requires that preference be given to technologies that have:

1. Been successfully demonstrated on a full-scale or a pilot scale under Federal Superfund Innovative Technology Evaluation (SITE) Program;

   or

2. Been successfully demonstrated on a full-scale or pilot-scale at a Federal Superfund site, at a Federal facility, at a State Superfund site anywhere in the country, at a potentially responsible party (PRP) site overseen by a State environmental agency or USEPA;

   or

3. A Resource Conservation and Recovery Act (RCRA) Part B permit;

   or

4. A RCRA Research and Development permit;

   or

5. A documented history of successful treatment such as granulated activated carbon unit.

With this in mind, XCG conducted a search and review of available technology types and process options that would be potentially applicable for the remediation of metals-impacted fill, and lead in particular. In the FS process, "technology types" refer to general categories of technologies, such as capping, separation, and solidification/stabilization. The term "process options" refers to specific processes within each technology type. For example, the capping technology type would include such process options as clay/soil cover, asphalt, concrete, and geosynthetic clay liners. XCG accessed the Federal Remediation Technology Roundtable (http://www.frtr.gov) and USEPA Reachit (http://www.epareachit.org) websites to review available technologies.

Some technologies and associated process options are emerging and relatively unproven, while others have a proven track record of success. As such, XCG consulted the USEPA Engineering Bulletin entitled "Technology Alternatives for the Remediation of Soils Contaminated with As, Cd, Cr, Hg, and Pb (EPA/540/S-97/500)," dated August 1997, to narrow the universe of alternatives considered. To further streamline the technology selection process, such that the FS is completed in an efficient manner, XCG referenced the USEPA document entitled "Presumptive Remedy for Metals-in-Soil Sites (EPA/540/F/98/054)," dated September 1999. In this document, presumptive remedies are defined as preferred technologies or response actions for sites with similar characteristics, and are based on patterns of historical remedy selection practices. This document identifies two presumptive remedies for metals-impacted soil: 1) reclamation/recover (e.g. soil washing), and 2) immobilization (i.e. solidification/stabilization). As such, these two technology types were strongly considered in the evaluation process, keeping in mind the hierarchy outlined in TAGM 4030. Although these two technologies are considered most suitable for the inorganic contaminants, other potentially applicable technologies were identified and screened out in the following sections, as deemed appropriate. The potential technologies were also evaluated on its suitability for each of the three operable units, taking into consideration that these areas are used for different purposes.

A description of technology types and associated process options for each general response action is provided below. The process options were screened and those that were not considered effective or that could not be implemented technically at the subject property were eliminated. The objective of this screening process was to reduce the number of potentially applicable process options in order to streamline the alternative development step. If possible, one process option was retained to represent a specific technology type or entire technology types were eliminated, if deemed appropriate. An initial screening of technology types and process options, with respect to effectiveness for addressing the hazardous constituents, was first conducted and is summarized in Table 9. Process options that passed the initial screening process were then further evaluated to determine their effectiveness and implementability for each of the three operable units (see Tables 10 to 12).

6.5.1 No Action

Description

As described above, there are no specific remedial technologies for No Action as a general response action. Although the term "no action" is used, some minimal activities including regular groundwater monitoring would be required to verify that the contaminants of concern are not leaching into the shallow groundwater.

TABLE 9
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	None	Not applicable	No action (some groundwater monitoring)	Required for consideration by NCP
Institutional Actions	Access restrictions	Fencing	Fence around west and central areas	Potentially applicable
	Action restrictions	Land use restrictions	Restricts land use	Potentially applicable
	Action restrictions	Deed restrictions	Restricts land use	Potentially applicable
Containment Action	Capping	Clay and soil	Compacted clay with vegetated soil over contaminated areas	Potentially applicable
		Asphalt	Asphalt over contaminated areas	Potentially applicable
		Concrete	Concrete slab over contaminated areas	Potentially applicable
		Geosynthetic liner	GSL liner with clay and vegetated soil cover placed over contaminated area	Potentially applicable
Excavation/ Treatment Action	Excavation/ Disposal	Excavation and Off-Site Disposal	Excavate contaminated soil and dispose in permitted landfill	Potentially applicable
		Excavation and On-Site Disposal	Excavate contaminated soil, treat, and dispose on-site	Potentially applicable
	In-Situ Separation	***Electrokinetic Separation***	Electrodes placed in soil with low-intensity current passed through soil. Metals migrate to electrodes	Not applicable since it is an emerging technology with limited use in US. Not tested in SITE program.

TABLE 9 (CONT'D)
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Excavation/ Treatment Action	In-Situ Separation	***Soil Flushing***	Extraction of metals from soil in-situ with water or other suitable aqueous solution	Not applicable. Difficulties withdrawing flushing fluids in shallow contaminants. Soil flushing is also more preferable for single target metal than multiple metals.
	In-Situ Solidification/ Stabilization	***In-Situ Cement-based Solidification/ Stabilization***	Mixing of soil in-situ with cement mixture immobilizes the metals in a monolithic block.	Not applicable. Monolithic block with volume increase limits potential future development.
		In-situ Vitrification	Electrical current passed through the soil by an array of electrodes to immobilize metals in a glassy monolithic block.	Not applicable. Mostly applied to non-volatile metals with glass solubilities exceeding the contamination level.
	Physical and Aqueous Separation	Soil Washing	Excavated soil is screened, processed and washed to physically separate metals from soil particles.	Potentially applicable
	Ex-Situ Solidification/ Stabilization/ Chemical Fixation	Ex-Situ Cement-Based S/S	Mixing excavated contaminated soils cement or similar binder/stabilizer, to create a monolithic block.	Potentially applicable
		EnviroBlend® (Americal Metals Inc.)	A stabilization technology, EnviroBlend is a proprietary fine, dry powder, which is mixed with contaminated soil to render the metals virtually insoluble.	Potentially Applicable

TABLE 9 (CONT'D)
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Excavation/ Treatment Action	Ex-Situ Solidification/ Stabilization/ Chemical Fixation	Molecular Bonding System ® (Solucorp Industries Ltd.)	A stabilization technology, MBS is a powdered proprietary reagent, which is mixed with contaminated soil to permanently reduce the leachability of metals in soil.	Potentially Applicable
		Advanced Chemical Treatment (Marcor Remediation Inc.)	ACT is a chemical fixation technology which mixes proprietary reagents with the contaminated soil to reduce its solubility	Potentially Applicable
	Pyrometallurgical Technologies	***Roasting/ Retorting/ Smelting***	Elevated temperature technique for extraction and processing of metals	Not applicable. Most applicable to concentrations higher than 5 to 20 %. Typically an off-site technology which is not feasible if supplier is not nearby.
		High Temperature Extraction and Immobilization	High temperatures causes volatile metals to separate from soil and immobilized in fly ash	Not applicable. Most applicable to concentrations higher than 5 to 20 %. Typically an off-site technology which is not feasible if supplier is not nearby.
		Incinerators	High temperatures capture volatile metals in exhaust gas and immobilizes non-volatile metals in bottom ash or slag.	Not applicable. Most applicable to concentrations higher than 5 to 20 %. Typically an off-site technology which is not feasible if supplier is not nearby.

NOTE:
Bolded and italicized technologies are screened out.

TABLE 10

EVALUATION OF PROCESS OPTIONS FOR WEST AND CENTRAL UNDEVELOPED AREAS

SOIL GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY
No Action	None	**No Action (some groundwater monitoring)**	Does not achieve remedial action objectives	Not acceptable to regulatory agencies
Institutional Actions	Access Restrictions	**Fencing**	Effective in limiting access to the site. Does not reduce contaminant levels	Easily constructed. Not acceptable to regulators if used alone.
	Action Restrictions	Land Use Restrictions	Useful in limiting exposures. Does not reduce contaminant levels	Land use changes may be difficult to implement
		Deed Restrictions	Effectiveness depends on continued future implementation. Does not reduce contaminant levels.	Legal requirement
Containment Action	Capping	Clay and Soil	Effective in preventing exposure. Susceptible to cracking and requires O & M.	Easily implemented using conventional construction equipment. Availability of nearby clay pit affects ease of implementation. Limits future development of west and central areas.
		Asphalt	Effective in preventing exposure. Susceptible to weathering and requires O & M.	Easily implemented using conventional construction equipment. Limits future development of central and west areas.
		Concrete	Effective in preventing exposure. Susceptible to weathering and requires O & M.	Easily implemented using conventional construction equipment. Limits future development on central and west areas.

TABLE 10 (CONT'D)
EVALUATION OF PROCESS OPTIONS FOR WEST AND CENTRAL UNDEVELOPED AREAS

SOIL GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY
Containment Action	Capping	**Geosynthetic liner**	Effective in preventing exposure.	GSL readily available and relatively easy to lay down. Limits future development of west and central areas.
Excavation/ Treatment Action	Excavation/ Disposal/ Management	**Excavation and Off-Site Disposal**	Effective in reducing risks at site. Transfers risks to landfill.	Easily implemented.
		Excavation and On-Site Management After Treatment	Effective.	Easily implemented. Does not exhaust available landfill space and natural resources (i.e. imported fill)
	Physical and Aqueous Separation	**Soil Washing**	Effectiveness and reliability will depend on treatability tests.	Moderately difficult to implement. Construction of treatment equipment required.
	Ex-Situ Solidification/ Stabilization/ Chemical Fixation	Ex-Situ Cement-Based S/S	Effectiveness and reliability will depend on treatability tests.	Readily implemented. Volume increase would impact off-site disposal or limit future development if disposed on-site.
		EnviroBlend® (RMT Inc. and Americal Metals Inc.)	Effectiveness and reliability will depend on treatability tests.	Readily implemented. Volume increase much lower than cement-based S/S.
		Molecular Bonding System ® (Solucorp Industries Ltd.)	Effectiveness and reliability will depend on treatability tests.	Readily implemented. Volume increase much lower than cement-based S/S.
		Advanced Chemical Treatment (Marcor Remediation Inc.)	Effectiveness and reliability will depend on treatability tests.	Readily implemented. Volume increase much lower than cement-based S/S.

NOTE:

Bolded process options retained to represent technology types

TABLE 11
EVALUATION OF PROCESS OPTIONS FOR TRUCKING YARD AND RAIL SIDING

SOIL GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY
No Action	None	**No Action (some groundwater monitoring)**	Does not achieve remedial action objectives	Not acceptable to regulatory agencies
Institutional Actions	Access Restrictions	**Fencing**	Effective in limiting access to the site. Does not reduce contaminant levels	Easily constructed. Not acceptable to regulators if used alone.
		Land Use Restrictions	Useful in limiting exposures. Does not reduce contaminant levels	Land use changes may be difficult to implement
		Deed Restrictions	Effectiveness depends on continued future implementation. Does not reduce contaminant levels.	Legal requirement
Containment Action	Capping	Clay and Soil	Effective in preventing exposure. Susceptible to cracking and requires O & M.	Cannot implement as this area is used by heavy trucks.
		Asphalt	Effective in preventing exposure. Susceptible to weathering and requires O & M.	Easily implemented using conventional construction equipment. May cause some disruption of regular site operations in trucking yard.
		Concrete	Effective in preventing exposure. Susceptible to weathering and requires O & M.	Easily implemented using conventional construction equipment. May cause some disruption to operation of business in trucking yard.

TABLE 11 (CONT'D)
EVALUATION OF PROCESS OPTIONS FOR TRUCKING YARD AND RAIL SIDING

SOIL GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY
Containment Action	Capping	Geosynthetic liner	Effective in preventing exposure.	Cannot implement as this area is used by heavy trucks.
Excavation/ Treatment Action	Excavation/ Disposal/ Management	**Excavation and Off-Site Disposal**	Effective in reducing risks at site. Transfers risks to landfill.	Implementation may cause significant disruption to operation of business in trucking yard.
		Excavation and On-Site Management After Treatment	Effective.	Easily implemented. Does not exhaust available landfill space and natural resources (i.e. imported fill)
	Physical and Aqueous Separation	**Soil Washing**	Effectiveness and reliability will depend on treatability tests.	Moderately difficult to implement. Construction of treatment equipment required. Soil excavation may cause significant disruption to operation of business in trucking yard.
	Ex-Situ Solidification / Stabilization / Chemical Fixation	Ex-Situ Cement-Based S/S	Effectiveness and reliability will depend on treatability tests.	Readily implemented. Volume increase would impact off-site disposal or future development if disposed on-site.
		EnviroBlend® (RMT Inc. and Americal Metals Inc.)	Effectiveness and reliability will depend on treatability tests.	Readily implemented. Volume increase much lower than cement-based S/S. Soil excavation disruptions.

TABLE 11 (CONT'D)
EVALUATION OF PROCESS OPTIONS FOR TRUCKING YARD AND RAIL SIDING

SOIL GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY
Excavation/ Treatment Action	Ex-Situ Solidification/ Stabilization/ Chemical Fixation	Molecular Bonding System ® (Solucorp Industries Ltd.)	Effectiveness and reliability will depend on treatability tests.	Readily implemented. Volume increase much lower than cement-based S/S. Soil excavation disruptions
		Advanced Chemical Treatment (Marcor Remediation Inc.)	Effectiveness and reliability will depend on treatability tests.	Readily implemented. Volume increase much lower than cement-based S/S. Soil excavation disruptions.

NOTE:

Bolded process options retained to represent technology types.

TABLE 12
EVALUATION OF PROCESS OPTIONS FOR BUILDING AND PARKING LOT

SOIL GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY
No Action	None	**No Action (some groundwater monitoring)**	Does not achieve remedial action objectives	Not acceptable to regulatory agencies
Institutional Actions	Access Restrictions	**Fencing**	Effective in limiting access to the site. Does not reduce contaminant levels	Easily constructed. Not acceptable to regulators if used alone.
	Action Restrictions	Land Use Restrictions	Useful in limiting exposures. Does not reduce contaminant levels	Land use changes may be difficult to implement
		Deed Restrictions	Effectiveness depends on continued future implementation. Does not reduce contaminant levels.	Legal requirement

TABLE 12 (CONT'D)
EVALUATION OF PROCESS OPTIONS FOR BUILDING AND PARKING LOT

SOIL GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY
Containment Action	Capping	Clay and soil	Effective in preventing exposure. Susceptible to cracking and requires O & M.	Not implementable as area is used for parking.
		Asphalt	Effective in preventing exposure. Susceptible to weathering and requires O & M.	Parking lot already paved with asphalt.
		Concrete	Effective in preventing exposure.	Concrete floor in building already exists.
		Geosynthetic liner	Effective in preventing exposure.	Not implementable as area is used for parking.
Excavation / Treatment Action	Excavation / Disposal/ Management	**Excavation and Off-Site Disposal**	Effective in reducing risks at site. Transfers risks to landfill.	Cannot be implemented for soil beneath building. Easily implemented for parking lot.
		Excavation and On-Site Management After Treatment	Effective.	Cannot be implemented for soil beneath building. Does not exhaust available landfill space and natural resources (i.e. imported fill)
	Physical and Aqueous Separation	**Soil Washing**	Effectiveness and reliability will depend on treatability tests.	Moderately difficult to implement. Construction of treatment equipment required.
	Ex-Situ Solidification / Stabilization / Chemical Fixation	Ex-Situ Cement-Based S/S	Effectiveness and reliability will depend on treatability tests.	Readily implemented. Volume increase would impact off-site disposal or future development if disposed on-site.
Excavation / Treatment Action	Ex-Situ Solidification / Stabilization / Chemical Fixation	**EnviroBlend® (RMT Inc. and Americal Metals Inc.)**	Effectiveness and reliability will depend on treatability tests.	Readily implemented. Volume increase much lower than cement-based S/S.
		Molecular Bonding System ® (Solucorp Industries Ltd.)	Effectiveness and reliability will depend on treatability tests.	Readily implemented. Volume increase much lower than cement-based S/S.

TABLE 12 (CONT'D)
EVALUATION OF PROCESS OPTIONS FOR BUILDING AND PARKING LOT

SOIL GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY
		Advanced Chemical Treatment (Marcor Remediation Inc.)	Effectiveness and reliability will depend on treatability tests.	Readily implemented. Volume increase much lower than cement-based S/S.

NOTE:

Bolded process options retained to represent technology types

Screening

Although No Action does not achieve the remedial action objectives identified for metals-impacted fill, it will be considered for further evaluation in accordance with the NCP.

6.5.2 Institutional Actions

Description

Institutional Actions included both action restrictions and access restrictions for the three main areas on the subject property. Applicable process options consisted of land use restrictions, deed restrictions, and fencing.

Land use restrictions and deed restrictions are designed to reduce risks of direct contact with the metals-impacted fill by restricting the activities that can be carried out on the subject property or specific areas of the property. Access to the contaminated areas would be limited by installing a fence around these areas, thereby reducing the risks of direct contact with the metals-impacted fill. Groundwater monitoring would also likely be required to confirm that this medium is not being impacted by the metals-impacted fill.

Screening

In the screening of these process options, each were determined to be potentially applicable (see Table 9). Following the initial screening, the process options for Institutional Actions were evaluated with respect to effectiveness and implementability. The process option evaluation for the west and central undeveloped area, trucking yard and rail siding, and building and parking lot is summarized in Tables 10, 11, and 12, respectively. All three of the above process options would not be effective in protecting public health and the environment through reductions in toxicity, mobility, and volume of the contaminated soil. They will, however, be protective by limiting direct contact and exposure to the impacted soil. As such, these process options were considered for further assessment. The process options of fencing and deed restrictions were retained to represent access restriction and action restriction, respectively.

6.5.3 Containment Actions

Description

The remedial technology type applicable for Containment Actions consists of surface capping. The capping process options include clay/soil, asphalt, concrete, and geosynthetic liners (GSLs). The placement of a surface cap would reduce the risks by preventing direct exposure to the metals-impacted fill. A cap would also mitigate the leaching of metals adhered to the soil particles by minimizing the amount of rain water infiltrating through the fill material.

Capping with clay in the undeveloped area would consist of placement and compaction of imported clay. A vegetated soil layer would then be placed over the compacted clay layer. As an alternative to a natural clay cap, a GSL could be placed over the undeveloped area, with an overlying vegetated soil layer. Similar to the above two options, an asphalt or concrete cap could be achieved by placing these materials over the impacted undeveloped portion of the property. A bottom liner would not be necessary since the native soil itself acts as barrier to vertical migration of contaminants.

The use of an asphalt and concrete cap on the parking lot and building, respectively, is a logical process option for the capping technology since these features already exist. With respect to the exterior operational area, a new layer of gravel was placed over the impacted soil in the trucking yard in November 1999. Although this gravel layer is currently limiting direct contact and exposure with the elevated metal in this area, it would not serve as a long-term capping solution since the continual trucking operations will eventually "kick-up" the underlying metals-impacted fill. As such, the placement of an asphalt layer or concrete over the trucking yard is a potential process option.

Screening

The initial screening of capping technologies and associated process options is shown on Table 9. All four of these process options were considered potentially applicable and evaluated further for each specific operable unit, with respect to effectiveness and implementability. This screening process is summarized in Tables 10 to 12.

In the west and central undeveloped portion of the property, a GSL with vegetated soil cover was selected to represent the capping technology. This process option would be effective in preventing ingestion, inhalation, and dermal contact with the metals-impacted fill. GSL's are easily implemented and can be readily purchased, whereas the use of a clay cap would depend on the availability of a nearby source of clay. The asphalt cap option was also carried through the screening process as this may be used in combination with the GSL cap in potential future land uses in the central area (e.g. new parking lot).

In the trucking yard and rail siding area, an asphalt pavement was considered to represent the capping technology. This process option would provide an effective barrier to eliminate potential exposure pathways and could be easily implemented using conventional paving equipment.

The parking lot and area beneath the building are already covered by asphalt and concrete, respectively. As such, these two process options were logically retained to represent the capping technology

6.5.4 Excavation and Disposal Actions

Description

Excavation and Disposal Actions consist of using heavy conventional heavy equipment, such as bulldozers and excavators, to excavate the impacted soil. Once brought to surface, the metals-impacted fill can be directly disposed of off-site at a RCRA Subtitle C landfill (i.e. hazardous). Alternatively, the metals-impacted fill can be treated to non-hazardous levels using a Treatment Action technology and disposed of at a RCRA Subtitle D landfill (i.e. non-hazardous). In addition, another process option would be to backfill the treated soil on-site. Specific regulations would need to be considered for the latter two process options, and are discussed further below.

