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REMEDIAL INVESTIGATION WORK PLAN

MALONE (AMSDEN STREET) FORMER MANUFACTURED GAS PLANT SITE MALONE, NEW YORK

Prepared for

Niagara Mohawk – A National Grid Company
Syracuse, New York

Prepared by

TRC Environmental Corporation
Windsor, Connecticut

March 2005

SPS

Niagara Mohawk
A **National Grid** Company

March 7, 2005

Mr. Russell Huyck
New York State Department of Environmental Conservation
P.O. Box 296
Route 86
Raybrook, New York 12977

Re: Malone (Amsden Street) Former MGP Remedial Investigation
Malone, New York

Dear Mr. Huyck:

In response to your 12/20/04 letter and subsequent correspondence, Niagara Mohawk, A National Grid Company (Niagara Mohawk), is submitting the enclosed remedial investigation (RI) work plan. Our 11/15/04 letter to the Department included the proposed RI scope of work. As requested by the Department, Niagara Mohawk has incorporated the RI scope of work in to a formal work plan for NYSDEC review and approval. Please note that we have included the Field Sampling Plan, Quality Assurance Project Plan, Health and Safety Plan, and Site Characterization Data Summary for reference only.

This work plan has been developed under Niagara Mohawk's Voluntary Cleanup Order (VCO) Index Number D0-0001-0011 and references several of Niagara Mohawk's existing NYSDEC-approved generic plans. The scope of work proposed in the work plan is consistent with that previously provided to you and consists of the following investigation activities:

- Pre-investigation bedrock literature review;
- Drilling and soil sampling of supplemental soil borings;
- Drilling and installation of bedrock monitoring wells;
- Performance of down-hole geophysical survey of completed bedrock coreholes;
- Packer testing;
- Collection of additional surface soil samples along the Site embankment;

- Reconnaissance of the Site riverbank with sediment sampling;
- Collection of surface water sample at the storm sewer outfall;
- Collection of ground water samples from the expanded well network; and
- Preparation of an RI Data Summary.

This scope of work, in combination with the previously completed Site Characterization Data Summary (see Appendix D of RI Work Plan), was developed to address data gaps identified from the Initial Site Characterization.

Niagara Mohawk intends to initiate the RI field program in 2005 following approval of the RI Work Plan by the NYSDEC, and completion of the Power House Foundation Abandonment and Miscellaneous Site Improvements.

Please contact me at (315) 428-5652 if you have any questions or require further information.

Sincerely,

Steven P. Stucker, C.P.G.
Senior Analyst

Cc w/o att:
William Holzhauer-National Grid Service Company, Inc
Terry Young-Niagara Mohawk, a National Grid Company
Pat Collette-National Grid Service Company
Doug Martin-TRC

Cc w/att.
Deanna Ripstein-NYSDOH
File

Stucker, Steven P.

[illegible]m: Stucker, Steven P.
Sent: Monday, June 06, 2005 8:51 AM
To: Young, Terry W.
Subject: Malone

As we discussed, I reviewed the cc: list for the Malone RI work plan and we copied the NYSDOH PM but we did not copy Schick or Deb Christian.

Please let me know if you would like me to send them a copy. The work plan went to Russ Huyck in March.

TRC
Customer-Focused Solutions

LETTER OF TRANSMITTAL

DATE 3/4/05 JOB NO. 46478-1000

ATTENTION

RE: MALONE RI WORK PLAN

TO Steve Stucker
NIAGARA MOHAWK

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via ______ the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ ______

COPIES	DATE	NO.	DESCRIPTION
3	2/05		RI WORK PLAN, MALONE FORMER MGP Site

THESE ARE TRANSMITTED as checked below:

☐ For approval
☒ For your use
☐ As requested
☐ For review and comment
☐ FOR BIDS DUE ______ 19 ______

☐ Approved as submitted
☐ Approved as noted
☐ Returned for corrections
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☐ Resubmit ______ copies for approval
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☐ Return ______ corrected prints
☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS
Steve -
three more copies of the RI Work Plan for your use.

Doug

COPY TO ______

SIGNED: ______

If enclosures are not as noted, kindly notify us at once.