The disposal of hazardous waste is partly governed by 6 NYCRR Part 376, Land Disposal Restrictions (LDR). This Part identifies hazardous wastes that are restricted from land disposal and defines those limited circumstances under which an otherwise prohibited waste may be land disposed. In this Part, land disposal is defined as the placement in or on the land, except in a corrective action management unit (CAMU), and includes placement in a landfill. The CAMU concept is discussed further below. Section 376.1 (h) (3) of this Part states that no prohibited waste which exhibits a characteristic under Section 371.3 (i.e. toxicity of lead) may be land disposed *unless* the waste complies with the treatment standards under Section 376.4 of this Part. As such, disposal of the currently hazardous soil can be disposed of at a Subtitle D landfill if it is treated such that the leachate levels are below the values identified in this section. Section 376.4 (j) identifies the Universal Treatment Standards (UTS) for lead in non-wastewater (i.e. soil) as 0.37 mg/L.

As mentioned above, one potential process option is to manage the remediation waste, once it has been treated, in an on-site CAMU. The USEPA promulgated the CAMU rule on February 16, 1993, and New York State became a CAMU-authorized state. The New York State definition of a CAMU mirrors the federal version as defined under 40 CFR 260.10. In Section 370.2 of 6 NYCRR 370, a CAMU means:

> "an area within a facility that is designated by the commissioner under Section 373-2.19 of this Title for the purpose of implementing corrective action requirements under subdivision 373-2.6(l), ECL 71-2727 (3), and RCRA Section 3008(h). A CAMU shall only be used for the management of remediation wastes pursuant to implementing such corrective action requirements at the facility."

Changes to the CAMU rule are forthcoming and were considered when evaluating the option of managing the soil on-site. These proposed changes are described in the Hazardous Waste Consultant publication (Volume 18, Issue 7, 2000) and are briefly summarized below.

Prior to the promulgation of the CAMU rule, hazardous remediation wastes had to be managed in accordance with the full RCRA Subtitle C program. For example, if an area of contaminated soil was to be excavated, treated, and disposed on-site, the following requirements applied: 1) the treatment process would require a RCRA permit; 2) the treated soil would have to meet LDR standards; and 3) the disposal unit (i.e. landfill) would have to have interim status or a RCRA permit and, if new, would have to meet minimum technology requirements (MTR).

While appropriate for managing hazardous wastes generated during normal industrial operations, this regulatory approach was impeding cost-effective and timely cleanup of wastes generated from remedial actions. Therefore, to avoid triggering Subtitle C regulations, the CAMU rule was implemented to establish a separate regulatory framework for the management of remediation waste.

Shortly after the CAMU was promulgated, a lawsuit was filed against the USEPA citing the provisions in this rule were too lenient. As a result of a settlement, EPA published proposed CAMU revisions on the Federal Register on August 22, 2000. The proposed revisions to the 1993 CAMU rule are summarized as follows:

- Grandfathering existing CAMUs, and those substantially within the approval process, to allow them to remain subject to the provisions of the 1993 CAMU rule;
- Clarify which waste may be managed in CAMUs;
- Specify information submission requirements for CAMU designation applications;
- Expand public participation requirements for CAMU decisions;
- Establish minimum design and operating standards for CAMUs that will be used for permanent disposal, including:
- Liner and capping standards,
- Treatment requirements for principal hazardous constituents (PHCs), and
- Responses to releases to groundwater
- Specify requirements for CAMUs used to temporarily treat or store remediation wastes; and,
- Exempt from the proposed standards CAMUs used to manage wastes with hazardous constituent levels at or below remedial levels or goals.

Screening

The process options of excavation and off-site disposal, and on-site management after treatment, were retained through the initial screening (see Table 9) and further evaluated. As shown on Tables 10 to 12, both of these options were considered to be potentially applicable for all three operable units, except for metals-impacted fill under the building. Excavation under the concrete floor slab is not feasible at this time as it would require the demolition of the building. However, given the age of the building, there is the potential that it may be demolished at some time in the future. If, as part of demolition, the foundations or floor slabs were removed, proper soil management of the metals-impacted fill beneath the building would be required at that time. Metals-impacted fill beneath the asphalt in the parking lot would also be managed at the same time. Excavation and off-site disposal at a permitted landfill will effectively reduce the risk to on-site and nearby receptors. Off-site disposal can be easily implemented using conventional construction and hauling equipment. For these same reasons, on-site management, after some form of treatment, can be easily implemented and can effectively reduce the risk to receptors.

6.5.5 Treatment Actions

Description

Treatment Actions consist of both in-situ and ex-situ remedial technologies. In-situ process options include electrokinetic separation, soil flushing, and solidification/stabilization (e.g. cement-based), and vitrification. Ex-situ process options include soil washing, solidification/stabilization, and pyrometallurgical technologies.

Electrokinetic separation is an in-situ process where metals and organic contaminants are removed from low permeability soils by use of low-intensity direct current. Ceramic electrodes are inserted into the ground and are divided into cathode and anode arrays. This mobilizes charged species, causing ions, and water to move toward the electrodes. The ions in the groundwater are then recovered by extraction wells.

Soil flushing is a technology that extracts contaminants from soil in-situ by a washing solution. Water or an aqueous solutions is injected into or sprayed onto the area of contamination, and the elutriate is collected and pumped to surface. The impacted water is then removed, recirculated, or treated on-site and re-injected into the ground.

Solidification/stabilization (S/S) can be performed both in-situ or ex-situ. Chemical fixation, a similar technology, transforms or re-orders the molecular structure of chemical bonds to create non-hazardous compounds. The S/S or chemical fixation technology involves the mixing or injection of treatment agents into the contaminated soil to accomplish one or more of the following:

- Produce a solid waste from a liquid or semi-liquid waste;

- Reduce the contaminant solubility by formation of sorbed species or insoluble precipitates;
- Decrease the exposed surface area from which mass transfer loss of contaminants may occur; and,
- Limit the contact between transport fluids and contaminants by reducing the material's permeability.

There is a wide range of inorganic binders, organic binders, and additives to immobilize the contaminants in the soil. XCG reviewed cement-based solidification and proprietary chemical fixation compounds, including EnviroBlend ®, Molecular Bonding System (MBS), and Advanced Chemical Treatment (ACT).

Ex-situ cement-based S/S is carried out on excavated soil, which has been classified to reject oversize. This technique involves the mixing of contaminated soil with an appropriate ratio of cement or similar binder/stabilizer, and possibly water and other additives. The resulting product is a monolithic block. The in-situ process is similar and is carried out with conventional earth moving equipment such as excavators, draglines, or drill augers. The greatest difficulty in the in-situ method is achieving complete and uniform mixing. Another drawback to cement-based S/S, both in-situ and ex-situ, is that bulking of the soil occurs.

EnviroBlend ® was developed and patented by RMT, Inc. (RMT) and is distributed by American Minerals, Inc. It is a proprietary chemical that converts targeted heavy metals, including lead, copper, and zinc, into virtually insoluble compounds. EnviroBlend ® can be mixed both in-situ and ex-situ, and is reported to have a much smaller bulking factor than cement-based S/S treatment systems. RMT has shown that after the impacted soil is mixed with this reagent, the resulting material meets Toxicity Characteristic levels and the UTS values using the TCLP method. RMT also indicates that leaching is reduced in other testing methods, such as the Synthetic Precipitation Leaching Procedure (SPLP) and the Multiple Extraction Procedure (MEP). RMT has carried out two remediation projects in New York State using the EnviroBlend ® technology and both were approved by NYSDEC. One of these projects (NIBCO, Inc.) involved the treatment of 4,587 m^3 (6,000 yd^3) of lead and cadmium contaminated soil. RMT completed a treatability test on two soil samples collected from the subject property, to determine the applicability of the reagent and the optimal dosage. The results are discussed in Section 8.

MBS is a proprietary compound designed specifically to stabilize heavy metals in soil and other solid waste (e.g. slag, sludge, etc.). Solucorp Industries Ltd. (Solucorp) developed this sulfide-based blend of powdered chemical reagents. MBS creates a sulfide bond with contaminants, thereby converting leachable ions into non-leaching sulfide molecules. These reagents are not pH sensitive, which allows concurrent stabilization of multiple metals, each with different solubility points. MBS is able to treat metals-impacted waste classified as D004 to D011 (lead is D008). This technology can be applied in-situ using conventional earth moving equipment or mixed ex-situ in a closed hopper pugmill. Treated soil can either be disposed of at a Subtitle D landfill or returned on-site to the excavated area. Similar to the EnviroBlend ® system, Solucorp reports that the MBS reagents only slightly increase the volume of the treated soil. Continual development of the MBS system has resolved two problems encountered in its earlier stages: hydrogen sulfide off-gas and degradation or resolubilization. The MBS technology has been demonstrated successfully at a PRP-lead remediation site with NYSDEC oversight (Ernst Steel in Cheektowaga, New York).

The third chemical fixation technology reviewed by XCG was the ACT reagent developed by Marcor Remediation, Inc. (Marcor). The ACT technology has successfully remediated soil contaminated with chromium and lead, coal tar wastes, PAHs, and BTEX compounds. These proprietary reagents are mixed into the soil, either in-situ or ex-situ, and results in destruction, alteration, or chemical bonding of the contaminants. Marcor indicated that NYSDEC has accepted the ACT technology and retained them to remediate a lead contaminated site (gun firing range) located in Rochester, New York.

Vitrification is a remedial technology that applies high temperatures to reduce the mobility of metals by incorporating them into a leach resistant, vitreous mass. The process can be performed both in-situ and ex-situ. This process converts contaminated soils to a stable glass and crystalline monolith. In the ex-situ method, heat is applied to a melter through various sources, including combustion of fossil fuels or input of electric energy by direct joule heat, arcs, plasma torches, and microwaves. The in-situ process is carried out by passing electrical current through a region that behaves as a resistive heating element. This is accomplished by inserting an array of electrodes vertically into the ground. As a result, a large glassy monolithic block is formed in the ground.

Soil washing is an ex-situ remediation technology, which has successfully remediated soils impacted with metals, organics, and radioactive contaminants. The technology utilizes a combination of physical separation and aqueous-based separation unit operations. The objective of soil washing is to transfer the contaminant from the soil into the washing fluid or concentrates the contaminants into a much smaller soil mass for subsequent treatment or disposal. XCG evaluated the soil washing services offered by Brice Environmental Services Corporation (Brice). Brice's soil washing process incorporates wet-screening, soil classification, gravity separation, magnetic separation, dewatering/water treatment, and humate removal. An example soil washing project carried out by Brice was the remediation at Small Arms Firing Range 24, Fort Dix, New Jersey. The U.S. Army retained Brice to remediate lead-contaminated soil. The results indicated that the soil washing process was able to reduce total lead levels from as high as 38,000 ppm to 400 ppm.

Pyrometallurgical technologies are a broad term used to describe elevated temperature techniques for extraction and processing of metals. Roasting, retorting, or smelting involves both metal extraction and recovery. These processes produce a metal-bearing waste slag, but it can be recovered for reuse. Another form of pyrometallurgical technique employs a combination of high temperature extraction and immobilization. In this process, the high temperatures cause volatile metals to separate from the soil and report to fly ash, where it is immobilized. The third class of this type of technology uses incinerators for mixed organic and inorganic wastes. The volatile metals are captured in the exhaust gases or the non-volatile metals are immobilized in the bottom ash or slag. Although vitrification utilizes high temperatures, it is not considered a pyrometallurgical technique, since neither metal extraction nor recovery is performed.

Screening

The initial screening of treatment technologies and associated process options is shown on Table 9. A number of process options were initially screened out, including electrokinetic separation, soil flushing, in-situ cement-based S/S, in-situ vitrification, and the pyrometallurgical technologies. Electrokinetic separation is an emerging technology with limited use in the US to date. In addition, the information sources reviewed indicate that it has not been tested in the SITE program or successfully tested at a site overseen by a federal or state agency. Soil flushing was not considered easily implementable at the subject property. Difficulties may be encountered in withdrawing the flushing fluids, as a hydraulic gradient may be hard to create in the shallow contaminant zone. In-situ cement-based S/S and vitrification would create a large monolithic block in the ground, which would severely limit any potential site redevelopment. In addition, the high temperatures would create a safety hazard near the natural gas line at the west side of the property. The pyrometallurgical technologies were screened since these techniques are more applicable to soils with much higher metals concentrations (5 to 20%).

Based on this initial screening, soil washing, ex-situ cement-based S/S, and the proprietary chemical fixation technologies were retained for further evaluation of effectiveness and implementability at the three operable units. This subsequent screening process is summarized in Tables 10 to 12.

For all three operable units, soil washing was considered to be effective in reducing the risks to public health and the environment by reducing the volume of characteristically hazardous material. As noted previously, the USEPA RI/FS guidance document suggests that one process option should be selected to represent a technology type, if possible. As such, the four solidification/stabilization/chemical fixation technologies were evaluated against each other to select one representative option. The cement-based S/S technology was compared against the three chemical fixation technologies and was eliminated, since the much larger bulking factor from this process would affect off-site disposal costs or limit future site redevelopment if disposed on-site. The three chemical fixation technologies offer similar processes, in that a proprietary reagent is used to reduce the leachability of the metal contaminants. All three technologies have demonstrated successful remediation of lead contaminated soil, with NYSDEC oversight on these projects. The EnviroBlend® technology was chosen as the process option to represent the solidification/stabilization/chemical fixation technology type. However, the MBS and ACT reagents could be used instead of EnviroBlend®. The remedial actions and mixing processes would essentially be the same except one powder would be used in place of the other.

7. DEVELOPMENT OF ALTERNATIVES

7.1 Introduction

The previous section identified potential remedial technology types and associated process options. The screening process resulted in the elimination of entire technology types, or if a technology type was retained, one process option (if possible) was selected to represent the technology. Those that were eliminated were considered either not protective of human health or the environment, or were not technically feasible based on the site-specific conditions. The goal of this screening process was to reduce the number of potentially applicable technologies to a more manageable number, such that the development of alternatives does not become too lengthy and cumbersome.

In this section, the technologies that were retained are formulated into various alternatives to address the issues at the three operable units. A long list of potential alternatives was developed and is summarized in Table 13 and described in detail in Section 7.2. A preliminary screening of the alternatives was then carried out to reduce the number (if warranted) that would undergo detailed analyses. This preliminary screening process was based on the criteria of effectiveness and implementability. Cost was not considered in the preliminary screening of alternatives, as identified in TAGM 4030.

The effectiveness criterion is the evaluation of the alternative's ability to protect human health and the environment. The alternatives were assessed on its ability to eliminate significant threats to public health and the environment by reducing the toxicity, mobility, and volume of the characteristically hazardous material, in both the short-term and long-term. The short term refers to the construction and implementation period while the long-term refers to the time after the remediation work has been completed.

The alternatives were also evaluated on its technical and administrative implementability. Technical implementability is defined as the ability to construct, reliably operate, and meet technical specifications. In addition, this criterion measures the requirements of operation, maintenance, replacement, and monitoring in the future after the remedial action is completed (if necessary). Administrative feasibility refers to compliance with applicable rules, regulations, and statutes. In addition, it refers to the ability of the alternative to obtain approvals from other offices and agencies, the availability of treatment, storage, and disposal services and capacity.

TABLE 13
REMEDIAL ALTERNATIVE MATRIX

GENERAL RESPONSE ACTION										
MEDIUM	TECHNOLOGY TYPE	PROCESS	A	B	C	D	E	F	G	H
Fill – West and Central Undeveloped Areas	Monitoring	All monitoring wells twice a year	•	•						
	Access Restrictions	Fencing		•						
	Action Restrictions	Deed Restrictions		•						
	Capping	GSL			•					
		Soil			•			•		
	Excavation/ Disposal	Subtitle C Landfill				•	•			
		Subtitle D Landfill							•	
		On-site					•			•
	Separation	Soil Washing					•			
	Chemical Fixation	EnviroBlend ®						•	•	•
Fill – Trucking Yard and Rail Siding	Monitoring	All monitoring wells twice a year	•	•						
	Access Restrictions	Fencing		•						
	Action Restrictions	Deed Restrictions		•						
	Capping	Asphalt			•			•		
	Excavation/ Disposal	Subtitle C Landfill				•	•			
		Subtitle D Landfill							•	
		On-site					•			•
	Separation	Soil Washing					•			
	Chemical Fixation	EnviroBlend ®						•	•	•

TABLE 13 (CONT'D)
REMEDIAL ALTERNATIVE MATRIX

GENERAL RESPONSE ACTION										
MEDIUM	**TECHNOLOGY TYPE**	**PROCESS**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Fill – Building and Parking Lot	Monitoring	All monitoring wells twice a year	•	•						
	Access Restrictions	Fencing								
	Action Restrictions	Deed Restrictions		•						
	Capping	Asphalt	•	•	•	•	•	•	•	•
		Concrete	•	•	•	•	•	•	•	•
	Excavation/ Disposal	Subtitle C Landfill								
		Subtitle D Landfill								
		On-site								
	Separation	Soil Washing								
	Chemical Fixation	EnviroBlend ®								

It should be noted that during development of alternatives, excavation of metals-impacted fill beneath the building was not considered feasible at this time, since it would require the demolition of the building. However, considering the age of the building, there is a possibility that at some time in the future the building may be demolished, in whole or in part. If, as part of demolition, the foundations or floor slabs were removed, proper soil management of the metals-impacted fill beneath the building would be required at that time. Furthermore, excavation in the parking lot was also not considered practical at this time, given the relatively small quantity of impacted soil in this area and the potential safety problems that may arise with excavation between the on-site and adjacent off-site buildings. Therefore, the metals-impacted fill below the parking lot would be managed at the same time during any future building demolition.

The alternatives listed in Table 13 are briefly summarized below and are described in greater detail in Section 7.1:

- Alternative A – No Action: Groundwater monitoring;
- Alternative B – Limited Action: Groundwater monitoring, access restrictions, deed restrictions;
- Alternative C – Capping: Provide surface cap with different materials at the west and central undeveloped areas, trucking yard, and rail siding. Maintain existing asphalt cap in parking lot and leave soil under the building;

- Alternative D – Excavate and Off-Site Disposal: Excavate fill from west and central undeveloped areas, trucking yard, and rail siding. Dispose soil at RCRA Subtitle C landfill (i.e. hazardous). Backfill excavated areas with clean imported fill. Maintain existing asphalt cap in parking lot and leave soil under building;
- Alternative E – Soil Washing – Excavate fill at west and central undeveloped areas, trucking yard, and rail siding. Wash excavated soil, dispose clean soil on-site, and dispose hazardous concentrate at RCRA Subtitle C landfill. Maintain existing asphalt cap in parking lot and leave soil under the building;
- Alternative F – In-Situ Chemical Fixation – Mix EnviroBlend® in-situ in west and central undeveloped areas, trucking yard, and rail siding. Cap the stabilized soil with different materials. Maintain existing asphalt cap in parking lot and leave soil under the building;
- Alternative G – Ex-Situ Chemical Fixation and Off-Site Disposal – Excavate soil from west and central undeveloped areas, trucking yard, and rail siding. Mix EnviroBlend® ex-situ, and dispose treated soil at RCRA Subtitle D landfill (i.e. non-hazardous). Backfill excavated areas with clean imported fill. Maintain existing asphalt cap in parking lot and leave soil under the building; and,
- Alternative H – Ex-Situ Chemical Fixation and On-Site Disposal – Excavate soil from west and central undeveloped areas, trucking yard, and rail siding. Mix EnviroBlend® ex-situ and dispose treated soil on-site. Cap the stabilized soil with different materials. Maintain existing asphalt cap in parking lot and leave soil under the building.

7.2 Screening of Alternatives

7.2.1 Alternative A

Description

Alternative A was identified as the No Action alternative. However, some minimal action, in the form of groundwater monitoring, is required in this alternative. Regular groundwater monitoring would verify that the contaminants are not leaching into the saturated water-bearing zone of the native silty clay. Considering the analytical results of the previous groundwater samples, a monitoring schedule of twice per year was considered to be adequate. The existing asphalt cap and concrete floor in the building would remain intact. An annual report summarizing the groundwater and site conditions would be prepared and submitted to NYSDEC, to keep it informed of any changes to the quality of the subsurface.