REMEDIAL INVESTIGATION WORK PLAN

MALONE (AMSDEN STREET) FORMER MANUFACTURED GAS PLANT SITE MALONE, NEW YORK

Prepared for
Niagara Mohawk – A National Grid Company
Syracuse, New York

Prepared by
TRC Environmental Corporation
Windsor, Connecticut

TRC Project No. 40478-100000013
March 2005

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APPENDICES

1.0 INTRODUCTION

This work plan has been developed for Niagara Mohawk – A National Grid Company (Niagara Mohawk) for a remedial investigation (RI) at the Malone (Amsden Street) former manufactured gas plant (MGP) Site, located in Malone, Fulton County, New York. This work plan has been developed in response to a request by New York State Department of Environmental Conservation (NYSDEC) following completion of a Site Characterization/Interim Remedial Measure (SC/IRM) Study at the Site in 2004.

This work plan has been developed under Niagara Mohawk's Voluntary Cleanup Order (VCO) Index Number D0-0001-0011 and the NYSDEC-approved Niagara Mohawk generic plans. Where applicable, the following NYSDEC-approved plans are referenced in this work plan:

- Generic Field Sampling Plan For Site Investigations At Non-Owned Former MGP Sites, dated November 2002;
- Generic Quality Assurance Project Plan For Site Investigations At non-owned Former MGP Sites, dated November 2002; and
- Health and Safety Plan for Malone (Amsden Street) Former Manufactured Gas Plant Site, amended July 13, 2003.

Copies of the Generic Field Sampling Plan and Generic Quality Assurance Project Plan (QAPP) are attached as Appendix A and Appendix B, respectively. The Site-specific HASP, consisting of the NYSDEC-approved generic HASP, amended with Site-specific emergency contact information, site information, and emergency procedures, is provided as Appendix C.

The remainder of this plan is organized as follows: Section 2.0 presents information regarding Site background, including a summary of previous investigations and description of physical Site conditions. Section 3.0 presents the proposed RI technical scope of work, by task. Project Quality Assurance/Quality Control (QA/QC) is discussed in Section 4.0. Project schedule is presented in Section 5.0.

2.0 SITE BACKGROUND

The Site is located in a mixed commercial and residential portion of the Village of Malone, New York. The Site is located near the Village center, and is bounded by Amsden Street to the west and the Salmon River to the east. Site location is depicted on a USGS 7.5 minute quadrangle map, provided as Figure 2-1. A Site plan is provided as Figure 2-2. Currently, several unused structures remain on-site, consisting of a single story cut stone and cinder block building in the southwest corner of the parcel and a two-story stone building immediately to the north, on Amsden Street. Remains of a former gas holder foundation slab and a former coal-fueled power house are evident to the northeast of the primary MGP facility. The entire primary MGP facility and portions of the remaining parcel are secured with chainlink fencing. Relief of the Site is significant, with a sharp drop of approximately of 50 feet from the Amsden Street to the Salmon River. The river flows to the north in the vicinity of the Site. Much of the site to the east and north is heavily forested, with frequent signs of fill debris noted along the embankment.

Several subsurface utilities have been identified on-site during previous investigations. In addition to the exposed sanitary line that runs approximately north-south along the riverbank, two other sewer lines are evident. An apparent inactive ten-inch diameter clay sanitary sewer line extends from the primary MGP facility down the embankment to the northeast, with a manhole located immediately west of the former Power House foundation. Visual inspection via the manhole indicated the potential presence of weathered MGP residuals within the manhole. In addition, according to Village of Malone Department of Public Works personnel, a 42-inch diameter concrete storm sewer extends from Amsden Street, beneath the northern part of the adjacent property to the north, to a discharge outfall along the river embankment. Extensive, visible rust-colored staining has been noted within the outfall and associated drainage swale of this sewer.

Development of the former MGP occurred over time. At its peak of operation, the plant consisted of a retort house, purifier house, coal storage facilities, coke storage building, two gas holders, the power house, and a substation building. Immediately north of the primary facility, a small parcel currently owned by Ralph Kriff is occupied by an unused, two-story warehouse building. Most recently, the building was used as a warehouse for furniture. Previous uses appear to have included garment manufacturing and production of rubber goods. The nearest

residences are located approximately 160 feet north of the former MGP site. A paved parking lot is located immediately south of the Site, with several commercial stores located further to the south.