In addition to the groundwater monitoring, this alternative would also include capping of the metals-impacted fill located in the parking lot and under the building.

These measures already exist, and therefore, were not included in the No Action alternative.

Screening

The No Action alternative is not effective in protecting human health and the environment, as it does not reduce the toxicity, mobility, and volume of the characteristically hazardous material. In the short-term, there is some level of protection, as human exposure to the metals-impacted fill is currently mitigated (see Section 5). The metals-impacted fill in the central undeveloped area has been covered and fenced-off as part of the IRM. In the west undeveloped area, the surficial soil does not contain concentrations that exceed the cleanup goals. In November 1999, the metals-impacted fill in the trucking yard was covered by a layer of imported gravel. The fill in the parking lot and within the footprint of the building has been capped with asphalt and concrete, respectively. As such, there are no exposure pathways in these areas. Although the current site conditions limit the exposure to metals-impacted fill, this would not be a long-term solution. Regardless of the limited level of protection, the No Action alternative was carried through to the detailed analysis step, in order to provide a baseline for comparison with other alternatives.

7.2.2 Alternative B

Description

Alternative B is an extension to the No Action alternative. This scenario also involves groundwater monitoring and maintaining the existing asphalt cap and concrete building floor. Additional actions include access and action restrictions to the use of the site. Fencing would be placed around the perimeter of the property to limit entry by potential off-site receptors. Chain-link fencing and lockable gates already exist in the trucking yard and in the area of the rail siding. In addition, a chain-link fence was erected in the central undeveloped area. Fencing would not be required in the parking lot as there is no exposed metals-impacted fill in this area. As such, the only part of the property requiring the construction of a new fence would be the west undeveloped area.

Restrictive covenants can be imposed on the use of the property. With respect to the surface, restrictions could be issued against any construction that would disturb an existing cap (e.g. construction in parking lot or demolishing part of the building). Restrictions could also be imposed on the use of the subsurface, such as excavation into the metals-impacted fill to construct a basement structure.

Screening

This alternative is a slight upgrade to the No Action alternative, in that there is no remedial actions undertaken, but it does provide additional measures to limit exposure to the contaminants of concern. Alternative B does not effectively reduce the toxicity, mobility, or volume of the impacted material. Threats to the public clay caps, are susceptible to cracking when there is a low moisture content. However, this should not be a significant concern with respect to the long-term effectiveness, given the types of contaminants present on-site. This issue would be more of a concern if the cap was placed over areas with high levels of volatile compounds, and the goal was to prevent vapour migration. Furthermore, any additional moisture seeping through the cracks would not significantly increase the leachability in the soil, considering that the impacted fill has been exposed to rain water for decades and the groundwater results show that there has been no significant leaching. Because of the flat grade of the property, erosion and degradation of the GSL cap is not expected to occur.

There would not be any significant difficulties in implementing this alternative. The construction of the GSL cap would require conventional earth moving equipment to conduct preparatory grading work. The GSLs are readily supplied by geosynthetic liner distributors (e.g. Terrafix) and are easily installed. The topsoil layer can be laid down by a general contractor. Placement of an asphalt layer in the trucking yard can be accomplished by a typical paving contractor.

Although Alternative C does not reduce the toxicity or volume of impacted soil on-site, it does effectively reduce its mobility and achieves the objective of preventing the ingestion, dermal absorption, and inhalation of soil with total lead concentrations above 500 ppm. A modified version of Alternative C (identified as C1) does, however, reduce the volume of impacted soil on-site, as a portion of the material would be treated and disposed of off-site, prior to placing the cap. Details of this sub-alternative are provided in Section 8.4. By placing a cap over the impacted soil, its ability to leach metals is virtually eliminated since the infiltration of rainwater would be significantly reduced. The surface cap in combination with the underlying hard native silty clay would essentially prevent any leaching of metals into the groundwater. As such, Alternative C presents a viable alternative and was retained for detailed analyses.

Alternative D

Description

Alternative D involves the excavation of impacted fill from the west and central undeveloped areas, trucking yard, and rail siding. The excavated soil would then be directly disposed of at an off-site RCRA Subtitle C landfill (i.e. hazardous). The existing asphalt cap in the parking lot would remain intact. The site characterization indicated that the central undeveloped area, trucking yard, rail siding, and most of the parking lot contained leachable lead above the regulatory levels, and is therefore, classified as hazardous. In the west undeveloped area, the fill contained high levels of lead and was classified as hazardous at sporadic locations. As such, this area is a mixture of characteristically hazardous and non-hazardous materials. However, in practical terms with respect to soil excavation/soil handling during remediation, the soil in the entire area has been conservatively considered to be characterisctially hazardous. Clean soil and gravel (for the trucking yard) would be imported and backfilled in the excavated areas. In addition, a vegetated topsoil layer would be placed in the west and central undeveloped area, to restore this part of the property to reusable conditions.

The closest RCRA Subtitle C landfill is the Waste Management, Inc. (CWM Chemical Services) facility in Model City, New York, which is located northeast of Niagara Falls (approximately 45 minutes from the property). A representative at this landfill indicated that upon receipt of the hazardous soils, the facility mixes it with a cement-based stabilization compound, prior to disposal in the cells.

Screening

This alternative would effectively eliminate the significant threats to the public health and environment in the subject property area, both in the short-term and long-term, by reducing the volume of characteristically hazardous materials at the site.

This alternative can be easily implemented as it would utilize conventional earth moving equipment (i.e. track-mounted excavator and bulldozer) and dump trucks. There would be no future operation or maintenance requirements once the remedial actions are completed. Although disposal at an off-site landfill would effectively eliminate any risks in the subject property area, this option would have a significant impact on the limited amount of hazardous landfill space, considering the large estimated quantity of impacted fill. In addition, the natural resources in the regional area would be impacted, since a large volume of clean imported soil is required for backfill in the excavated area. Furthermore, the direct disposal of impacted soil at an off-site permitted facility is the last option in the hierarchy of technology types identified in TAGM 4030.

Considering the aforementioned factors, Alternative D is not considered to be the most practical option. However, this alternative was retained for detailed analyses, as it likely represents the highest cost option and was used for comparison purposes (note: actual cost evaluation was not conducted at this point). Preliminary cost estimates for this alternative were developed for different depths of excavation. This is discussed further in Section 8.5.

7.2.5 Alternative E

Description

Alternative E consists of implementing soil washing at the west and central undeveloped areas, the trucking yard, and rail siding. Impacted fill would be excavated in these areas and hauled to an on-site washing unit. The cleaned soil would then be returned to the excavated areas, backfilled, and compacted. In the west and central undeveloped areas, a vegetated topsoil layer would be placed over the backfilled area, to restore the site to reusable conditions. The soil washing process will generate a reduced volume of concentrated hazardous soil and contaminated water. The hazardous soil would then be disposed of off-site at a

RCRA Subtitle C landfill. The existing asphalt cap in the parking lot would remain intact.

In Brice's soil washing technique, its closed-loop water recycling system lowers water consumption, which reduces the generation of contaminated water. A clarifier and dewatering screen may be used in series to segregate/dewater heavy humates and condition the fines-slurry for subsequent dewatering using a belt filter press. Sand and carbon filtration follows as a polishing step for final rinse spray bars, if required. This enables the counter-current reuse of process waters while minimizing water consumption and associated disposal costs.

Screening

Soil washing projects completed at other sites in the U.S. have shown success in treating metals, including some Superfund sites where it was either selected in the Record of Decision (ROD) or actually completed (e.g. Twin Cities Army Munition Plant, Minneapolis). Brice's soil washing technology has been completed in the SITE demonstration program. The effectiveness of soil washing for the conditions at the subject property would depend on the results of a treatability test, which has not been completed to date for this technology. If the testing indicates that it is applicable, this technology would be effective in eliminating significant threats to public health and the environment through reductions in contaminant volume.

The implementation of this alternative in the west and central undeveloped area should not encounter any significant difficulties with respect to work space. There is sufficient area to set-up the washing plant and temporary stockpiles for confirmatory testing, prior to backfilling. The implementation of soil washing in the trucking yard, however, would be much more difficult. Excavation of impacted soil would extend to depths ranging between 4 and 6 feet (1.2 and 1.8 metres) below grade. This would significantly impact the daily operations of Metro Waste, as it requires the entire space in the trucking yard. Trucks are continually loading and unloading shipments, and the trailers are parked at the west side of the yard. Excavation of the trucking yard to perform soil washing for any length of time would impact on the daily operations. Similar problems may be encountered during excavation at the rail siding area.

Although soil excavation in the trucking yard and rail siding could present some logistical problems, they can be resolved by carefully planning and co-ordinating the remedial work and site operations with Metro Waste's facility manager. For example, one of the shipping bays could be temporarily shutdown and remediated, while the other bays remain operational. Upon completing the remediation of the first bay, the next shipping bay would be shut down and this alternating process continued until the entire loading and unloading area is cleaned-up. This same process could be used for the west side of the trucking yard where the trailers are parked. Furthermore, the central undeveloped area, which would be remediated first, could be used for additional trailer parking space. Since Alternative E would be effective in eliminating significant threats to public health and the environment, and possible logistical problems could be addressed through proper planning and co-ordination, it was retained for detailed analysis. Preliminary cost estimates for this alternative were developed for excavating and washing different depths of impacted soil. This is discussed further in Section 8.6.

7.2.6 Alternative F

Description

Alternative F consists of carrying out in-situ chemical fixation at the west and central undeveloped areas, trucking yard, and rail siding. The existing asphalt cap in the parking lot would remain intact. The proprietary compound, EnviroBlend®, would be mixed in-situ with conventional construction equipment (e.g. excavators, augers, etc.). This would meet the remedial action objective of reducing the leachable lead to below hazardous levels. To meet the remedial action objective of preventing exposure to soil containing total lead greater than 500 ppm, a cap would be placed over the stabilized soil. In the west and central undeveloped area, a surface cap consisting of vegetated topsoil would be used. The trucking yard would be paved with new asphalt.

Screening

The implementation of in-situ chemical fixation would utilize conventional construction equipment to perform the mixing activities. The in-situ mixing process in the trucking yard and rail siding could encounter problems with respect to the daily site operations; however, as discussed in Alternative E, careful planning and co-ordination can overcome any potential logistical difficulties. Although mixing can be conducted in-situ, this approach can encounter more difficulties in achieving a uniform and homogenous mixture of the reagent, when compared to the ex-situ approach. Additional in-situ mixing problems may be encountered in areas with densely packed soil, such as the trucking yard. Re-mixing of areas that do not achieve the remedial goals during the first pass could substantially delay the project schedule and introduce significant additional costs. Nonetheless, this alternative was retained for further evaluation. Preliminary cost estimates for in-situ mixing at various depths were developed and is discussed further in Section 8.7.

7.2.7 Alternative G

Description

Alternative G is similar to Alternative F, except the mixing of EnviroBlend® would be performed ex-situ and the treated soil would be disposed of at a RCRA Subtitle D landfill (i.e. non-hazardous), such as the BFI Waste Systems (BFI) facility in Niagara Falls, New York. A representative at BFI indicated that the treated soil could be disposed of at its landfill, based on the current information. A waste profile would need to be completed and final disposal approval would be determined by NYSDEC. As mentioned previously in Section 6.5.4, disposal of the treated soil must meet the more stringent UTS value for lead listed in the State's LDR regulation

(6 NYCRR Part 376). Impacted fill from the west and central undeveloped area, trucking yard, and rail siding would be excavated and hauled to a central processing area. The impacted soil and reagents would be mixed in a pug mill, and subsequently hauled off-site for disposal. Clean soil and gravel would be imported to the property for backfill and compaction. In the west and central undeveloped area, a vegetated topsoil layer would be placed to restore this area to reusable conditions. The existing asphalt cap in the parking lot would be maintained in this alternative.

Screening

Alternative G would effectively eliminate the significant threats to the public health and environment, both in the short-term and long-term, by reducing the volume of characteristically hazardous materials in the subject property area.

This alternative can be easily implemented as it would utilize conventional earth moving equipment (i.e. track-mounted excavator and bulldozer), dump trucks, and a pugmill to carry out the mixing process. As discussed previously, proper planning and co-ordination could overcome any logistical problems with excavating in the trucking yard and rail siding. There would be no future operation or maintenance requirements once the remedial actions are completed. Although off-site disposal of impacted soil is the last option in the hierarchy of technology types identified in TAGM 4030, the pre-treatment with a chemical fixation compound prior to disposal addresses the requirement that preference be given to a technology that permanently reduces the mobility of the contaminants. Furthermore, on-site chemical fixation followed by disposal at a non-hazardous landfill avoids the use of a hazardous landfill (i.e. Alternative D). The availability of hazardous landfill space in the region is more limited than non-hazardous landfills. As such, Alternative G was retained for detailed analyses. Preliminary cost estimates for excavating various depths were developed and are discussed further in Section 8.8.

7.2.8 Alternative H

Description

Alternative H is similar to Alternative G, except that the treated soil would be managed on-site after completing the ex-situ mixing with EnviroBlend®. The existing asphalt cap in the parking lot would be maintained in this alternative. Impacted fill from the west and central undeveloped area, trucking yard, and rail siding would be excavated and hauled to a central processing area. The impacted soil and reagents would be mixed in a pug mill, and subsequently returned to the excavated areas for backfill and compaction. This would meet the remedial action objective of reducing the leachable lead to below hazardous levels. To meet the remedial action objective of preventing exposure to soil containing total lead greater than 500 ppm, a cap would be placed over the stabilized soil. In the west and central undeveloped area, a surface cap consisting of vegetated topsoil would be used. The trucking yard would be paved with new asphalt.

Screening

Alternative H would effeetively mitigate significant threats to the public health and environment, both in the short-term and long-term, by reducing the leachability of metals in soil and preventing exposure to total lead by the placement of a cover cap after treatment.

The implementation of ex-situ chemical fixation, followed by on-site management, would utilize conventional construction equipment to perform the excavating, hauling, and mixing activities. Excavation in the trucking yard and rail siding could encounter problems with respect to the daily site operations; however, as discussed previously, careful planning and co-ordination can overcome any potential logistical difficulties. Nonetheless, this alternative was retained for further evaluation. Preliminary cost estimates were developed for excavation of different depths followed by ex-situ mixing. This is discussed further in Section 8.9.

7.2.9 Summary

In summary, all the alternatives were retained for detailed evaluation in Section 8 and are summarized as follows:

- Alternative A – No Action: Groundwater monitoring;
- Alternative B – Limited Action: Groundwater monitoring, access restrictions, deed restrictions;
- Alternative C – Capping: Provide surface cap with different materials at west and central undeveloped areas, trucking yard, and rail siding. Maintain existing asphalt cap in parking lot and leave soil under the building;
- Alternative D – Excavate and Off-Site Disposal: Excavate fill from west and central undeveloped areas, trucking yard, and rail siding. Dispose soil at RCRA Subtitle C landfill (i.e. hazardous). Backfill excavated areas with clean imported fill. Maintain existing asphalt cap in parking lot and leave soil under building;
- Alternative E – Soil Washing – Excavate fill at west and central undeveloped areas, trucking yard, and rail siding. Wash excavated soil, dispose clean soil on-site, and dispose hazardous concentrate at RCRA Subtitle C landfill. Maintain existing asphalt cap in parking lot and leave soil under the building;
- Alternative F – In-Situ Chemical Fixation – Mix EnviroBlend® in-situ in west and central undeveloped areas, trucking yard, and rail siding. Cap the stabilized soil with different materials. Maintain existing asphalt cap in parking lot and leave soil under the building;
- Alternative G – Ex-Situ Chemical Fixation and Off-Site Disposal – Excavate soil from west and central undeveloped areas, trucking yard, and rail siding.

Mix EnviroBlend® ex-situ, and dispose treated soil at RCRA Subtitle D landfill (i.e. non-hazardous). Backfill excavated areas with clean imported fill. Maintain existing asphalt cap in parking lot and leave soil under the building; and,

- Alternative H – Ex-Situ Chemical Fixation and On-Site Management – Excavate soil from west and central undeveloped areas, trucking yard, and rail siding. Mix EnviroBlend® ex-situ and manage treated soil on-site. Cap the stabilized soil with different materials. Maintain existing asphalt cap in parking lot and leave soil under the building.

The above descriptions of Alternatives D to H, are for remediation to the full-depth of metals-impacted fill. As described in Section 8, sub-alternatives of these main alternatives were considered and consist of remediation to different depths (i.e. 1 foot, 2 feet, 3 feet, and 4 feet), as opposed to full-depth. For these sub-alternatives, capping with different materials in the various sections of the property would be required, since some metals-impacted fill would remain untreated.

8. DETAILED ANALYSIS OF ALTERNATIVES

8.1 Introduction

This section presents detailed analyses of the alternatives that were retained after the initial screening was carried out in Section 7. The goal of this step is to present the relevant information needed to select a preferred remedial alternative. In performing this evaluation, each alternative is assessed on whether it addresses the following:

- Be protective of human health and the environment;
- Attain SCGs (or explain why compliance with SCGs was not needed to protect public health and the environment);
- Satisfy the preference for treatment that significantly and permanently reduces toxicity, mobility, or volume of hazardous wastes as a principal element (or provide an explanation in the ROD as to why it does not); and,
- Be cost-effective.

As outlined in TAGM 4030, there are seven criteria that are used to address the above noted requirements. These criteria form the basis of the detailed analyses and are summarized as follows:

1. Compliance with New York SCGs;
2. Protection of human health and the environment;
3. Short-term effectiveness;
4. Long-term effectiveness and permanence;
5. Reduction of toxicity, mobility, or volume;
6. Implementability; and,
7. Cost.

The eight alternatives retained from the preliminary screening were evaluated for each of these seven criteria in the following sections.

8.2 Alternative A

This alternative is referred to as the No Action alternative. Although there are no remedial actions performed, some activities in the form of regular groundwater monitoring will be carried out. Institutional controls will be implemented to restrict future site activities or development that could involve the excavation and handling of impacted soil or the disturbance of existing covers (i.e. building floor slab and asphalt cap in the parking lot). A Soils Management Plan (SMP) will provide instructions on the management of soil should future activities breach the cover system. The SMP is included in Appendix I and will also be part of the site's Operation, Monitoring, and Maintenance (OM&M) Plan. The SMP may be modified as needed in the future and will be submitted to NYSDEC for review and approval.

8.2.1 Compliance With New York SCGs

Chemical Specific SCGs

The following chemical specific SCGs would apply to Alternative A:

- TAGM 4046 – Determination of Soil Cleanup Objectives and Cleanup Levels; and,
- TOGS 1.1.1 – Ambient Water Quality Standards & Guidance Values.

The first SCG forms the basis of the remedial action objectives identified in Section 6.2. Soil with total lead concentrations of 500 ppm or less would indicate compliance with the SCGs. The implementation of the No Action alternative would not comply with the above chemical specific SCGs. There is little natural attenuation associated with metals, and therefore, these contaminants will not degrade over the long-term to levels below the remedial action objectives. The results of regular groundwater monitoring would be compared to the standards or guidance values outlined in TOGS 1.1.1. However, as noted previously, this SCG is applied to groundwater used for drinking. The groundwater in the subject property area is not used for potable purposes. Therefore, the criteria would be used as a guide to assess the levels of contaminants.

Action Specific SCGs

6 NYCRR Part 375 – Inactive Hazardous Waste Disposal Site Remedial Program;

TAGM 4030 – Selection of Remedial Actions at Inactive Hazardous Waste Sites.

These two SCGs identify the process to be used in selecting a site-specific remedy that permanently and significantly reduces the volume, toxicity and/or mobility of the characteristically hazardous materials. The No Action alternative does not achieve this goal; however, as discussed previously, this alternative was retained to provide a baseline for comparison with other alternatives.

Location Specific SCGs

No location specific SCGs were identified for Alternative A.

8.2.2 Protection of Human Health and the Environment

The qualitative baseline risk assessment (see Section 5) identified that there are no current significant threats to human health and the environment, based on the present site conditions. The inhalation of dust particulates, dermal contact, and ingestion pathways are mitigated by the IRM, new gravel cover in the trucking yard, the paved parking lot, and building floor. At the west side of the property, the concentrations of lead on the ground surface are below background values. Although human health and the environment are currently protected, exposure pathways may be developed in the future by natural processes (e.g. erosion) or human activities (e.g. trucking activities affecting the gravel cover). Therefore, the No Action alternative is not expected to provide protection in the long-term.