According to historical information presented in the Site-specific work plan dated November 2002, the site was used for manufacture of coal gas from the 1880s to the 1940s. The Power House was constructed in the mid- to late-1890s and operated for approximately 10 years before being converted to a transformer house for an undetermined period of time. Following cessation of gas production in the 1940s, the property was used for storage and distribution of propane gas until it was sold to an adjacent property owner. The property was subsequently repurchased by Niagara Mohawk in 2001. More recent Site use was for warehousing of carpeting and other home furnishings, however the Site has not been used or occupied since its repurchase in 2001.

2.1 Previous Investigations

Under the VCO for Non-owned former MGP sites, Niagara Mohawk conducted the initial SC/IRM investigation of the Site in 2004. The work was conducted under an amended, NYSDEC-approved site-specific work plan. The original approved work plan scope was amended by Niagara Mohawk to accommodate physical Site access limitations. The investigation consisted of exploratory test pit excavation, advancement of soil borings, installation of two overburden monitoring wells, collection and analysis of surface soil samples on-site and off-site, collection and analysis of subsurface soils, and collection and analysis of one round of ground water samples. In addition, per request by NYSDEC, a ground water seep sample was collected for analysis adjacent to the river to supplement ground water sampling. Results of that investigation were presented in the Site Characterization Data Summary submitted to NYSDEC on February 23, 2005.

Results of the investigation indicated that MGP-related impacts are present on-site, including coal tar residuals within one of the former holders and a former tar well, and presence of weathered tar with associated polycyclic aromatic hydrocarbon (PAH) concentrations above *Technical and Administrative Guidance Memorandum (TAGM) 4046* criteria in surface and subsurface soils. MGP-related impacts were also detected in shallow Site ground water. A copy of the SC data summary package that was submitted to NYSDEC is provided as Appendix D.

2.1.1 Soil Sampling

A total of eight soil borings were completed to determine the presence or absence of MGP-related impacts on-site. All borings were completed using standard hollow-stem auger (HSA) methods, in accordance with the NYSDEC-specified guidance for continuous split-spoon sampling. All borings were characterized with respect to encountered soils and physical evidence of MGP impacts; in addition, analytical samples were collected from selected intervals for chemical analysis. Detailed physical findings for each boring are summarized in the boring logs provided in Appendix D.

Analytical samples were collected from each soil boring, at approximate five-foot intervals. Samples were submitted for laboratory analysis of a combination of BTEX, PAHs, total cyanide and Total Organic Carbon (TOC). Selected samples were submitted for full Target Compound List (TCL) VOCs and SVOCs, and Target Analyte List (TAL) metals analysis. A summary of the analytical results for the samples collected throughout the completed soil borings is provided in Tables 1 through 8 of Appendix D. In general, these laboratory results are consistent with the observed extent of physical impacts noted during the boring program. For screening purposes, all analytical data was compared to the current NYSDEC TAGM 4046 Cleanup Criteria, where applicable. Exceedances of at least one TAGM criterion were detected in one or more soil samples collected from seven of the eight borings. Except for the southern sub-grade holder foundation, identified impacts appear to be limited primarily to shallow soils.

2.1.2 Surface Soils

Eight surface soil samples (0 to 2 inches bgs) were collected on-site, and five surface soil samples were collected off-site as representative background samples. All samples were submitted for VOC, SVOC, TAL metal, and TOC analysis. Of note during on-site sample collection was the visible widespread surficial evidence of weathered tar across much of the embankment between the primary former MGP and the river. Surface soil samples in this area were collected from the miscellaneous fill/soil material.

In all surface soil samples (on-and off-site), at least two or more individual PAH TAGM criteria were exceeded. All off-site sample total carcinogenic PAH (cPAH) concentrations were below the TAGM criterion of 10 mg/Kg. On-site, all but one of the samples collected on the

primary MGP parcel yielded total cPAHs under the criterion of 10 mg/Kg, however concentrations were greater (e.g., maximum Total cPAHs of 643 mg/Kg) in the three samples collected from the embankment immediately to the east (samples SS-6, SS-7 and SS-8).

2.1.3 Ground Water

One round of ground water sampling was completed, in accordance with the approved SC Work Plan, on August 29, 2003. The second planned sampling event was attempted on October 3, 2003, however there was insufficient recharge to enable sample collection. Samples were analyzed for VOCs, SVOCs, and TAL metals. In summary, *Technical and Operational Guidance Series (TOGS)* exceedances were detected in both well samples. The sample from MW-3 yielded TOGS exceedances for o-Cresol, Naphthalene, and Dibenzofuran. The sample from MW-4 yielded TOGS exceedances for Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene, and Indeno(1,2,3-cd)pyrene. Based on these results, ground water quality downgradient of the former MGP appears somewhat degraded. Potential for off-site impacts is not known, although the sample collected at the seep location directly downgradient of the former MGP yielded no detectable concentrations of MGP constituents of concern

2.1.4 Potential Areas/Media of Concern

Results of the SC indicate several areas of concern that appear to require additional evaluation:

- *Site Ground Water:* Due to the presence of shallow bedrock, only two shallow overburden monitoring wells were installed on-site during the SC; MGP constituents were detected above TOGS criteria in both wells. As a result, Site ground water has not been adequately characterized.
- *Site Bedrock:* Due to the shallow nature of bedrock and the detection of DNAPL on-site in several locations, including the observance of weathered tar-like material within an historic seep along the river bank, investigation of site bedrock is necessary to determine if mobile NAPL and/or dissolved-phase contaminants may be migrating within Site bedrock and may be providing a preferential migration pathway for Site contamination.
- *Surface Soils:* Elevated concentrations of PAHs were detected in the surface soils collected along the embankment. Visual evidence of highly weathered tar-type

residual was observed across much of the embankment, however areal extent of these residuals has not been delineated.

- *River Sediments:* Due to the observation of an historic seep of tar-like material beneath the former Power House foundation adjacent to the riverbank, and the detection of mobile NAPL further to the west (up-slope), the potential exists for MGP residual impacts to the adjacent river.
- *Site Infrastructure*: Two existing sewer lines, the inactive sanitary line extending from the primary MGP and the storm sewer that discharges along the embankment, have been identified on-site which may have the potential to act as conduits for Site MGP constituents.

2.2 Site Geology

Based upon the physical conditions encountered during the SC investigation, Site geology appears to consist of a thin veneer of overburden, overlying shallow bedrock. Overburden on-site consists of fill, fine-grained sand/silt/clay, and a thin layer of till. Fill was encountered on-site, extending to a depth of approximately six feet bgs across the Site; the fill consisted of native sand, silt and/or gravel mixed with a wide assortment of demolition debris, cinders and ash. The silt/sand unit ranges from 15 feet in thickness, near Amsden Street (SB-01) to approximately ten feet closer to the river. Beneath this unit, a thin till layer (consisting of sand, some gravel and/or cobbles and occasional boulders) was encountered immediately above bedrock. Depth to bedrock ranged on-site from approximately 22 feet below ground surface (bgs) adjacent to Amsden Street, to 10 feet bgs close to the river (boring SB-4), although exposed bedrock is visible along the river bank. A geologic cross-section for the Site, based on subsurface information developed during the SC investigation, is presented in Appendix D, Figure 2.

3.0 RI SCOPE OF WORK

3.1 Investigation Objectives

Based upon the results of the SC investigation, review of other available Site information, and subsequent discussions with NYSDEC, the following objectives of the RI will be addressed by the planned scope of work:

- Evaluation of shallow bedrock to determine the presence/absence of MGP residuals, and the potential for contaminant migration associated with Site bedrock;
- Further evaluation of overburden soils along the downgradient slope and within the historic fill area located north of the former MGP facilities;
- Further characterization of surface soil quality along the site embankment, where extensive surface MGP impacts were noted, to support human health assessment;
- Additional characterization of Site ground water behavior and quality;
- Qualitative evaluation of shallow sediments along the eastern Site boundary to determine presence/absence of MGP impacts; and
- Evaluation of the surface water quality at the outfall of the storm sewer that discharges from the embankment in the northern portion of the Site, for the potential presence of MGP constituents.

To address the objectives listed in Subsection 1.4, the following scope of work is planned to be completed under the RI for the Site:

- Pre-investigation bedrock literature review;
- Drilling and soil sampling of supplemental soil borings;
- Drilling and installation of bedrock monitoring wells;
- Performance of down-hole geophysical survey of completed bedrock coreholes;
- Collection of additional surface soil samples along the Site embankment;
- Reconnaissance of the Site riverbank with sediment sampling;
- Collection of surface water sample at the storm sewer outfall;
- Collection of ground water samples from the expanded well network; and
- Preparation of an RI Data Summary.