8.2.3 Short-Term Effectiveness

As discussed above, the short-term impact of No Action to the on-site workers, truck drivers, nearby residential receptors, and the environment would be expected to be minimal. Based on the visual observations made by XCG during the many site visits, the on-site workers spend very little time in the trucking yard and the drivers typically remain in the trucks until the shipping/receiving activities are completed inside the building. Further, there are no site operations conducted at the west and central undeveloped areas.

8.2.4 Long-Term Effectiveness

The overall long-term effectiveness of this alternative is considered to be low, since it leaves a large volume of fill with high lead concentrations in place. If degradation of the existing protective covers occur in the future, exposure pathways may be opened up, thereby creating potential risks to the workers and nearby residents. In addition, non-human receptors such as burrowing animals may eventually enter the site and may become exposed to the impacted fill.

8.2.5 Reduction of Toxicity, Mobility, and Volume

The No Action alternative does not reduce the toxicity, mobility, or volume of contaminants.

8.2.6 Implementability

Regular groundwater monitoring is easily implemented using standard sampling equipment and protocol.

8.2.7 Cost

Cost estimates were conducted for all alternatives under three main categories: 1) direct and indirect capital costs (e.g. construction and engineering, respectively), 2) operation and maintenance, and 3) future capital costs. All cost estimates are provided in US funds (excluding any applicable taxes). The assumptions used to estimate the cost of Alternative A are summarized as follows:

Capital Costs

- There are no direct or indirect capital costs associated with this alternative. Sampling will be conducted in the existing monitoring wells;

Operation and Maintenance

- The No Action alternative includes a groundwater monitoring program of two sampling events per year for 30 years. Two sampling events each year was considered appropriate, based on the previous groundwater analytical results. The 30-year time period was arbitrarily chosen and would provide a reasonable indication of any changes to the groundwater quality over the long-term;
- Groundwater sampling costs would include engineering field labour (2 man days per sampling event), sampling equipment (e.g. disposable bailers), laboratory testing, miscellaneous disbursements (e.g. travel, accommodation, etc.), and report preparation;
- Laboratory costs include groundwater analyses for metals, VOCs, and PAHs. A total to 8 samples (including one duplicate for QA/QC) will be analyzed during each sampling event (total of 16 per year);
- A total of 2 man days will be required for purging and sampling during each sampling event (total of 4 days per).

Future Capital Costs

- No future costs were included with this alternative;

The annual costs for groundwater monitoring was estimated to be $10,040. The annual costs for 30 years of monitoring were converted to a present worth value, such that alternatives could be properly compared against each other. An inflation rate of 3% was assumed. The estimated present worth of the groundwater monitoring programs is $196,788. The cost estimate is summarized in the tables in Appendix E. The No Action alternative is by far the least costly alternative to implement.

8.3 Alternative B

Alternative B is a slight upgrade from the No Action alternative. Regular groundwater monitoring would be carried out. In addition, fencing would be installed at the west undeveloped area to restrict site access and action restrictions would be placed on the use of the property. Institutional controls will be implemented to restrict future site activities or development that could involve the excavation and handling of impacted soil or the disturbance of existing covers (i.e. building floor slab and asphalt cap in the parking lot). A SMP will provide instructions on the management of soil should future activities breach the cover system. The SMP is included in Appendix I and will also be part of the site's OM&M Plan. The SMP may be modified as needed in the future and will be submitted to NYSDEC for review and approval. Chain-link fences already exist in the central undeveloped area, trucking yard, and rail siding. Fencing would not be required in the parking lot since the existing asphalt layer is covering the impacted soil in this area.

8.3.1 Compliance With New York SCGs

Chemical Specific SCGs

The following chemical specific SCGs would apply to Alternative B:

- TAGM 4046 – Determination of Soil Cleanup Objectives and Cleanup Levels;
- 6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes; and,
- TOGS 1.1.1 – Ambient Water Quality Standards & Guidance Values.

As discussed in the No Action alternative, Alternative B would not comply with the above chemical specific SCGs, as there are no actual remediation actions undertaken. There is little natural attenuation associated with metals, and therefore, these contaminants will not degrade over the long-term to levels below the remedial action objectives.

Action Specific SCGs

- 6 NYCRR Part 375 – Inactive Hazardous Waste Disposal Site Remedial Program;
- TAGM 4030 – Selection of Remedial Actions at Inactive Hazardous Waste Sites.

These two SCGs identify the process to be used in selecting a site-specific remedy that permanently and significantly reduces the volume, toxicity and/or mobility of the characteristically hazardous materials. Alternative B does not achieve this goal.

Location Specific SCGs

No location specific SCGs were identified for Alternative B.

8.3.2 Protection of Human Health and the Environment

As discussed in Alternative A, there are no current significant threats to human health and the environment. The existing site conditions are mitigating any potential exposure pathways. The installation of a chain-link fence at the west side of the property would provide additional site access restrictions to off-site receptors. In addition, the restrictive covenants would provide further protective measures for on-site workers. Although human health and the environment are currently protected, exposure pathways may be developed in the future by natural processes (e.g. erosion) or human activities (e.g. trucking activities affecting the gravel cover). Therefore, Alternative B is not expected to provide adequate protection in the long-term.

8.3.3 Short-Term Effectiveness

As discussed in the No Action alternative, the short-term impact of Alternative B to the on-site workers, truck drivers, nearby residential receptors, and the environment would be expected to be minimal. Based on the visual observations made by XCG during the many site visits, the on-site workers spend very little time in the trucking yard and the drivers typically remain in the trucks until the shipping/receiving activities are completed inside the building. Further, there are no site operations conducted at the west and central undeveloped areas.

8.3.4 Long-Term Effectiveness

The overall long-term effectiveness of this alternative is considered to be low, since it leaves a large volume of fill with high lead concentrations in place. If degradation of the existing protective covers occur in the future, exposure pathways may be opened up, thereby creating potential risks to the workers and nearby residents. In addition, non-human receptors such as burrowing animals may eventually enter the site and may become exposed to the impacted fill.

8.3.5 Reduction of Toxicity, Mobility, and Volume

Alternative B does not reduce the toxicity, mobility, or volume of contaminants.

8.3.6 Implementability

Regular groundwater monitoring is easily implemented using standard sampling equipment and protocol. Construction of the chain-link fence at the west undeveloped area could be easily implemented by a fencing contractor. The placement of restrictive covenants on the use of the property involves legal procedures and should be implemented without any significant difficulties.

8.3.7 Cost

The assumptions used to estimate the cost of Alternative B are summarized as follows:

Capital Costs

- Chain-link fencing would be installed at the west undeveloped area using the same material as the central undeveloped area, and would include a man-gate and a double vehicle gate; and,

- Legal costs would be required to implement the restrictive covenants on the use of the property.

Operation and Maintenance

- A groundwater monitoring program of two sampling events per year for 30 years would be required for Alternative B. Two sampling events each year was considered appropriate, based on the previous groundwater analytical results. The 30-year time period was arbitrarily chosen and would provide a reasonable indication of any changes to the groundwater quality over the long-term;
- Groundwater sampling costs would include engineering field labour (2 man days per sampling event), sampling equipment (e.g. disposable bailers), laboratory testing, miscellaneous disbursements (e.g. travel, accommodation, etc.), and report preparation;
- Laboratory costs include groundwater analyses for metals, VOCs, and PAHs. A total of 8 samples (including one duplicate for QA/QC) will be analyzed during each sampling event (total of 16 per year);
- A total of 2 man-days will be required for purging and sampling during each sampling event (total of 4 days per year); and,
- Annual reporting and project management costs would be required.

Future Capital Costs

- No future costs were included with this alternative;

The capital costs for fencing and legal requirements was estimated to be $25,000. The annual costs for groundwater monitoring was estimated to be $10,040. The annual costs for 30 years of monitoring were converted to a present worth value, such that alternatives could be properly compared against each other. An inflation rate of 3% was assumed. The estimated present worth of Alternative B is $221,788. The cost estimate is summarized in the tables in Appendix E.

8.4 Alternative C

Alternative C consists of placing a surface cap over the entire subject property. Different cover materials would be used for the various sections of the property. A GSL with a vegetated soil cover would be installed at the west and central undeveloped areas. The surface cap in the trucking yard would consist of paving the entire area with asphalt. As noted previously, the trucking yard was paved with asphalt in December 2004. The rail siding will be capped with a geotextile fabric covered by a granular material (e.g. crusher run, 2 inch clear stone, etc.). The existing asphalt cap in the parking lot on the east side of the property would remain intact. A long-term groundwater monitoring program will be implemented as part of this alternative. Groundwater from the existing monitoring wells, as well as two new monitoring wells to be installed in the future, will be sampled and analyzed on a regular basis to verify that the groundwater has not been impacted. The sampling will be conducted on a semi-annual basis for the life of the project or until such time NYSDEC determines less frequent sampling is justified.

Institutional controls will be implemented to restrict future site activities or development that could involve the excavation and handling of impacted soil or the disturbance of existing covers (i.e. building floor slab and asphalt cap in the parking lot). A SMP will provide instructions on the management of soil should future activities breach the cover system. The SMP is included in Appendix I and will also be part of the site's OM&M Plan. The SMP may be modified as needed in the future and will be submitted to NYSDEC for review and approval.

Since Norampac is considering expanding its trucking yard, a modification or sub-alternative to Alternative C (identified as C1) was also considered in the detailed assessment. Alternative C1 consists of consolidating a portion of the impacted fill from the west and west-central undeveloped areas into the east-central and trucking area and capping the consolidated soils with a GSL and asphalt cap. The portion that cannot be placed under the cap will be treated and disposed of off-site. The excavated material will be aerated (where necessary) to allow it to be properly compacted. It is expected that the compacted soil fill will have the necessary shear strength to increase the bearing capacity and support expected traffic loads. As such, stabilization of the excavated material is not considered necessary to increase the bearing capacity. Further, stabilization would not be needed to reduce the mobility of the lead, since the numerous investigations on-site have shown that the lead already has a low mobility. The asphalt cap would be designed to allow its use as a truck parking area. In the draft version of the RIFS, it was envisaged that the existing gravel-covered trucking yard outside of the consolidated soils area would also be capped with asphalt. As discussed previously, the trucking yard was recently paved with asphalt (December 2004) to provide a better driving surface for the daily on-site trucking activities. The side slopes leading up to the asphalt cap/parking area would also be covered by a GSL overlain by soil and vegetated. The existing asphalt cap and underlying impacted fill in the east parking area would remain in-place as would the existing building foundations. The concrete floor and asphalt would be repaired or replaced, as necessary.

8.4.1 Compliance With New York SCGs

Chemical Specific SCGs

The following chemical specific SCGs would apply to Alternative C:

- TAGM 4046 – Determination of Soil Cleanup Objectives and Cleanup Levels; and,
- 6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes.

As discussed previously, the two remedial action objectives were based on the above SCGs. The objective of preventing exposure to soil with lead concentrations exceeding 500 ppm would be met in Alternative C and C1. This alternative would not reduce the TCLP lead concentrations to below 5.0 mg/L. However, the cap would significantly reduce the potential for metals to leach from the soil because the infiltration of rainwater would be substantially reduced.

Action Specific SCGs

- 6 NYCRR Part 375 – Inactive Hazardous Waste Disposal Site Remedial Program;
- TAGM 4030 – Selection of Remedial Actions at Inactive Hazardous Waste Sites;
- TAGM 4031 – Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites; and,
- 29 CFR Part 1910.120 – Hazardous Waste Operations and Emergency Response.

These four SCGs identify the process to be used in selecting a site-specific remedy that permanently and significantly reduces the volume, toxicity and/or mobility of the characterisctially hazardous materials. The placement of surface caps over the impacted areas would limit the amount of rainwater contacting the soil, thereby reducing its mobility.

Location Specific SCGs

No location specific SCGs were identified for Alternative C.

8.4.2 Protection of Human Health and the Environment

The placement of surface caps over the entire property, using various materials, would provide an overall level of protection to human health and the environment. The inhalation, ingestion, and dermal exposure pathways would be eliminated. Alternatives C and C1 provide protection in both the short-term and long-term, as long as the integrity of the caps is maintained.

8.4.3 Short-Term Effectiveness

For Alternative C, potential short-term environmental effects in the west and central undeveloped areas would consist of impacted dust generated during grading activities, prior to the placement of the GSLs. This issue can be easily resolved by implementing a dust monitoring and dust suppression program. In addition, proper personal protective equipment would be provided to the site workers. Potential dust problems in the trucking yard during paving activities would not be a significant concern since the surficial layer consists of clean imported gravel. Regardless, a dust monitoring and suppression program was implemented during the paving-related activities in December 2004.

For Alternative C1, potential short-term environmental effects in the west and west-central undeveloped areas would consist of impacted dust generated by the excavation activities and subsequent placement and grading of the excavated soils. This issue can be easily resolved by implementing a dust monitoring and suppression program. In addition, proper personal protective equipment would be provided to the site workers. Potential dust problems during paving activities in the trucking yard outside of the containment area would not be a significant concern since the surficial layer consists of imported gravel. As noted above, a dust monitoring and suppression program was implemented during the paving activities conducted in December 2004.

8.4.4 Long-Term Effectiveness

Alternative C would provide an effective long-term protection to human health and the environment. As long as the integrity of the caps is maintained, exposure pathways would not exist. Regular monitoring and maintenance of the caps can be easily conducted to address any degradation of the caps.

8.4.5 Reduction of Toxicity, Mobility, and Volume

Alternative C does not reduce the toxicity or volume of contaminants. However, it does significantly reduce the mobility by limiting the amount of rainwater contacting the soil.

8.4.6 Implementability

The installation of the GSL cap in the west and central areas can be implemented without any significant difficulties. Preparatory grading activities would utilize conventional earth moving equipment. The GSLs are readily supplied by and installed by geosynthetic liner distributors. A general contractor or landscape contractor can install the vegetated topsoil layer above the GSL. Placement of an asphalt cap in the trucking yard was accomplished by a paving contractor. Competitive bids could be obtained for the placement of the topsoil cover. However, the installation of GSLs is more specialized and available suppliers are more limited.

An inspection and maintenance program would need to be developed to ensure that the integrity of the GSL and asphalt caps is maintained. The inspection would not require a person with special skills or highly technical background. A management level employee (e.g. operations manager) could be designated to inspect the caps at a set schedule (e.g. semi-annually). Repairs to the caps would be conducted as necessary. An annual report of the site inspection results and any maintenance work would be prepared and submitted to NYSDEC.

Although Alternative C provides effective protection to human health and the environment, it limits the potential future development of the west and central areas of the property.

For Alternative C1, the excavation of soils for consolidation and installation of a combination GSL/asphalt/soil cap can be implemented without any significant difficulties. Conventional earth moving equipment would be used to excavate soils and grade the containment area in preparation for capping. Installation of a GSL is a straightforward operation that can be performed by most remedial contractors. Placement of an asphalt cap in the containment area and the trucking yard (which as already been completed) can be performed by a conventional paving contractor. Because the top of the containment area would be used for parking, the height of the consolidated soils is restricted by what would be reasonable to the property owner for an elevated parking area. Stability of the side slopes should not be a concern if the consolidated material is compacted properly once vegetation is established.

An inspection and maintenance program would be required to ensure that the integrity of the asphalt caps is maintained. The inspection would not require a person with special skills or highly technical background. The property owner's consultant will develop an operation, maintenance, and monitoring plan (OM&M) and will provide the training to the site representative responsible for implementing the plan. A semi-annual inspection should suffice, with repairs to the asphalt cap as necessary. An annual report of the site inspection results and any maintenance work would be prepared by a qualified environmental expert with input from the site representative, and submitted to NYSDEC. The report will include a certificate signed by a qualified environmental expert and the owner of the property. This certificate form will be developed as part of the OM&M document.

Consolidation of the soils into the east-central portion of the site allows for future development of the remaining property to the west of the containment area.

8.4.7 Cost

The assumptions used to estimate the cost of Alternative C are summarized as follows:

Capital Costs

- A GSL membrane would be installed over the entire west and central undeveloped area;
- A 6 inch (15 centimetres) hydro-seeded topsoil layer would be placed over the GSL; and,
- The asphalt cap in the trucking yard was installed in December 2004 to provide a better driving surface for the trucking activities. The existing surface in the trucking yard consisted of clean imported granular material that was placed on-site on several occasions over the years. This granular

material was considered to be a suitable subbase for placement of the asphalt surface, which consisted of 4.5 inches (11 centimetres) of binder and 1.5 inches (4 centimetres) of asphalt topcoat; and,

- Site engineering would include two field staff.

Operation and Maintenance

- The cost of the cover cap inspection program was based on a 30 year period;
- Repair work to the asphalt was assumed to be required approximately once every five years and would consist of repaving or resealing all or a portion of the entire cap area, as appropriate (assumed 500 yd^2 requiring repair each time); and,
- Engineering costs would include annual reporting to NYSDEC.

Future Capital Costs

- Potential future costs may consist of asphalt capping in the area of the building, if demolished and if necessary, and the existing asphalt parking lot at the east side of the site (if necessary). This would be required if the existing cover materials are damaged and not in good shape.

The cost for implementing Alternative C was estimated to be $690,475. The cost estimate details are provided in the tables in Appendix E.

The design concept for Alternative C1 was developed by AGC. The assumptions used to estimate the cost of Alternative C1 are summarized as follows:

Capital Costs:

- Imported clean fill would be placed in the excavated areas to accomplish the final design grades and establish the desired drainage;
- A GSL would be placed over the consolidated soils and covered with 12 inches of suitable subbase below the asphalt or general clean fill on the side slopes;
- The asphalt cap over the containment area would consist of 12 inches of subbase overlain by a 3-inch asphalt base course and a 3- inch asphalt wearing course;
- Six inches of topsoil would be placed over the 12 inches of suitable subbase on the side slopes followed by seeding. This would give the fill cover a total thickness of 18 inches;
- The trucking yard was paved in December 2004 and is described above in the cost estimate for Alternative C;

- A geotextile fabric overlain by 4 inches of granular (e.g. crusher run, 2 inch clear stone) would be placed over the rail siding;
- The municipal storm sewer situated between the subject property and the outfall at Scajaquada Creek will be cleaned and accumulated soil particles will be removed and disposed of;
- Two new monitoring wells will be installed; and,
- Oversight during remediation activities would consist of two field staff.

Operations and Maintenance

- The cost of the site monitoring and asphalt cap inspection and maintenance program is based on a 30-year period.
- Repair work to the asphalt was assumed to be required approximately once every five years and would consist of repaving or resealing all or a portion of the entire cap area, as appropriate (assumed 500 yd^2 requiring repair each time).
- An annual report would be submitted to NYSDEC which presents the results of semi-annual monitoring and discusses any required maintenance associated with the containment area.
- The existing monitoring wells (excluding those that will be removed in the consolidation area) and the two new wells will be sampled twice per year for a three-year period.

Future Capital Costs

- Potential future costs may consist of asphalt capping in the area of the building, if demolished and if necessary, and the existing asphalt parking lot at the east side of the site (if necessary). This would be required if the existing cover materials are damaged and not in good shape.

The cost for implementing Alternative C1 was estimated by AGC to range between $1,946,057 and $1,963,754. The range in costs reflects two different design concepts: 1) a 3-foot consolidation height 2) a 6-foot consolidation height. AGC's cost estimate details are provided in the tables in Appendix E.

8.5 Alternative D

Alternative D would consist of excavation of all metals impacted fill at the west and central undeveloped areas, trucking yard, and rail siding, and transporting it to a RCRA Subtitle C landfill (i.e. hazardous) for disposal. The proposed hazardous landfill to be used is the Waste Management Inc. (CWM Chemical Services) facility located in Model City, New York. Once the waste is received, the landfill will mix it with a cement-based S/S stabilizer before placement in the cells. Clean imported fill and gravel would then be brought to the site to be backfilled and compacted. The impacted soil beneath the building and parking lot on the east side will remain in-place.