Summary of the proposed program is provided in Table 3-1; Figure 3-1 (Plate) depicts the proposed locations for these investigations. A brief description of each of the proposed investigation tasks is provided below.

3.2 Literature Review

Prior to initiation of field investigation activities, a thorough review of available scientific literature regarding local/bedrock geomorphology will be conducted to develop a clearer understanding of potential Site bedrock conditions. A search of the available literature will be performed, including contact with several upstate New York colleges/universities. Inquiries will be made to compile available information regarding regional and local bedrock, including type/composition of the bedrock, extent/nature of fracturing, local/regional bedrock aquifer behavior, ground water quality, local ground water use, etc. Available information will be reviewed to develop an understanding of expected site bedrock conditions and to direct the planned subsurface RI investigation activities described below. A receptor survey will be completed to determine the presence of any sensitive receptors downgradient of the Site.

3.3 Drilling Program

This Subsection summarizes the overburden soil sampling, bedrock coring, well installation, and down-hole geophysical survey investigations that are proposed under the RI.

3.3.1 Overburden Soil Sampling

Supplemental drilling activities will include completion of two additional soil borings to characterize overburden soils along the fill area north of the above-grade holder foundation, and one additional boring south of the former Power House foundation. Boring location rationale is provided in Table 3-1. Sampling will be performed using standard HSA methods, with continuous split-spoon soil sampling, in accordance with guidance provided in the NYSDEC-approved generic plans (Appendices A and B). The borings will be advanced to auger refusal. Representative soil samples will be collected every five feet, for analysis of BTEX, PAHs, TAL metals, total cyanide and TOC. Summary of the soil sampling and analysis program is presented in Table 3-2.

3.3.2 Bedrock Drilling

As a supplement to the preliminary bedrock literature review and to provide larger scale, site-specific bedrock information prior to the initiation of the bedrock drilling program, a bedrock outcrop evaluation will be conducted at the Site. The bedrock outcrop located along the

east side of the Site along the Salmon River will be inspected and evaluated for bedrock type, fracture sets, bedding planes, and any other physical features (e.g., water or NAPL seeps, etc) associated with the outcrop. The attitude (strike and dip) of the fractures and/or bedding planes will be measured with a Brunton compass.

For physical characterization of shallow bedrock, and to enable installation of additional ground water monitoring wells, three additional borings will be advanced into bedrock. Drilling will be performed in accordance with the Generic Field Sampling Plan (Appendix A), and will consist of overburden HSA sampling with collection of soil samples (as described above), installation/grouting of permanent steel overburden casing a minimum of three feet into competent bedrock, and bedrock coring to those pre-determined depths noted in Table 3-1. The approximate elevation of the adjacent Salmon River bottom has been selected as an appropriate target depth for all three bedrock borings, to provide sufficient vertical characterization of Site bedrock as a potential migration pathway for non-aqueous phase liquid (NAPL). Bedrock sampling will be conducted using oriented HQ (four-inch diameter) coring; recovered cores will be evaluated with respect to rock quality designation (RQD), presence/nature of bedding planes, fractures or other physical attributes, presence of MGP residuals, etc. Recovered core samples will be placed in marked core boxes, and archived in a secure location.

Following completion of the deep bedrock corehole (BMW-1), packer testing will be conducted in the corehole to determine the hydraulic conductivity of selected bedrock zones. Testing will involve evaluation of two intervals of the completed boring, to be selected based upon field findings and inspection of the recovered rock core samples. Packer testing will follow the procedures presented in Appendix B of the Generic Field Sampling Plan (Appendix A).

3.3.3 Bedrock Geophysical Survey

Following completion of the soil and bedrock sampling at each bedrock location, down-hole geophysical methods will be instituted to better evaluate the physical nature of the bedrock, bedding planes and fractures to determine the potential for contaminant migration and to guide subsequent monitoring well installation. A geophysical firm will be contracted to perform a series of down-hole tests on each of the three borings including the following: caliper, natural gamma, acoustic televiewer, fluid temperature, fluid resistivity, and single-point resistivity. In addition, in the one deepest corehole (i.e., BMW-1), heat pulse flowmeter testing will be

performed to help detect the presence of possible vertical fracturing. Results will be used to characterize the physical nature of Site bedrock and to assist in final design of bedrock wells.