Institutional controls will be implemented to restrict future site activities or development that could involve the excavation and handling of impacted soil or the disturbance of existing covers (i.e. building floor slab and asphalt cap in the parking lot). A SMP will provide instructions on the management of soil should future activities breach the cover system. The SMP is included in Appendix I and will also be part of the site's OM&M Plan. The SMP may be modified as needed in the future and will be submitted to NYSDEC for review and approval.

8.5.1 Compliance With New York SCGs

Chemical Specific SCGs

The following chemical specific SCGs would apply to Alternative D:

- TAGM 4046 – Determination of Soil Cleanup Objectives and Cleanup Levels; and,
- 6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes.

The remedial actions carried out in Alternative D would comply with the above SCGs, with respect to the subject property. The remaining soil after completing the excavation and disposal activities would meet the TAGM 4046 Background Value of lead (i.e. 500 ppm), which was the basis of one of the cleanup objectives. The impacted soil would be sent to a Subtitle C landfill as a characteristic hazardous waste under 6 NYCRR Part 371, as the leachable lead concentrations exceed the regulatory level. Stabilization of the waste at the landfill prior to disposal would drop the leachable lead concentrations to below the hazardous criteria.

Action Specific SCGs

The following action specific SCGs would apply to Alternative D:

- 6 NYCRR Part 372 – Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities;
- 6 NYCRR Subpart 373-1 – Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements;
- 6 NYCRR Part 375 – Inactive Hazardous Waste Disposal Site Remedial Program;
- 6 NYCRR Part 376 – Land Disposal Restrictions;

- TAGM 4031 – Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites; and,
- 29 CFR Part 1910.120 – Hazardous Waste Operations and Emergency Response.

The pertinent content in these regulations and guidance documents were summarized in Section 6.3.2. The excavation, transportation, and disposal of hazardous soil could be conducted in accordance with the above action specific SCGs.

8.5.2 Location Specific SCGs

No location specific SCGs were identified for Alternative D.

8.5.3 Protection of Human Health and the Environment

This alternative would provide an overall protection to human health and the environment in the subject property area. On-site and off-site human receptors would no longer be exposed to potential migration and uptake pathways since the metals impacted fill would be completely removed from the property. This would also apply to potential non-human receptors in the area, such as burrowing animals. Although protection is provided to human health and the environment in the subject property area, the environment as a whole is impacted by the fact that a large volume of soil generated from the property would occupy valuable hazardous landfill space. In addition, natural resources in the regional area would also be impacted by the large amount of clean soil required to backfill the site.

8.5.4 Short-Term Effectiveness

During implementation of Alternative D, measures would be implemented to ensure effective protection of human health and the environment. The remedial actions in this alternative consist of conventional earth moving activities, including excavation with track-mounted excavators, and truck movement to the off-site landfill. Therefore, the main environmental concerns during the construction period include the potential to generate lead-impacted dust and tracking of impacted soil to the roadways. These issues are common in excavation work and would exist through the duration of the project.

The potential dust problems would be addressed by continuous air monitoring to ensure that fugitive is maintained below the criteria identified in TAGM 4031 (150 $\mu g/m^3$). Elevated dust levels can be easily suppressed by spraying the soil with water. Tracking of soil onto the roadways can be avoided by setting up a decontamination area and sweeping the trucks before they leave the site. In addition, personal protective equipment (PPE), including disposable gloves, tyvek suits, and half face respirators will be worn by site workers, as required. To ensure the short-term protectiveness, a detailed site-specific health and safety plan would be developed in accordance with 29 CFR Part 1910.120.

8.5.5 Long-Term Effectiveness

The excavation and off-site disposal of impacted soil would be very effective in providing long-term protection of human health and the environment in the subject property area. This alternative would provide a permanent solution with respect to the study area, and there would be no residual quantities of lead impacted soil remaining on-site, other than the fill below the building. In addition, there would be no future site activity requirements, such as monitoring and maintenance of containment systems.

8.5.6 Reduction of Toxicity, Mobility, and Volume

With respect to the subject property, the volume of impacted soil is considerably reduced, which significantly reduces the risk to on-site workers and nearby residents. However, the volume of characteristically hazardous materials is not reduced with respect to the environment as a whole. However, at the point of disposal, the mobility would be significantly and permanently lowered by the addition of stabilizing agents at the Subtitle C landfill. This meets the NYSDEC policy of giving preference to treatment technologies that destroys toxic contaminants, reduces to the total mass of toxic contaminants, irreversibly reduces the mobility, or reduces the total volume of contaminated media. With that said, disposal of hazardous waste in a landfill is the last alternative in the hierarchy of preferred technologies outlined in TAGM 4030.

8.5.7 Implementability

The implementation of Alternative D should not present any significant difficulties. Excavation and hauling of soil, whether contaminated or not, is standard heavy construction work. This alternative can be easily implemented and does not require any special skilled labour, other than the ability to operate an excavator. The technology is reliable in meeting the remedial action objectives as it permanently removes the source of health and environmental risk from the subject property. Discussions with the Subtitle C landfill in Model City, New York, indicated that there is sufficient capacity at the facility to dispose of the large volume of impacted soil. Since there are numerous excavation contractors available, there would be no difficulties in obtaining competitive bids to complete this alternative.

The excavation activities carried out in the trucking yard would likely encounter significant difficulties, since the yard is used on a daily basis to operate the business. However, these potential logistical problems could be resolved by carefully planning and coordinating the remedial activities with the daily site operations.

8.5.8 Cost

The cost estimate to carry out Alternative D is preliminary in nature and was based on a number of assumptions. The goal of estimating the cost was to provide an order of magnitude price by which this alternative can be compared to others. Unit pricing was obtained from contractors and the hazardous waste landfill, and may change, depending on the time that the remedial actions are implemented. A more accurate cost would be obtained once a contract specification document is prepared and issued for tender. The assumptions used for this preliminary cost estimate are summarized as follows:

Capital Costs

- For Alternative D, cost estimates for five sub-alternatives were developed for different excavation depths. These sub-alternatives were identified as Options D1 to D5. Option D5 represents the approximate cost for the conservative high-end quantity estimate of 52,000 yd^3 (78,000 tons), as identified in Section 4.3.4. Options D1 to D4 provide cost estimates for excavation to 1 foot (0.3 metres), 2 feet (0.6 metres), 3 feet (0.9 metres), and 4 feet (1.2 metres), respectively. In areas where the estimated depth of impact is less than 4 feet (1.2 metres), such as the west undeveloped area (i.e. 3 feet), the calculated volumes for Option D4 were terminated at this depth (i.e. 3 feet);

- As discussed previously, the impacted soil beneath the building and parking lot would not be remediated at this time. However, this soil would be managed in the future if the building were demolished. As such, cost estimates were developed for this operable unit to determine potential future costs. The remedial work for the building and parking lot area is identified as Alternative DD, with sub-alternatives Option DD1 to DD5 for different excavation depths below grade. The floor in the building is approximately 4 feet (1.2 metres) higher than ground level. Therefore, each of the sub-alternatives would include this additional depth of metals-impacted fill. For example, Option DD1 would be excavated a total of 5 feet (i.e. 4 feet above ground surface plus 1 foot below grade);

- A density factor of 1.5 tons/yd^3 was used to determine the tonnage;

- The landfill could accept approximately 1,300 tons of soil each day;

- The approximate schedules to complete each sub-alternative were based on the estimated quantity and daily production rate. The projected schedules include backfill and compaction time, and also accounts for breakdowns and other unforeseen problems (e.g. weather). This number was used to estimate other costs such as field engineering supervision and related disbursements;

- The excavated areas would be backfilled with imported fill. In the west and central undeveloped areas, a vegetated topsoil layer would be placed over the backfill, to restore this part of the property to reusable conditions;

- For Alternatives D1 to D4, a GSL cap would be placed in the west and central undeveloped areas and an asphalt cap would be constructed in the trucking yard, since some impacted soil would remain on-site (i.e. not full depth remediation);

- Soil verification testing on the base and walls of the excavation soil would be conducted for metals only and tested on a 33 feet x 33 feet grid (10 metres x 10 metres);
- An XRF field instrument may be used during site remediation, which may potentially assist in optimizing the actual quantity of soil that requires remediation; and,
- Site engineering would include two field staff.

Operation and Maintenance

- There would be no future operation and maintenance costs;

Future Capital Costs

- No future capital costs would be required for this alternative;

The costs for implementing Alternative D, Options D1 to D5, were estimated to be:

- Option D1 - $3,201,385 (remediate 1 foot)
- Option D2 - $5,262,015 (remediate 2 feet)
- Option D3 - $7,335,845 (remediate 3 feet)
- Option D4 - $8,955,815 (remediate 4 feet)
- Option D5 - $12,316,150 (remediate full impacted depth)

The costs for implementing Alternative DD, Options DD1 to DD5, were estimated to be:

- Option DD1 - $3,025,437 (remediate 1 foot)
- Option DD2 - $3,655,627 (remediate 2 feet)
- Option DD3 - $4,269,317 (remediate 3 feet)
- Option DD4 - $4,897,857 (remediate 4 feet)
- Option DD5 - $4,897,857 (remediate full impacted depth)

Alternative D (and associated sub-alternatives) would represent the high end cost of the eight alternatives retained for detailed analyses. The cost estimate details are provided in the tables in Appendix E.

8.6 Alternative E

Alternative E consists of soil washing for all impacted fill on-site, except the material beneath the building and parking lot. The washing plant would likely be constructed in the undeveloped area. Since this section of the property is entirely impacted, a portion of the fill would have to be excavated and temporarily stockpiled before washing takes place, in order to set-up the equipment in a clean working area. Once the soil has been processed through the washing unit, it will be stockpiled for verification testing, prior to backfilling. If the results indicate that the treated soil still does not meet the remedial action objectives (i.e. total and leachable lead), it will be sent through the washing unit again. Cleaned soil will be backfilled and compacted in the excavated areas. The washing process will produce a smaller volume of concentrated characteristically hazardous materials, which would be disposed of at a Subtitle C landfill.

Institutional controls will be implemented to restrict future site activities or development that could involve the excavation and handling of impacted soil or the disturbance of existing covers (i.e. building floor slab and asphalt cap in the parking lot). A SMP will provide instructions on the management of soil should future activities breach the cover system. The SMP is included in Appendix I and will also be part of the site's OM&M Plan. The SMP may be modified as needed in the future and will be submitted to NYSDEC for review and approval.

8.6.1 Compliance With New York SCGs

Chemical Specific SCGs

The following chemical specific SCGs would apply to Alternative E:

- TAGM 4046 – Determination of Soil Cleanup Objectives and Cleanup Levels; and,
- 6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes.

The remedial actions carried out in Alternative E would comply with the above SCGs. The goal of soil washing is to physically remove the contaminants from the soil particles or to reduce the quantity of impacted soil to a smaller volume. This is accomplished by a combination of processes, such as particle sizing by dry and wet screening, attrition scrubbing, and possibly leaching. The soil washing technology is expected to comply with the chemical specific SCGs. The process would concurrently reduce the total and leachable lead concentrations. Treatability testing would be required to verify its applicability with the site-specific soil conditions.

Action Specific SCGs

The following action specific SCGs would apply to Alternative E:

- 6 NYCRR Part 370 – Hazardous Waste Management System: General;

- 6 NYCRR Part 372 – Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities;
- 6 NYCRR Subpart 373-1 – Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements;
- 6 NYCRR Part 375 – Inactive Hazardous Waste Disposal Site Remedial Program;
- TAGM 4031 – Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites; and,
- 29 CFR Part 1910.120 – Hazardous Waste Operations and Emergency Response.

The soil washing technology and disposal of residual hazardous soil at a Subtitle C landfill can be conducted in accordance with the above action specific SCGs.

Location Specific SCGs

No location specific SCGs were identified for Alternative E.

8.6.2 Protection of Human Health and the Environment

Alternative E would be effective in providing protection of human health and the environment for the subject property area. Brice reviewed the analytical data and site conditions, and indicated to XCG that their soil washing technology could be used to treat the contaminants at the property. However, a treatability test would still be required to verify the applicability and to determine sizing requirements, based on the site-specific soil conditions. If proven to be applicable to the site, soil washing would significantly reduce the risks at the subject property by physically removing the contaminants from the soil or concentrating it into a smaller volume for off-site disposal. Upon completing the remedial actions, on-site workers and nearby residents would no longer be exposed to soils with lead above background values.

8.6.3 Short-Term Effectiveness

Potential short-term environmental concerns associated with Alternative E are similar to Alternative D. Soil excavation and hauling to the on-site washing plant would be required to perform the remedial work. As such, the main health and environmental issue would be the potential generation of impacted dust, which could be inhaled by on-site workers and residents on the north side of Walden Avenue. The time period in which receptors may be exposed to potential air-borne particulates is essentially the length of the remedial activities. As mentioned in Alternative D, this short-term exposure could be effectively mitigated by implementing an air monitoring and dust suppression program. In addition, site workers would wear proper PPE when conditions warrant it.

8.6.4 Long-Term Effectiveness

As indicated in TAGM 4030, separation technologies (i.e. soil washing) are considered permanent remedies. With respect to inorganic contaminants, separation techniques are given the highest preference in the hierarchy of preferred technologies. Soil washing would provide a permanent solution by effectively reducing the volume of hazardous soil, which would be disposed of at an off-site permitted facility, and the treated stream can be re-used on-site. Therefore, human health and the environment in the subject property area will be protected in the long-term. In addition, there would be no future site activity requirements, such as monitoring and maintenance of containment systems.

8.6.5 Reduction of Toxicity, Mobility, and Volume

The soil washing technology would permanently and significantly reduce the volume of metals impacted soil on-site. The treatment process is considered irreversible since the metals are either removed from the soil particles or the impacted soil is reduced to a much smaller volume for off-site disposal. Therefore, there would be no residual impacted soil remaining on the property, except for the fill situated beneath the building.

8.6.6 Implementability

Soil washing involves some conventional remedial processes, such as excavation and hauling; however, the core components of this technology require specialized equipment and skilled operators. Soil washing has been implemented at other sites in the US and has been demonstrated in the SITE program. However, the applicability of this technology is site-specific. Since treatability testing has not been conducted to date, it is currently unknown whether this technology would be effective in treating the types and concentrations of contaminants at the subject property. Without this testing, the percent of volume reduction expected is currently unknown. In addition, re-processing of a substantial volume of treated soil that fails the remedial action objectives during the first run could cause significant scheduling delays. These unknowns and their impact on the site remediation as a whole would obviously not be determined until the actions are implemented. Soil washing is a specialized technology with a limited number of vendors. Therefore, it would be difficult to obtain competitive bids to perform this treatment process for the west and central undeveloped area. Since the goal of soil washing is to permanently reduce the volume of impacted soil on the property, there would be no requirements for future monitoring in this area once the project is completed and the remedial action objectives are attained.

8.6.7 Cost

The cost estimate to carry out Alternative E is preliminary in nature. Preliminary cost estimates were obtained from a soil washing vendor (Brice) and was based on a review of the site data. Treatability tests would need to be performed to obtain more accurate cost estimates. The assumptions used for this preliminary cost estimate are summarized as follows:

Capital Costs

- Prior to carrying out full-scale soil washing activities, a field-scale pilot test would be conducted to verify the applicability of this technology on the site-specific conditions. This field testing would assist in providing a more detailed cost estimate and identifying any obstacles that may be encountered during full-scale activities;

- An XRF field instrument could be used during the field-scale pilot test to develop a correlation curve for results of total metals, TCLP metals, and XRF data, for both the untreated and treated soil. The XRF and correlation data could then be used during site remediation, which may potentially assist in optimizing the actual quantity of soil that requires remediation;

- For Alternative E, cost estimates for five sub-alternatives were developed for washing soil excavated to different depths. These sub-alternatives were identified as Options E1 to E5. Option E5 represents the approximate cost for the conservative high-end quantity estimate of 52,000 yd^3 (78,000 tons), as identified in Section 4.3.4. Options E1 to E4 provide cost estimates for excavation to 1 foot (0.3 metres), 2 feet (0.6 metres), 3 feet (0.9 metres), and 4 feet (1.2 metres), respectively. In areas where the estimated depth of impact is less than 4 feet (1.2 metres), such as the west undeveloped area (i.e. 3 feet), the calculated volumes for Option E4 were terminated at this depth (i.e. 3 feet);

- As discussed previously, the impacted soil beneath the building and parking lot would not be remediated at this time. However, this soil would be managed in the future if the building were demolished. As such, cost estimates were developed for this operable unit to determine potential future costs. The remedial work for the building and parking lot area is identified as Alternative EE, with sub-alternatives Option EE1 to EE5 for different excavation depths below ground surface. As described in Section 8.5.8, the floor in the building is approximately 4 feet (1.2 metres) higher than ground level. Soil washing and leaving this soil on-site would not be practical since the relatively large volume would significantly raise the grade on-site, which would limit the possible future uses and redevelopment. Therefore, the metals-impacted fill between the floor slab and ground surface would be disposed of off-site. The two options would be direct disposal at a hazardous landfill or chemical fixation followed by disposal at a non-hazardous landfill. Based on cost-effectiveness, the 4 feet (1.2 metres) of metals-impacted fill above ground surface would be chemically fixated ex-situ and disposed of off-site;

- The daily process rate is approximately 500 tons/day,

- A portion of the fill will need be excavated and temporarily stockpiled to set up the washing plant;

- Soil washing will consist of volume reduction only (i.e. no chemical leaching);

- 30 percent of the processed soil (i.e. the clay/fines content) will require off-site disposal at a Subtitle C landfill;

- 5 percent of the "clean" fraction would require a second round of soil washing;

- The approximate schedules to complete each sub-alternative were based on the estimated quantity and daily production rate. The projected schedules include backfill and compaction time, re-processing of washed soil, and also accounts for breakdowns and other unforeseen problems (e.g. weather). This number was used to estimate other costs such as field engineering supervision and related disbursements;

- The wash water can be treated and disposed of in the sanitary sewers. Brice indicated that their experience has shown that publicly owned treatment works (POTW) will generally accept the disposal of treated water;

- The clean portion of the washed soil would be backfilled on-site. In the west and central undeveloped areas, a vegetated topsoil layer would be placed over the backfill, to restore this part of the property to reusable conditions;

- For Alternatives E1 to E4, a GSL cap would be placed in the west and central undeveloped areas and an asphalt cap would be constructed in the trucking yard, since some impacted soil would not be washed (i.e. not full depth remediation);

- Verification testing would be conducted for each daily batch of washed soil (approximately every 500 tons). The analyses would include total metals and TCLP metals. This testing would be conducted on a rush-turnaround time such that the verified clean soil can be immediately backfilled and compacted;

- Soil verification testing on the base and walls of the excavation would be conducted for metals only and tested on a 33 feet x 33 feet (10 metres x 10 metres) grid. This testing would also be conducted on a rush-turnaround time for backfilling purposes; and,

- Site engineering would include two field staff.

Operation and Maintenance

- There would be no future operation and maintenance costs;

Future Capital Costs

- No future capital costs are anticipated for alternative E; and,

The costs for implementing Alternative E, Options E1 to E5, were estimated to be:

- Option E1 - $3,021,792 (remediate 1 foot)
- Option E2 - $4,685,014 (remediate 2 feet)
- Option E3 - $6,380,779 (remediate 3 feet)
- Option E4 - $7,687,590 (remediate 4 feet)
- Option E5 - $10,360,205 (remediate full impacted depth)

The costs for implementing Alternative EE, Options EE1 to EE5, were estimated to be:

- Option EE1 - $2,510,195 (remediate 1 foot)
- Option EE2 - $3,022,778 (remediate 2 feet)
- Option EE3 - $3,521,848 (remediate 3 feet)
- Option EE4 - $4,033,992 (remediate 4 feet)
- Option EE5 - $4,033,992 (remediate full impacted depth)

The cost estimate details are provided in the tables in Appendix E.

8.7 Alternative F

Alternative F consists of in-situ chemical fixation in the west and central undeveloped areas, trucking yard, and rail siding. The impacted soil beneath the building and east parking lot would not be chemically fixated in-situ. The chemical fixation compound EnviroBlend® would be mixed in-situ with the impacted soil. After the treatment process, a cap consisting of vegetated topsoil would be placed over the stabilized soil in the west and central areas, while an asphalt cap would be constructed in the trucking yard. The existing asphalt cap in the parking lot would remain intact. As discussed previously, an alternative chemical fixation compound (e.g. MBS, ACT, etc.) could be used in place of EnviroBlend®. The remedial activities would essentially be the same, with the only difference being the type of reagent used.

Institutional controls will be implemented to restrict future site activities or development that could involve the excavation and handling of impacted soil or the disturbance of existing covers (i.e. building floor slab and asphalt cap in the parking lot). A SMP will provide instructions on the management of soil should future activities breach the cover system. The SMP is included in Appendix I and will also be part of the site's OM&M Plan. The SMP may be modified as needed in the future and will be submitted to NYSDEC for review and approval.

8.7.1 Compliance With New York SCGs

Chemical Specific SCGs

The following chemical specific SCGs would apply to Alternative F:

- TAGM 4046 – Determination of Soil Cleanup Objectives and Cleanup Levels; and,
- 6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes;

The remedial actions carried out in the undeveloped areas, trucking yard, and rail siding would comply with the above chemical specific SCGs. The chemical fixation technology would reduce the leachability of lead in the impacted fill, to concentrations below the hazardous level identified in 6 NYCRR Part 371 (i.e. 5.0 mg/L). Although the leachable lead levels would be reduced, the total concentrations would remain in the soil. However, capping the stabilized soil would prevent any exposure to the impacted soil by inhalation, ingestion, and dermal contact.

Action Specific SCGs

The following action specific SCGs would apply to Alternative F:

- 6 NYCRR Part 370 – Hazardous Waste Management System: General;
- 6 NYCRR Part 375 – Inactive Hazardous Waste Disposal Site Remedial Program;
- TAGM 4031 – Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites;
- 29 CFR Part 1910.120 – Hazardous Waste Operations and Emergency Response

The in-situ chemical fixation and surface capping alternative can be conducted in accordance with the above action specific SCGs.

Location Specific SCGs

No location specific SCGs were identified for Alternative F.

8.7.2 Protection of Human Health and the Environment

The chemical fixation alternative would provide effective protection to human health and the environment by reducing and controlling the risks currently associated with the subject property. The natural environment would be protected by reducing the leachability of the lead content in the fill to non-hazardous levels. This would prevent lead from impacting on the groundwater resources, albeit the groundwater in the area is not used for potable purposes. Although the total lead levels would remain high, human and non-human exposure to the stabilized soil would be prevented by placing caps over the treated areas.

The use of the capping technology in the parking lot would similarly achieve this exposure protection. Although the impacted fill in this area would not be treated with the chemical fixation compound, the leaching potential would be significantly reduced by limiting the contact with rainwater.

8.7.3 Short-Term Effectiveness

Potential short-term environmental concerns associated with Alternative F would be the generation of dust during the in-situ soil mixing activities. This concern would be present for the duration of the remedial actions. As discussed previously, short-term exposure concerns could be effectively mitigated by implementing an air monitoring and dust suppression program, and providing workers with proper PPE.

8.7.4 Long-Term Effectiveness

The objective of chemical fixation technologies is to cause chemical changes to render the metals virtually insoluble. The long-term effectiveness will depend on the irreversibility of the treated soil. RMT indicates that materials from other sites treated with EnviroBlend® consistently passed the USEPA's Multiple Extraction Procedure (MEP), which is a test designed to simulate 1,000 years of leaching.

As mentioned previously, XCG submitted two soil samples from the central area to RMT for treatability testing. RMT conducted total lead and TCLP lead testing on both the untreated soil and after the soil was mixed with EnviroBlend®. RMT's treatability report is provided in Appendix F. The total lead concentrations were 6,500 ppm and 1,700 ppm while the TCLP lead concentrations prior to treatment were 250 mg/L and 74 mg/L, respectively. The TCLP lead results of the treated samples were 0.036 mg/L and 0.027 mg/L, respectively, which are below the TCLP regulatory level (5.0 m/L) and UTS criteria (0.37 mg/L). Based on these results, RMT indicated that a 6 percent dosage of EnviroBlend ® would be adequate to treat the impacted soil to regulatory levels.

XCG submitted duplicate samples to an independent laboratory (PASC in Burlington, Ontario) for analytical testing to verify the concentrations of the untreated soil. The results of both the total lead and TCLP lead were significantly different. The total lead concentrations detected by PASC (22,000 and 4,600 ppm) were higher than RMT's results (6,500 and 1,700 ppm, respectively). This may be explained by the difference in the analytical testing method employed by PASC and RMT's in-house laboratory. RMT used a cold-acid digestion method whereas PASC utilized a heated digestion method, which would dissolve more metals. In addition, PASC conducted the metals testing on 1 gram of soil while RMT used 10 grams. The TCLP lead concentrations in PASC's testing (170 mg/L and 63 mg/L) were lower than RMT's results (250 mg/L and 74 mg/L, respectively). The variance in concentrations is likely a result of the different extract solutions used by the two laboratories, which is based on the pH of the pre-test. PASC used extract solution 1 (weaker acetic acid) while RMT used extract solution 2 (stronger acetic acid). This explains the higher TCLP levels detected by RMT.

Although the initial treatability testing indicates that EnviroBlend® can reduce the leachable lead concentrations to regulatory levels using the TCLP method, this testing method was designed to predict the leaching in a municipal landfill. These results are applicable for Alternative G where the treated soil is to be disposed of off-site at a non-hazardous landfill. However, the approach in Alternative F is to leave the treated soil at the subject property, the conditions of which are not representative of a landfill. Therefore, additional treatability testing to simulate more realistic on-site disposal conditions would be required to verify that this technology could be applied in-situ. This can be accomplished using the SPLP test method, commonly referred to as the "acid rain" test.

The long-term effectiveness of capping the parking lot was discussed previously.

8.7.5 *Reduction of Toxicity, Mobility, and Volume*

The chemical fixation technology, and EnviroBlend® in particular, does not permanently reduce the toxicity of metal contaminants or reduce the volume of impacted soil. However, TAGM 4030 indicates that this type of technology will significantly and permanently reduce the mobility of inorganic hazardous waste. As discussed above, the initial treatability tests indicate that the leachability of lead can be reduced to regulatory levels based on the TCLP test method, which is designed for landfill conditions. For Alternative F, additional testing that is representative of leaching by acid rain (i.e. SPLP method) at the subject property would be required to verify the applicability of EnviroBlend ® for on-site placement.

The reduction of toxicity, mobility, and volume by capping the parking lot with asphalt was discussed previously.

8.7.6 *Implementability*

Alternative F can be completed using conventional in-situ mixing processes, such as excavators and augers. Specialized equipment and skilled operators are not required for this treatment technology since it is performed with conventional construction processes. There are two possible scenarios that can be used to carry out the in-situ chemical fixation. First, RMT, who is the patent holder of EnviroBlend ®, can serve as the general remediation contractor. Secondly, the EnviroBlend ® compound can be purchased from AMI, who is the sole distributor of this reagent, while a general construction contractor can perform the in-situ mixing activities. As such, there is the potential to obtain competitive bids for this alternative. However, RMT's site experience using its own proprietary compound should be a significant weighing factor when comparing the cost of using another general contractor to conduct the mixing activities.

Although this alternative utilizes conventional heavy construction processes, there is the potential that significant difficulties may be encountered in the in-situ mixing process. This approach can encounter more difficulties in achieving a uniform and homogenous mixture of the reagent, when compared to the ex-situ approach. Additional in-situ mixing problems may be encountered in areas with densely packed soil, such as the trucking yard. Re-mixing of areas that do not achieve the remedial goals during the first pass could substantially delay the project schedule and introduce significant additional costs. A pilot-scale test could be conducted to verify this approach before a full-scale use of this alternative is considered.

As discussed previously, placement of the caps after the soil is stabilized should not encounter any significant difficulties. Future site requirements would consist of a regular inspection and repair program to ensure the integrity of the asphalt and vegetated topsoil caps.

8.7.7 Cost

The cost estimate to carry out Alternative F is preliminary in nature. Preliminary cost estimates were obtained from RMT and other general contractors. The unit rates may change, depending on when the project is implemented. The assumptions used for this preliminary cost estimate are summarized as follows:

Capital Costs

- Additional treatability tests will be required to mimic conditions more representative of on-site management (i.e. SPLP test);
- In addition to the lab-scale treatability testing, a field-scale pilot test would be conducted to verify the applicability of this technology on the site-specific conditions. This field testing would assist in providing a more detailed cost estimate and identifying any obstacles that may be encountered during full-scale activities;
- An XRF field instrument could be used during the field-scale pilot test to develop a correlation curve for results of total metals, TCLP metals, and XRF data, for both the untreated and treated soil. The XRF and correlation data could then be used during site remediation, which may potentially assist in optimizing the actual quantity of soil that requires remediation;
- For Alternative F, cost estimates for five sub-alternatives were developed for chemically fixating the soil in-situ to different depths. These sub-alternatives were identified as Options F1 to F5. Option F5 represents the approximate cost for the conservative high-end quantity estimate of 52,000 yd^3 (78,000 tons), as identified in Section 4.3.4. Options F1 to F4 provide cost estimates for excavation to 1 foot (0.3 metres), 2 feet (0.6 metres), 3 feet (0.9 metres),

and 4 feet (1.2 metres), respectively. In areas where the estimated depth of impact is less than 4 feet (1.2 metres), such as the west undeveloped area (i.e. 3 feet), the calculated volumes for Option F4 were terminated at this depth (i.e. 3 feet);

- As discussed previously, the impacted soil beneath the building and parking lot would not be remediated at this time. However, this soil would be managed in the future if the building were demolished. As such, cost estimates were developed for this operable unit to determine potential future costs. The remedial work for the building and parking lot area is identified as Alternative FF, with sub-alternatives Option FF1 to FF5 for different excavation depths below ground surface. As described previously, the floor in the building is approximately 4 feet (1.2 metres) higher than ground level. In-situ chemical fixation and leaving this above-grade material on-site would not be practical and would significantly raise the grade. Based on cost-effectiveness, the 4 feet (1.2 metres) of metals-impacted fill above ground surface would be chemically fixated ex-situ and disposed of off-site;

- The daily process rate is 1,000 tons/day;

- The approximate schedules to complete each sub-alternative were based on the estimated quantity and daily production rate. The projected schedules include backfill and compaction time, and also accounts for breakdowns and other unforeseen problems (e.g. weather). This number was used to estimate other costs such as field engineering supervision and related disbursements;

- Soil verification testing would be conducted for metals only and tested on a 33 feet x 33 feet (10 metres x 10 metres) grid;

- Chemically fixated soil in the west and central undeveloped area would be covered with a vegetated topsoil layer (approximately 6 inches);

- The asphalt cap in the trucking yard would consist of gravel sub-base, 4 inches (0.1 metres) of type 3 dense binder, 1.5 inches (0.04 metres) of type 7 top course blacktop, and 2 coats of asphalt sealer;

- For Alternatives F1 to F4, a GSL cap would also be placed in the west and central undeveloped areas, and an asphalt cap would be placed in the trucking yard, since some impacted soil would not be chemically fixated (i.e. not full depth remediation);

- Site engineering would include two field staff.

Operation and Maintenance

- The cost of the cover cap inspection program was based on a 30-year period;

- Repair work to the asphalt and vegetated topsoil would be required once every five years; and,
- Engineering costs would include annual reporting to NYSDEC.

Future Capital Costs

- No future capital costs are anticipated for alternative F.

The costs for implementing Alternative F, Options F1 to F5, were estimated to be:

- Option F1 - $1,600,725 (remediate 1 foot)
- Option F2 - $2,258,195 (remediate 2 feet)
- Option F3 - $2,921,715 (remediate 3 feet)
- Option F4 - $3,424,745 (remediate 4 feet)
- Option F5 - $4,487,620 (remediate full impacted depth)

The costs for implementing Alternative FF, Options FF1 to FF5, were estimated to be:

- Option FF1 - $1,953,822 (remediate 1 foot)
- Option FF2 - $2,153,912 (remediate 2 feet)
- Option FF3 - $2,349,602 (remediate 3 feet)
- Option FF4 - $2,549,692 (remediate 4 feet)
- Option FF5 - $2,549,692 (remediate full impacted depth)

The cost estimate details are provided in the tables in Appendix E.

8.8 Alternative G

Alternative G consists of ex-situ chemical fixation of impacted soil from the west and central undeveloped area, trucking yard, and rail siding. The impacted fill beneath the building and east parking lot would not be chemically fixated ex-situ. The impacted fill would be excavated and mixed with the reagent in a pugmill, which would likely be set-up in the undeveloped area. The stabilized soil would then be disposed of at a non-hazardous landfill. The excavated areas would then be backfilled with clean imported soil. The chemical fixation compound chosen in this study was EnviroBlend®. However, a reagent from another company (e.g. MBS, ACT, etc.) could be used in place of EnviroBlend®. The excavation, mixing, and disposal activities would essentially be the same, with the only difference being the type of chemical fixation compound used.

Institutional controls will be implemented to restrict future site activities or development that could involve the excavation and handling of impacted soil or the disturbance of existing covers (i.e. building floor slab and asphalt cap in the parking lot). A SMP will provide instructions on the management of soil should future activities breach the cover system. The SMP is included in Appendix I and will also be part of the site's OM&M Plan. The SMP may be modified as needed in the future and will be submitted to NYSDEC for review and approval.

8.8.1 Compliance With New York SCGs

Chemical Specific SCGs

The following chemical specific SCGs would apply to Alternative G:

- TAGM 4046 – Determination of Soil Cleanup Objectives and Cleanup Levels;
- 6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes; and,
- 6 NYCRR Part 376 – Land Disposal Restrictions.

The remedial actions carried out in Alternative G would comply with the above SCGs, with respect to the subject property. The remaining soil after completing the ex-situ chemical fixation, followed by off-site disposal at a non-hazardous landfill, would meet the remedial action objective of 500 ppm for total lead. This objective was based on the TAGM 4046 Background Value for lead. Treatment of the soil with the EnviroBlend® reagent (or similar reagent) would reduce the TCLP lead concentrations to below the hazardous level of 5.0 mg/L, as outlined in 6NYCRR Part 371. In addition, the treatability testing conducted by RMT indicated that TCLP lead would be reduced to concentrations below the UTS value for lead (0.37 mg/L) identified in 6NYCRR Part 376. The treated soil must meet the UTS value for disposal at a non-hazardous landfill.

Action Specific SCGs

The following action specific SCGs would apply to Alternative G:

- 6 NYCRR Part 372 – Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities;
- 6 NYCRR Subpart 373-1 – Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements;
- 6 NYCRR Part 375 – Inactive Hazardous Waste Disposal Site Remedial Program;
- TAGM 4031 – Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites; and,

- 29 CFR Part 1910.120 – Hazardous Waste Operations and Emergency Response.

The pertinent content in these regulations and guidance documents were summarized in Section 6.3.2. The excavation, treatment, and disposal of impacted soil could be conducted in accordance with the above action specific SCGs.

Location Specific SCGs

No location specific SCGs were identified for Alternative G.

8.8.2 Protection of Human Health and the Environment

The chemical fixation and off-site disposal of impacted fill would effectively protect human health and the environment in the subject property area. Upon completion of the remedial actions, on-site and off-site receptors would no longer be exposed to soil in this area with lead concentrations above background values.

8.8.3 Short-Term Effectiveness

The short-term potential health and environmental concerns are associated with the generation of impacted dust and the tracking of soil onto the roadways. These issues and the mitigation measures to be used to effectively reduce the short-term risks to potential receptors during the construction stage was discussed previously in Alternatives D, E, and F.

8.8.4 Long-Term Effectiveness

Alternative G would provide a permanent and effective long-term solution for the protection of human health and the environment. Potential on-site and off-site receptors would no longer be exposed to the hazardous soil located in these areas.

8.8.5 Reduction of Toxicity, Mobility, and Volume

The use of the chemical fixation technology would permanently and significantly reduce the mobility of metals in soil. In addition, the volume of impacted soil at the subject property would be significantly reduced by transferring it to a non-hazardous landfill. Although the impacted soil volume would not be actually reduced, but merely transferred, the treated soil would be placed in a more controlled environment (i.e. non-hazardous landfill).

8.8.6 Implementability

The implementation of this alternative should not encounter any significant problems. The excavation, mixing, and hauling of soil would utilize conventional heavy construction equipment. Specialized equipment and skilled operators are not required for this treatment technology since it is performed with conventional construction processes. There are two possible scenarios that can be used to carry out the chemical fixation activities. First, RMT, who is the patent holder of

EnviroBlend ®, could serve as the general remediation contractor. Secondly, the EnviroBlend ® compound could be purchased from AMI, who is the sole distributor of this reagent, while a general construction contractor can perform the excavation, mixing, hauling, and backfilling activities. As such, there is the potential to obtain competitive bids for this alternative. However, RMT's site experience using its own proprietary compound should be a significant weighing factor when comparing the cost of using another general contractor to conduct the mixing activities.

As discussed previously, careful planning and coordination with the daily site operations can overcome any potential logistical problems with respect to excavation activities carried out in the trucking yard.

8.8.7 Cost

The cost estimate to carry out Alternative G is preliminary in nature. Preliminary cost estimates were obtained from RMT and other general contractors. Unit rates may change depending on when the project is initiated. The assumptions used for this preliminary cost estimate are summarized as follows:

Capital Costs

- Additional lab-scale treatability tests on soil samples from other locations on the subject property would be conducted to verify the initial results. The additional testing may result in significant savings if the dosage of EnviroBlend® can be further refined;

- In addition to the lab-scale treatability testing, a field-scale pilot test would be conducted to verify the applicability of this technology on the site-specific conditions. This field testing would assist in providing a more detailed cost estimate and identifying any obstacles that may be encountered during full-scale activities;

- An XRF field instrument could be used during the field-scale pilot test to develop a correlation curve for results of total metals, TCLP metals, and XRF data, for both the untreated and treated soil. The XRF and correlation data could then be used during site remediation, which may potentially assist in optimizing the actual quantity of soil that requires remediation;

- For Alternative G, cost estimates for five sub-alternatives were developed for chemically fixating the soil ex-situ to different depths. These sub-alternatives were identified as Options G1 to G5. Option G5 represents the approximate cost for the conservative high-end quantity estimate of 52,000 yd^3 (78,000 tons), as identified in Section 4.3.4. Options G1 to G4 provide cost estimates for excavation to 1 foot (0.3 metres), 2 feet (0.6 metres), 3 feet (0.9 metres), and 4 feet (1.2 metres), respectively. In areas where the estimated depth of impact is less than 4 feet (1.2 metres), such as the west undeveloped area (i.e. 3 feet), the calculated volumes for Option G4 were terminated at this depth (i.e. 3 feet);

- As discussed previously, the impacted soil beneath the building and parking lot would not be remediated at this time. However, this soil would be managed in the future if the building were demolished. As such, cost estimates were developed for this operable unit to determine potential future costs. The remedial work for the building and parking lot area is identified as Alternative GG, with sub-alternatives Option GG1 to GG5 for different excavation depths below ground surface. An additional 4 feet (1.2 metres) would be added to each sub-alternative to account for the metals-impacted fill between the floor slab and ground surface. For example, the remediation depth for GG1 would be 5 feet (i.e. 4 feet above grade plus 1 foot below ground surface);

- The daily process rate is 600 tons/day;

- Chemically fixated soil would be disposed of off-site at a non-hazardous landfill;

- The approximate schedules to complete each sub-alternative were based on the estimated quantity and daily production rate. The projected schedules include backfill and compaction time, and also accounts for breakdowns and other unforeseen problems (e.g. weather). This number was used to estimate other costs such as field engineering supervision and related disbursements;

- The excavated areas would be backfilled with imported fill. In the west and central undeveloped areas, a vegetated topsoil layer would be placed over the backfill, to restore this part of the property to reusable conditions;

- For Alternatives G1 to G4, a GSL cap would also be placed in the west and central undeveloped areas and an asphalt cap would be constructed in the trucking yard, since some impacted soil would not be chemically fixated (i.e. not full depth remediation);

- TCLP verification testing would be conducted for each daily batch of treated soil (approximately every 600 tons). This testing would be conducted on a rush-turnaround time to verify that the treated soil can be disposed of at a non-hazardous landfill;

- Soil verification testing would be conducted on the base and walls of the excavation for metals only, and tested on a 33 feet x 33 feet (10 metres x 10 metres) grid; and,

- Site engineering would include two field staff.

Operation and Maintenance

- There would be no future operation and maintenance costs.

Future Capital Costs

- No future capital costs are anticipated for alternative G.

The costs for implementing -Alternative G, Options G1 to G5, were estimated to be:

- Option G1 - $2,293,126 (remediate 1 foot)
- Option G2 - $3,712,995 (remediate 2 feet)
- Option G3 - $5,142,544 (remediate 3 feet)
- Option G4 - $6,222,095 (remediate 4 feet)
- Option G5 - $8,426,110 (remediate full impacted depth)

The costs for implementing Alternative GG, Options GG1 to GG5, were estimated to be:

- Option GG1 - $2,044,237 (remediate 1 foot)
- Option GG2 - $2,463,458 (remediate 2 feet)
- Option GG3 - $2,891,039 (remediate 3 feet)
- Option GG4 - $23,308,467 (remediate 4 feet)
- Option GG5 - $3,308,467 (remediate full impacted depth)

The cost estimate details are provided in the tables in Appendix E.

8.9 *Alternative H*

Alternative H is similar to Alternative G, except that the ex-situ treated soil would be managed on-site, rather than at a non-hazardous landfill. The impacted soil beneath the building and east parking lot would not be chemically fixated ex-situ. Impacted soil from the west and central undeveloped area, trucking yard, and rail siding would be excavated and mixed with the EnviroBlend® reagent in a pugmill. The stabilized soil would then be backfilled into the excavated areas. To achieve the remedial action objective of preventing exposure to metals-impacted soil, a cap consisting of vegetated topsoil would be placed over the stabilized soil in the west and central areas, while an asphalt cap would be constructed in the trucking yard. The existing asphalt cap in the parking lot would remain intact. As discussed previously, a reagent from another company (e.g. MBS, ACT, etc.) could be used in place of EnviroBlend® to perform the chemical fixation.

Institutional controls will be implemented to restrict future site activities or development that could involve the excavation and handling of impacted soil or the disturbance of existing covers (i.e. building floor slab and asphalt cap in the parking lot). A SMP will provide instructions on the management of soil should future activities breach the cover system. The SMP is included in Appendix I and will also be part of the site's OM&M Plan. The SMP may be modified as needed in the future and will be submitted to NYSDEC for review and approval.

8.9.1 Compliance With New York SCGs

Chemical Specific SCGs

The following chemical specific SCGs would apply to Alternative H:

- TAGM 4046 – Determination of Soil Cleanup Objectives and Cleanup Levels;
- 6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes; and,

The remedial actions carried out in the undeveloped areas, trucking yard, and rail siding would comply with the above chemical specific SCGs. The chemical fixation technology would reduce the leachability of lead in the impacted fill, to concentrations below the hazardous level identified in 6 NYCRR Part 371 (i.e. 5.0 mg/L). Although the leachable lead levels would be reduced, the total concentrations would remain in the soil. However, capping the stabilized soil would prevent any exposure to the impacted soil by inhalation, ingestion, and dermal contact.

Action Specific SCGs

The following action specific SCGs would apply to Alternative H:

- 6 NYCRR Part 370 – Hazardous Waste Management System: General;
- 6 NYCRR Part 375 – Inactive Hazardous Waste Disposal Site Remedial Program;
- TAGM 4031 – Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites; and,
- 29 CFR Part 1910.120 – Hazardous Waste Operations and Emergency Response.

The pertinent content in these regulations and guidance documents were summarized in Section 6.3.2. The excavation, treatment, and disposal of impacted soil could be conducted in accordance with the above action specific SCGs.

Location Specific SCGs

No location specific SCGs were identified for Alternative H.

8.9.2 Protection of Human Health and the Environment

The ex-situ chemical fixation alternative, followed by on-site placment with capping, would provide effective protection to human health and the environment by reducing and controlling the risks currently associated with the subject property. The natural environment would be protected by reducing the leachability of the lead content in the fill to non-hazardous levels. This would prevent lead from impacting on the groundwater resources, albeit the groundwater in the area is not used for potable purposes. Although the total lead levels would remain high, human and non-human exposure to the stabilized soil would be prevented by placing caps over the treated areas.

The use of the capping technology in the parking lot would similarly achieve this exposure protection. Although the impacted fill in this area would not be treated with the chemical fixation compound, the leaching potential would be significantly reduced by limiting the contact with rainwater.

8.9.3 Short-Term Effectiveness

The short-term potential health and environmental concerns are associated with the generation of impacted dust, which may be inhaled by site workers and off-site receptors. This issue and the mitigation measures to be used to effectively reduce the short-term risks to potential receptors during the construction stage was discussed previously.

8.9.4 Long-Term Effectiveness

As discussed previously in Alternative F, the initial treatability testing indicates that EnviroBlend® can reduce the leachable lead concentrations to regulatory levels using the TCLP method. However, this testing method was designed to predict the leaching in a municipal landfill. The approach in Alternative H is to leave the treated soil at the subject property, the conditions of which are not representative of a landfill. Therefore, additional treatability testing to simulate more realistic on-site placement or management conditions would be required to verify that this technology could be applied in-situ. This can be accomplished using the SPLP test method, commonly referred to as the "acid rain" test.

The long-term effectiveness of capping the parking lot was discussed previously.

8.9.5 Reduction of Toxicity, Mobility, and Volume

The chemical fixation technology, and EnviroBlend® in particular, does not permanently reduce the toxicity of metal contaminants or reduce the volume of impacted soil. However, TAGM 4030 indicates that this type of technology will significantly and permanently reduce the mobility of inorganic hazardous waste. As discussed above, the initial treatability tests indicate that the leachability of lead can be reduced to regulatory levels based on the TCLP test method, which is designed for landfill conditions. For Alternative H, additional testing that is representative of leaching by acid rain (i.e. SPLP method) at the subject property would be required to verify the applicability of EnviroBlend ® for on-site placment.

The reduction of toxicity, mobility, and volume by capping the parking lot with asphalt was discussed previously.

8.9.6 Implementability

The implementation of this alternative should not encounter any significant problems. The excavation, mixing, and hauling of soil would utilize conventional heavy construction equipment. Specialized equipment and skilled operators are not required for this treatment technology since it is performed with conventional construction processes. There is the potential to obtain competitive bids for this alternative. However, RMT's site experience using its own proprietary compound should be a significant weighing factor when comparing the cost of using another general contractor to conduct the mixing activities.

As discussed previously, careful planning and coordination with the daily site operations can overcome any potential logistical problems with respect to excavation activities carried out in the trucking yard.

8.9.7 Cost

The cost estimate to carry out Alternative H is preliminary in nature. Preliminary cost estimates were obtained from RMT and other general contractors. Unit rates may change depending on when the project is initiated. The assumptions used for this preliminary cost estimate are summarized as follows:

Capital Costs

- Additional lab-scale treatability tests on soil samples from other locations on the subject property would be conducted to verify the initial results. The additional testing may result in significant savings if the dosage of EnviroBlend® can be further refined;
- In addition to the lab-scale treatability testing, a field-scale pilot test would be conducted to verify the applicability of this technology on the site-specific conditions. This field testing would assist in providing a more detailed cost estimate and identifying any obstacles that may be encountered during full-scale activities;
- An XRF field instrument could be used during the field-scale pilot test to develop a correlation curve for results of total metals, TCLP metals, and XRF data, for both the untreated and treated soil. The XRF and correlation data could then be used during site remediation, which may potentially assist in optimizing the actual quantity of soil that requires remediation;

- For Alternative H, cost estimates for five sub-alternatives were developed for chemically fixating the soil to different depths. These sub-alternatives were identified as Options H1 to H5. Option H5 represents the approximate cost for the conservative high-end quantity estimate of 52,000 yd^3 (78,000 tons), as identified in Section 4.3.4. Options H1 to H4 provide cost estimates for excavation to 1 foot (0.3 metres), 2 feet (0.6 metres), 3 feet (0.9 metres), and 4 feet (1.2 metres), respectively. In areas where the estimated depth of impact is less than 4 feet (1.2 metres), such as the west undeveloped area (i.e. 3 feet), the calculated volumes for Option H4 were terminated at this depth (i.e. 3 feet);

- As discussed previously, the impacted soil beneath the building and parking lot would not be remediated at this time. However, this soil would be managed in the future if the building were demolished. As such, cost estimates were developed for this operable unit to determine potential future costs. The remedial work for the building and parking lot area is identified as Alternative HH, with sub-alternatives Option HH1 to HH5 for different excavation depths below ground surface. As described previously, the floor in the building is approximately 4 feet (1.2 metres) higher than ground level. Ex-situ chemical fixation followed by on-site placment of this above ground metals-impacted fill would not be practical and would significantly raise the grade. Based on cost-effectiveness, the 4 feet (1.2 metres) of metals-impacted fill above ground surface would be chemically fixated ex-situ and disposed of off-site;

- The daily process rate is estimated to be 600 tons/day;

- The approximate schedules to complete each sub-alternative were based on the estimated quantity and daily production rate. The projected schedules include backfill and compaction time, and also accounts for breakdowns and other unforeseen problems (e.g. weather). This number was used to estimate other costs such as field engineering supervision and related disbursements;

- The treated soils would be backfilled on-site;

- Chemically fixated soil in the west and central undeveloped area would be covered with a vegetated topsoil layer (approximately 6 inches);

- The asphalt cap in the trucking yard would consist of gravel sub-base, 4 inches (10 centimetres) of type 3 dense binder, 1.5 inches (4 centimetres) of type 7 top course blacktop, and 2 coats of asphalt sealer;

- For Alternatives H1 to H4, a GSL cap would also be placed in the west and central undeveloped areas and an asphalt cap would be constructed in the trucking yard, since some impacted soil would not be chemically fixated (i.e. not full depth remediation);

- TCLP verification testing would be conducted for each daily batch of treated soil (approximately every 600 tons). This testing would be conducted on a rush-turnaround time to verify that the treated soil can be disposed of at a non-hazardous landfill;
- Soil verification testing would be conducted on the base and walls of the excavation for metals only, and tested on a 33 feet x 33 feet (10 metres x 10 metres) grid; and,
- Site engineering would include two field staff.

Operation and Maintenance

- There would be no future operation and maintenance costs.

Future Capital Costs

- No future capital costs are anticipated for alternative H.

The costs for implementing -Alternative H, Options H1 to H5, were estimated to be:

- Option H1 - $1,580,326 (remediate 1 foot)
- Option H2 - $2,401,795 (remediate 2 feet)
- Option H3 - $3,228,544 (remediate 3 feet)
- Option H4 - $3,846,095 (remediate 4 feet)
- Option H5 - $5,186,610 (remediate full impacted depth)

The costs for implementing Alternative HH, Options HH1 to HH5, were estimated to be:

- Option HH1 - $1,863,837 (remediate 1 foot)
- Option HH2 - $2,102,658 (remediate 2 feet)
- Option HH3 - $2,354,239 (remediate 3 feet)
- Option HH4 - $2,591,267 (remediate 4 feet)
- Option HH5 - $2,591,267 (remediate full impacted depth)

The cost estimate details are provided in the tables in Appendix E.

8.10 Comparison of Alternatives

The previous sections provided an evaluation of each alternative independent of the consideration of interrelationships between alternatives. In the following section, the eight alternatives and their sub-alternatives (for Alternatives D to H) are assessed against each other to highlight the strengths and weaknesses. This evaluation is conducted for each of the seven criteria used in the individual analysis. A preferred remedial alternative is then selected (see Section 8.10.8), based on weighing the advantages and disadvantages of each alternative described in the seven criteria.

8.10.1 Compliance With New York SCGs

The remedial action objective for this study was based on reducing the exposure to soils above the Background Value for lead (TAGM 4046). Alternative A, which is the No Action alternative, would not comply with the chemical specific SCGs, since the elevated total and leachable lead concentrations will remain in the soil over the long-term. This is also true with Alternative B, which is a slight upgrade from Alternative A using access and deed restrictions. Conversely, the full depth remediation option for Alternative D (i.e. Option D5) would meet these SCGs, with respect to the subject property. This alternative consists of disposal of all impacted soil at a hazardous landfill (except soil below the building and asphalt at this time). Alternative D1 to D4 and the other five alternatives (and their respective sub-alternatives) are situated in between these two extremes. In Alternatives C and C1, the capping of all impacted areas would mitigate exposure to total lead exceeding 500 ppm (TAGM 4046), but would not reduce the leachable lead to non-hazardous levels (6NYCRR 371). However, by capping the impacted material, its potential to leach metals would be significantly reduced by minimizing the amount of rainwater infiltrating through the soil. The full depth option for Alternatives E to H would meet the chemical-specific SCGs, since the soil placed back into the excavation would either be clean imported fill or treated soil (and capped where appropriate). For the sub-alternatives of D to H where remediation is to be conducted to specified depths not reaching full-depth, the chemical specific SCGs would be partially met, since some untreated metals-impacted soil would remain in-place.

In carrying out each of the eight alternatives, it was considered that the applicable action specific SCGs could be met. No location specific SCGs were identified.

8.10.2 Protection of Human Health and the Environment

Based on the current site conditions, Alternatives A (No Action) and B would provide protection of human health and the environment; however, potential changes to the site conditions in the future may create exposure pathways, thereby introducing unacceptable risks. Alternatives C and C1 would protect human health by limiting exposure to both on-site and off-site receptors. Alternatives D to H and their respective sub-alternatives would provide more protection to human health and the environment, to varying degrees, than would Alternatives A to C.

The level of protection offered by Alternatives D and G (full depth option) are somewhat similar, since both alternatives involve the disposal of impacted soil at an off-site facility. Therefore, the risks in the subject property area would be significantly reduced. However, this would be at the expense of the environment as a whole, since the relatively large volume of impacted soil would consume a substantial amount of valuable landfill space. Further, this would impact on the regional natural resources, as a large quantity of clean fill would need to be acquired to backfill the excavated areas. For Alternative E (full depth option), the level of protection to human health and the environment is comparable to Alternatives D and G, as the treated soil placed back into the excavation would not contain total and leachable lead concentrations greater than the chemical-specific SCGs.

Alternatives F and H provide slightly less protection than Alternatives D, G, and E, since the chemically fixated soil would remain on-site. However the leachable levels would be reduced, thereby protecting the environment, and human health would be protected by the caps placed over the treated soil.

For Alternatives D to H, their partial depth sub-alternatives would provide less protection since some untreated soil would remain on-site in each option.

8.10.3 Short-Term Effectiveness

As discussed above, the current site conditions are effectively protecting human and non-human receptors. As such, Alternative A (No Action) and Alternative B would be applicable in the short-term. With respect to the other six alternatives and their sub-alternatives, the short-term human health and environmental concerns are similar. Each of these alternatives involves conventional earth moving activities. As such, impacted dust may be generated and inhaled by site workers or off-site receptors during the construction stage. This issue can be easily mitigated by implementing an air monitoring and dust suppression program, and providing site workers with proper PPE. Alternatives D and G involve the movement of soil off-site. A potential environmental concern is the tracking of impacted soil onto the roadways. However, this potential problem would be easily addressed by constructing a decontamination pad and ensuring that each truck is swept before leaving the site.

Alternatives C and C1, all options in Alternative F, all options in Alternative H, and all non full-depth options in Alternatives D, E, and G involve the placement of an asphalt cap in the trucking yard. There are no significant short-term environmental concerns anticipated with the paving activities. Although some surficial gravel may be disturbed during grading, this activity is not expected to generate any significant amounts of impacted dust, as this area is currently covered with clean imported gravel.

8.10.4 Long-Term Effectiveness

Alternatives A and B would not provide long-term solutions to address the impacted fill. For Alternatives C and C1, the GSL and asphalt cap would be effective in providing human health and the environment over the long term, as it would mitigate exposure to the material. The leachable portion of the metals would not be reduced since the soil is not treated; however, the leaching potential would be significantly reduced since the caps would decrease the amount of rain water contacting the metals-impacted fill. The other five alternatives are designed to remediate the soil, such that human health and the environment in the subject property area are protected.

In Alternative D, any risks to potential on-site and off-site receptors would be virtually eliminated over the long-term, since all the impacted soil (except the inaccessible soil below the building and parking lot) would be completely removed. However, landfill disposal is the least preferred choice in the TAGM 4030 hierarchy of technologies. Although Alternative G includes off-site disposal of metals-impacted fill, the soil is chemically fixated and could be sent to a non-hazardous landfill. The chemical fixation addresses NYSDEC's requirement that preference be given to technologies that permanently and significantly reduces the toxicity, mobility, or volume of the characteristically hazardous material. Alternatives E (soil washing), F (in-situ chemical fixation), and H (ex-situ chemical fixation) involve treating and leaving the soil on-site. However, there is a greater confidence in the long-term effectiveness of Alternative H since the contaminants are physically removed from the property, either by volume reduction or chemical leaching.

For Alternatives D to H, their partial depth sub-alternatives would provide less protection since some untreated soil would remain on-site in each option.

8.10.5 Reduction of Toxicity, Mobility, and Volume

Alternatives A and B offer no reduction in the toxicity, mobility, or volume of impacted fill. The mobility of the metals in the fill material would be reduced in Alternatives C and C1, since the caps would minimize the amount of rain water contacting the soil. Although the toxicity is not reduced in Alternative D, the volume of metals-impacted fill existing at the property would be drastically reduced by removing it for off-site disposal. Furthermore, the mobility of the metals would be reduced at the hazardous landfill, since the facility mixes it with a cement-based S/S compound. Alternative G is somewhat similar to Alternative D, as it provides a combination of mobility and volume reduction, with respect to the subject property. The only difference is that the metals-impacted fill is stabilized on-site prior to shipment and the soil is disposed of at a non-hazardous landfill.

Alternatives F and H are not as advantagous as Alternatives D and G with respect to volume reduction, since the treated soil remains at the subject property. However, they do accomplish the goal of significantly reducing the mobility of the metals in the fill by chemically fixating them to the soil particles.

Alternative E would permanently and significantly reduce the volume of characteristically hazardous material by size reduction and possibly chemical treatment, followed by off-site disposal of residuals.

For the partial depth sub-alternatives of Alternatives D to H, the volume and mobility reduction would obviously be less than the full-depth remedial option, and the degree of reduction would correspond to the depth of remediation (i.e. 1 foot, 2 feet, etc.). However, the addition of a surface cap on top of the treated soil would assist in significantly minimizing the amount of water reaching the remaining untreated soil.

8.10.6 *Implementability*

Alternative A (No Action) would be the easiest to implement, as it only requires regular groundwater monitoring in the existing wells. Alternative B would also be easy to implement since the main action item is the erection of a fence at the west undeveloped area. The other six alternatives involve conventional earth moving activities combined with specific remedial technologies. However, some of the alternatives would be considered more difficult to implement. This is discussed further below.

Comparing Alternatives C and C1 to H, Alternatives C and C1 would be the easiest to implement. In the west and central undeveloped areas, the initial grading activities is a relatively simple exercise involving conventional earth moving equipment (e.g. bulldozer, front-end loader, etc.). The GSL liners are shipped in rolls and can be easily installed by the supplier. In Alternatives C and C1, the capping of the trucking yard with asphalt should not encounter any significant difficulties and can be conducted by any general paving contractor.

The implementation of Alternatives D to H would encounter the same difficulties in the trucking yard, as the daily shipping and receiving activities, as well as the parking of trucks, would impact on the ability to carry out the excavation activities (or in-situ mixing). However, as described in Section 7, the logistical problems could be resolved by careful planning and co-ordination with Metro Waste.

The soil washing technology (Alternative E) may be more difficult to implement, compared to the chemical fixation technology. Soil washing is a treatment process that uses unique equipment and specially trained operators. The steps involved in soil washing are more complicated than the chemical fixation technology, which simply involves mixing a proprietary compound with the metals-impacted fill and allowing the chemical reactions to take place. Uncertainties related to the quantity of residuals requiring off-site disposal, or the potential for re-processing washed soil that fails the remedial action objectives could significantly impact on the schedule and overall performance. These uncertainties can be addressed to a certain degree by carrying out treatability testing.

In comparing the three chemical fixation alternatives (Alternatives F, G, and H), the in-situ process would be considered much more difficult to implement compared to excavation followed by mixing in a pug-mill. There are two points that need to be considered in the in-situ method. The physical mixing process would be difficult in areas that are densely packed, such as the trucking yard. Secondly, there are greater uncertainties regarding the even distribution of the chemical fixation compounds in the in-situ method.

8.10.7 Cost

The preliminary cost estimates for Alternatives A to H (and associates sub-alternatives) are summarized in Table 14. This table also provides a summary of the preliminary cost estimates for remediating the soil beneath the building and parking lot, which would not be carried out at this time.

TABLE 14
PRELIMINARY REMEDIAL COST ESTIMATES

ALTERNATIVE	OPTION 1 (1 FT)	OPTION 2 (2 FT)	OPTION 3 (3 FT)	OPTION 4 (4 FT)	OPTION 5 (FULL DEPTH)
Current Remedial Actions – West and Central Area, Trucking Yard, and Rail Siding					
Alternative A	Na	Na	Na	Na	$196,788
Alternative B	Na	Na	Na	Na	$221,788
Alternative C	Na	Na	na	Na	$690,475
Alternative C1 (3')	Na	Na	Na	Na	$1,946,057
Alternative C1 (6')	Na	Na	Na	Na	$1,963,754
Alternative D	$3,201,385	$5,262,015	$7,335,845	$8,995,815	$12,316,150
Alternative E	$3,021,792	$4,685,014	$6,380,779	$7,687,590	$10,360,205
Alternative F	$1,600,725	$2,258,195	$2,921,715	$3,424,745	$4,487,620
Alternative G	$2,293,126	$3,712,995	$5,142,544	$6,222,095	$8,426,110
Alternative H	$1,580,326	$2,401,795	$3,228,544	$3,846,095	$5,186,610
Future Remedial Actions – Building and Parking Lot					
Alternative DD	$3,025,437	$3,655,627	$4,269,317	$4,897,857	$4,897,857
Alternative EE	$2,510,195	$3,022,778	$3,521,848	$4,033,992	$4,033,992
Alternative FF	$1,953,822	$2,153,912	$2,349,602	$2,549,692	$2,549,692
Alternative GG	$2,044,237	$2,463,458	$2,891,039	$3,308,467	$3,308,467
Alternative HH	$1,863,837	$2,102,658	$2,354,239	$2,591,267	$2,591,267

NOTE:

na – not applicable

As shown on this table, Alternatives A and D (full-depth) represent the two extremes with respect to remediation costs. Alternative A is by far the least costly alternative, but it does not achieve the remedial action objectives. This alternative was retained throughout the alternative development, preliminary screening, and detailed evaluation steps to provide a baseline for comparison with other alternatives. The high cost of Alternative D is driven by the tipping rates at the hazardous landfill and the large volume of soil requiring disposal. Due to this large volume, slight changes in the disposal rates can have a dramatic effect on the overall cost. For example, if the hazardous landfill increases its tipping fees by $10, this would result in an increase of approximately $858,000 for Alternative D. With respect to full-depth remediation, Alternative E (soil washing) is comparable to Alternative D (i.e. 16 % lower).

The costs of chemical fixation alternatives are much lower than either Alternatives D or E. Alternatives F and H are much lower than Alternative G since there are no off-site disposal fees. The difference in costs between Alternatives F (in-situ) and H (ex-situ) is relatively small (14 %). The slightly higher cost of Alternative H may be worthwhile, when comparing these two alternatives, since it would provide a greater certainty of complete and thorough mixture.

Not surprisingly, the cost of each alternative drops with decreasing depth of remediation. However, it is interesting to note that at the low end depth of remediation (i.e. 1 foot), the costs of Alternatives D to H come closer together. This is likely a result of the tipping fees not playing as big of a factor as some of other cost items (e.g. mobilization, start-up costs, etc.), due to the lower volumes.

8.10.8 Selection of Preferred Soil Remedial Management Plan

In selecting the preferred remedial alternative, the advantages and disadvantages offered by the nine alternatives (including Alternative C1 as a separate alternative) were weighed with respect to the seven evaluation criteria. Alternatives A and B are eliminated because they do not adequately protect human health and the environment in the long-term although they are protective in the short term. The remaining alternatives all provide long-term protection of human health and the environment.

Alternative D is considerably more expensive and does not offer any appreciable advantages in increased protectiveness to justify the additional cost and thus is eliminated because it is not a cost effective alternative. Alternatives E (soil washing) and F (in-situ stabilization) are eliminated due to concerns over the technical implementability of the treatment processes. The probable technical difficulties associated with these two alternatives would lead to increased time to complete the remediation and increased costs. The alternatives do not offer any significant advantages in increased protectiveness which would justify the uncertainty associated with the implementation.

The viable remedial alternatives are thus Alternatives C, C1, G and H. Between Alternatives C and C1, C1 offers the advantages of consolidating the impacted fill which reduces the area of capping and would allow for future development of the western half of the property. The containment area is still usable to the facility thus allowing full utilization of the property for beneficial purposes as opposed to simply being fenced off. The two alternatives offer comparable levels of protectiveness but Alternative C1 offers more advantages in terms of usefulness of the property and reduced area for maintenance. Therefore, Alternative C is eliminated and Alternative C1 is retained for further evaluation.

Alternatives C1, G and H all meet the NYSDEC's requirement that preference be given to technologies which permanently and significantly reduce the toxicity, mobility or volume of the contaminants. Each of these alternatives involves a combination of technologies, one of which is containment. For Alternatives C1 and H, the containment is on-site; for Alternative G, the containment is off-site. The primary difference in Alternatives C1 and H is that Alternative H involves ex-situ stabilization of the impacted fill prior to placement in the containment area.

Stabilization reduces the leachability of the metals in the impacted fill in order to protect groundwater. The treatment does not destroy the contaminants nor does it reduce its toxicity under the primary pathway of concern at the site which is direct contact. The volume of material to be addressed is not reduced by the treatment. Hence the sole benefit to the treatment is to reduce leachability in order to protect groundwater. Sampling of groundwater at the site demonstrates that the occurrence of elevated concentrations of metals in the fill on the site has not impacted groundwater to a measurable degree. The on-site well data is a better measure of a material's potential to impact the groundwater than a laboratory test and the data show that the fill does not require treatment to prevent impact to groundwater. Furthermore, groundwater is not used as a source of drinking water in the site vicinity and thus it does not constitute a completed exposure pathway. When comparing Alternatives C-1 and H, Alternative H is not a cost-effective alternative because it adds over $3,000,000 to the remediation cost without reducing the risks at the site. On this basis, Alternative H is eliminated.

Alternative G involves the treatment of over 52,000 cubic yards of contaminated materials (if conducted over the full depth) followed by transportation to a landfill for disposal. This activity increases the short term risks of implementation due to dust generated by the increased volume of material being excavated and the treatment process, plus the risks associated with the transportation of a significant quantity of material. The treatment for the material, ex-situ stabilization, does not reduce the toxicity or concentration of the contaminants and thus does not reduce the risk of exposure to the materials should an accident and spill occur. Lastly, the alternative transfers the risk associated with the material to another location rather than addressing the risks at the location where they were generated. Since impacted material would remain in place beneath the trucking yard (if full depth excavation is not carried out), the building and the east parking area, the requirements for deed restrictions and site monitoring and maintenance are not eliminated or even significantly reduced to justify the increased short term risk and cost associated with Alternative G. However, this alternative could be required if there is insufficient room for the material on the site.

This analysis demonstrates that Alternative C1 best meets the criteria established for remediation at this site. It is protective of human health and the environment, it permanently reduces the risks associated with the contaminants at the site, it is easily implementable and it allows for full use of the property in a beneficial manner. For these reasons, Alternative C1 is the preferred soil remedial management plan. Alternative G would be utilized for any material which could not fit within the containment area. Implementation of this alternative is described in more detail below.

A preliminary design concept for the consolidation and capping alternative (C1) was developed by AGC. AGC's design concept drawings are provided in Appendix H. The first drawing (labeled Alternative #1) consolidates the material to a height of 3 feet (0.9 metres), while the second one (Alternative #2) has a height of 6 feet (1.8 metres). The two design drawings shown in Appendix H are both for Alternative C1. They were presented as two different design concepts or dimensional layouts for consideration (i.e. 3 feet versus 6 feet height), in order to provide flexibiiltiy during the detailed design. However, it is understood that NYSDEC will only accept the 6 feet design concept. As such, this will be the preferred alternative. Implementation of this alternative would first involve a more detailed delineation of the contamination in the western portion of the property, beyond the limit of the former lagoon (approximately 160 feet west of the existing fence). The purpose of this pre-excavation sampling is to streamline project activities by delineating the limits of lead with a very high degree of certainty in the design stage. The delineation sampling will minimize the amount of post-excavation sampling. Geotechnical information which is needed for design of the side slopes and the asphalt parking area will also be obtained during this investigation. The sample results will be used to refine the volume estimates of material to be consolidated which will be critical for design of the containment area.

Fill material with lead concentrations above 500 ppm in the western portion of the site will be excavated and brought to the containment area. The consolidated materials will be placed in lifts and compacted. Side slopes will be constructed at no steeper than 3H:1V grades. A GSL cap will be placed over the entire consolideated soil (i.e. top and side slopes). A ramp will be constructed from the trucking yard to the top of the containment area to allow access for parking. A height of the consolidated materials prior to cap construction of six feet is considered a reasonable height for the anticipated use of parking truck trailers. The length of cap construction, under this design concept, would be approximately 290 feet. This configuration creates a parking area of just over one acre. A guide rail will be installed around the asphalt parking area for protection of the side slopes from the trucks.

The top of the containment area will be graded for drainage and paved. Drainage will be directed towards inlets, which will tie into the storm sewer on Walden Avenue, either directly or through the storm sewers on-site (if any). The pavement cross-section will consist of 12 inches of suitable subbase overlain by a 6-inch thick asphalt cap on top of the containment area. The 18 inches of cover material plus the six feet of consolidated impacted fill results in a total height of seven and a half feet. The side slopes will be covered with with 12 inches of suitable subbase, and 6 inches of topsoil and grass, over the GSL. As described previously, the trucking yard was paved in December 2004, and was graded to drain properly into a new storm sewer. The rail siding is still currently used. As such, the capping of this area will consist of placing a geotextile fabric overlain with approximately 4 inces of crusher run or 2 inch clear stone.

The western portion of the site will be backfilled and graded to drain, either with positive drainage to the street or the area could be left low to promote a wetland/wildlife habitat. Approximately four acres of the site could thus be subdivided and sold at a future date without restriction on its use. Deed restrictions would be put in place on the remainder of the property to protect the containment area and asphalt cap and would contain provisions for additional action if the building were demolished in the future. Regular site inspections would be conducted to ensure that the containment area and cap are functioning properly and maintenance conducted as necessary. An OM&M Plan will be developed to describe the details of how the building and institutional barriers will be maintained. The OM&M Plan will include a SMP should the institutional barriers (building floor and/or pavement) cease to cover the impacted soil (e.g. excavation and removal of soil if the building and floor slab is demolished). The SMP is included as Appendix I and will also form part of the OM&M Plan. These documents will be submitted to NYSDEC for approval before they are implemented. The SMP may be modified as needed in the future and will be submitted to NYSDEC for review and approval.

Approximately 5,200 cubic yards of soil would be required to be taken off-site for treatment and disposal under the preferred remedial alternative.

The storm sewer in the road allowance between the subject property and the outfall at Scajaquada Creek will be cleaned of any accumulated soil particles. The capping of the site will prevent any future release of impacted soil particles to the municipal storm sewers.

To verify that the groundwater on-site is not impacted, the existing monitoring wells (excluding those that will be removed in the consolidation area) and the two new wells will be sampled twice per year for a three-year period.

9. CONCLUSIONS AND LIMITATIONS

9.1 Limitations

This Remedial Investigation and Feasibility Study (RI/FS) focused on characterizing the type and extent of contaminants, and the possible remedial alternatives to address the impacted soil located at 3241 Walden Avenue in Depew, New York.

The conclusions drawn from this RI/FS were based on information at selected observation and sampling locations on the dates identified in Sections 2.3 and 2.4. In addition, the conclusions were based on the parameters that were chemically analyzed, as identified in Section 2.5. Conditions between and beyond these locations may become apparent, during future investigations or on-site work, which could not be detected or anticipated at the time of this study. The testing program was based on limited information provided by persons knowledgeable about the past and current activities on the site. As such, XCG cannot be held responsible for environmental conditions that were not apparent from the available information.

The cost estimates provided in this report are preliminary in nature and are used for budgetary purposes. XCG has prepared this report using the level of care and professionalism in the industry for similar projects under similar conditions. XCG's cost estimates have been based upon current industry practices and prevailing rates (January 2001). The cost estimate for the preferred remedial alternative (Alternative C1) was determined by AGC as a supplement to the XCG analysis. XCG will not be responsible for conditions or consequences arising from relevant facts that were concealed, withheld, or not fully disclosed at the time this report was prepared. XCG believes that the conclusions stated herein are factual; however, no guarantee is made or implied.

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9.2 Conclusions

The overall conclusion from this Remedial Investigation and Feasibility Study is that a majority of the fill material at the subject property contains metals, and lead in particular, at concentrations that exceed the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values. The metals-impacted fill is considered to be characteristically hazardous, based on TCLP results of lead. Low levels of residual petroleum hydrocarbons are present at the former lagoon/marsh, south part of the trucking yard, rail siding, and south side of parking lot. These are considered co-contaminants with the metals. The

preferred soil remedial management plan consists of consolidation of impacted fill from the western portion of the property into a containment area located in the central portion of the site and construction of an asphalt cap over the containment area and trucking yard to provide needed parking and truck maneuvering area. Materials which do not fit within the new parking area would be disposed of off-site.

Supporting conclusions are as follows:

1. Historical brass foundry operations, smelting operations, and the processing of babbitt explains the elevated levels of lead, zinc, and copper in the fill material. Brass is an alloy of copper and zinc, and babbitt is formed from an alloy of various metals including lead and copper. Metal waste produced by these operations, including the dredged material from the former lagoon and foundry sand, was apparently spread throughout the property;

2. Lead, which is the main contaminant of concern, was detected in all fill material samples in the central undeveloped area at concentrations exceeding the typical high end Background Value in metropolitan areas, as identified in TAGM 4046 (i.e. 500 ppm). All but one surficial soil sample in this area contained lead concentrations above 500 ppm. TCLP analyses of fill material from the central area indicate that lead exceeds the regulatory level, and is therefore, characteristically hazardous. Potential exposure to lead in this area has been temporarily mitigated by the implementation of an IRM in July 1999;

3. Low levels of residual petroleum hydrocarbons were detected in the former lagoon and marsh area. Some VOC and PAH parameters exceeded the STARS1 TCLP Alternative Guidance Value (groundwater protection), but many were below the STARS1 Human Health Guidance Value and/or the TAGM 4046 Cleanup Objectives;

4. Lead in the fill material at the west undeveloped area ranged from very high concentrations to levels more comparable to the typical Background Value. The varying concentrations of lead were located in a sporadic pattern. The TCLP lead results in the fill material varied, but in practical terms with respect to excavation/soil handling during remediation, the fill material in this area was considered to be hazardous. The samples collected from ground surface contained lead concentrations below the Background Value. Therefore, potential exposure to lead in this area by inhalation, ingestion, and dermal contact is minimal;

5. All fill material samples, including surficial soil samples, collected from the trucking yard contained elevated lead concentrations above the Background Value. Residual petroleum hydrocarbons with concentrations similar to the fill in the former lagoon were detected at the south side of the trucking yard.

Potential exposure to lead in this area has been mitigated in the interim by the addition of a new gravel layer in November 1999;

6. The fill material under the rail siding also contained lead concentrations above the Background Values. Based on the TCLP results for lead, a majority of the fill material in this area is classified as hazardous. Residual petroleum hydrocarbons with concentrations similar to the fill material in the former lagoon and south side of the trucking yard were detected beneath the rail siding. The metals-impacted fill is covered by the rail ballast, which is mitigating potential exposure to on-site receptors;

7. The fill material in the parking lot also contains elevated concentrations of lead. Residual petroleum hydrocarbons were encountered at the south side of the parking lot. Based on TCLP lead concentrations, a majority of the metals-impacted fill in this area was considered to be hazardous. The existing asphalt cap in the parking lot is preventing any exposure to the impacted fill;

8. Elevated concentrations of lead and residual petroleum at select locations were also detected in the fill material beneath the building. The concrete floor is preventing any exposure to the contaminants;

9. The native silty clay soil unit beneath the fill material is acting as an effective barrier to vertical migration of contaminants. The concentrations of lead in all silty clay samples, except for one, were well below the Background Value;

10. Groundwater sampling indicates that the contaminants in the fill material have not significantly impacted the saturated water-bearing zone in the silty clay unit. Of the 17 groundwater samples collected, there was only one isolated sample that contained a slightly elevated concentration of lead. However, this assessment was based on a comparison of the results with the TOGS 1.1.1 Standard, which is used for drinking water. The groundwater in the subject property area is not used for potable purposes, as the Village of Depew is serviced by a municipal water supply, which draws its water from Lake Erie. Therefore, groundwater was not considered a medium of concern;

11. Available remedial technologies were reviewed and screened, and a short list of technologies was retained to develop a long-list of potential alternatives. These potential alternatives were then screened and evaluated in detail. Cost estimates were developed for sub-alternatives for each main alternative, which was based on remediation to different depths. The nine alternatives are summarized as follows:

    - Alternative A – No Action: Groundwater monitoring;
    - Alternative B – Limited Action: Groundwater monitoring, access restrictions, deed restrictions;

- Alternative C – Capping: Provide surface cap with different materials at west and central undeveloped areas, and trucking yard. Maintain existing asphalt cap in parking lot and leave soil under the building;

- Alternative C1 - Consolidation and Capping: Consolidate a portion of the soils from the western and west-central undeveloped sections of the property into a new central parking area in the east-central and west side of the existing trucking yard areas. A Geosynthetic Liner (GSL) will be used to cap the entire containment area (i.e. top and side slopes). A suitable subbase will be placed over the GSL. The top will be paved with asphalt, and the side slopes will be covered with topsoil and grass. The existing trucking yard area was paved with asphalt in December 2004. The rail siding, which is still in use, will be covered with a geotextile fabric overlain by crusher run or 2 inch stone. Any excavated soils from the west and west-central area that does not fit into the cap will be treated and disposed of off-site (see Alternative G). Leave soil in place under building and east parking area.

- Alternative D – Excavate and Off-Site Disposal: Excavate fill from west and central undeveloped areas, trucking yard, and rail siding. Dispose soil at RCRA Subtitle C landfill (i.e. hazardous). Backfill excavated areas with clean imported fill. Maintain existing asphalt cap in parking lot and leave soil under building;

- Alternative E – Soil Washing – Excavate fill at west and central undeveloped areas, trucking yard, and rail siding. Wash excavated soil, place clean soil on-site, and dispose hazardous concentrate at RCRA Subtitle C landfill. Maintain existing asphalt cap in parking lot and leave soil under the building;

- Alternative F – In-Situ Chemical Fixation – Mix EnviroBlend® in-situ in west and central undeveloped areas, trucking yard, and rail siding. Cap the stabilized soil with different materials. Maintain existing asphalt cap in parking lot and leave soil under the building;

- Alternative G – Ex-Situ Chemical Fixation and Off-Site Disposal – Excavate soil from west and central undeveloped areas, trucking yard, and rail siding. Mix EnviroBlend® ex-situ, and dispose treated soil at RCRA Subtitle D landfill (i.e. non-hazardous). Backfill excavated areas with clean imported fill. Maintain existing asphalt cap in parking lot and leave soil under the building; and,

- Alternative H – Ex-Situ Chemical Fixation and On-Site Management – Excavate soil from west and central undeveloped areas, trucking yard, and rail siding. Mix EnviroBlend® ex-situ and place treated soil on-site. Cap the stabilized soil with different materials. Maintain existing asphalt cap in parking lot and leave soil under the building.

12. A thorough comparison of these alternatives using different factors was conducted and it was concluded that the preferred remedial alternative is Alternative C1. The preferred alternative will also include the cleaning of accumulated soil particles in the municipal storm sewer pipe between the subject property and the outfall located on Scajaquada Creek, installation of two new monitoring wells, and the implementation of a semi-annual sampling monitoring well sampling program.

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