3.4 Monitoring Well Installation

Following completion of all down-hole geophysical testing, each of the bedrock coreholes will be completed with installation of a monitoring well. The two downgradient wells (refer to Figure 3-1), which are co-located with existing overburden wells, will be completed as two-inch PVC wells, comprised of ten-foot 20-slot screens and equipped with two-foot sumps. A well cluster will be installed in the single upgradient bedrock core-hole, consisting of two smaller diameter (i.e., less than two-inch diameter) PVC wells. Screened intervals will be determined based upon results of the rock coring and geophysical tests. All of the new wells will subsequently be developed using approved methods specified in the Generic Field Sampling Plan (Appendix A).

3.5 Surface Soil Sampling

Results of previous SC surface soil sampling indicated the presence of concentrations of PAHs above TAGM 4046 criteria, within the surficial fill material along the Site embankment. In addition, extensive visible evidence of weathered tar-like material has been observed across the embankment, indicating potential widespread presence of MGP residuals in this area of the Site. Niagara Mohawk plans to further define the nature and extent of these impacts to potentially support site human health exposure assessment. Specifically, grid-based sampling is planned (using 50-foot spacing), which will provide adequate coverage of the entire central portion of the Site (refer to Table 3-1). Samples will be collected in accordance with the Generic Work Plan, and analyzed for Target Compound List (TCL) semi-volatile organic compounds (SVOCs), TAL metals, total cyanide and TOC (refer to Table 3-2).

3.6 Surface Water/Sediment Evaluation

Surface water and sediment evaluation will be performed to assess the potential for Site-derived impacts to the adjacent Salmon River (Table 3-1). Thus far, although visible evidence of non-mobile, weathered tar-like material has been observed near the river, no other indications of potential Site discharges have been noted. Initially, a thorough qualitative reconnaissance of the

river bank abutting the Site will be conducted for presence/absence of MGP-related impacts (e.g, sheens, seeps, residuals). Reconnaissance will include use of a metal probe to evaluate shallow sediments.

Three representative sediment samples will be collected from the bank of the river, one upstream of the site, one along the site, and one downstream of the site. In addition, one sample of sediment material will be collected from the manhole associated with an inactive sanitary sewer line, where visual indications of staining/tar-like material were previously observed. In addition to the samples that are collected for standard laboratory analysis, split samples of each of the river sediment samples will be collected for potential fingerprint (GC/FID and GC/MS) analysis in the event elevated concentrations of PAHs are detected in the samples. Samples will be collected in accordance with the Generic Work Plan, and analyzed for TCL VOCs, TCL SVOCs, TAL metals, total cyanide, and TOC (Table 3-2). Up to two of the archived sediment samples may be submitted for fingerprint analysis.

One surface water sample will be collected from the drainage swale that extends from the outfall of the large storm sewer, located along the northern embankment of the Site (refer to Figure 3-1), to evaluate the visible staining within the swale. The sample will be analyzed for TCL VOCs, TCL SVOCs, TAL metals, and total cyanide. One river gauge will be installed along the site to provide river level information. Construction and installation of the gauge will be determined prior to initiation of field activities, but will be installed in order to adequately monitor full seasonal fluctuations and to withstand expected high flow conditions.

3.7 Survey

Following completion of the drilling program, and collection of all soil, sediment and surface water samples, complete survey of all completed sample locations will be conducted. Location and elevation of each sample location will be obtained in accordance with the generic work plan. Elevation of the top of casing as well as the river gauge will be surveyed to the nearest 0.01 foot. Survey information will be integrated into the existing CADD-compatible Site survey plan.

3.8 Ground Water Sampling

Following installation and development of the new monitoring wells, a round of water level measurements and evaluation of potential NAPL will be conducted for the entire well network, including the new river gauge, using an electronic interface probe. These evaluations will be performed in accordance with the generic Field Sampling Plan.

A minimum of one week following well development, ground water sampling will be performed in the six Site monitoring wells to better characterize Site ground water quality. Prior to sampling, each well will first be evaluated with respect to water level and potential presence of NAPL. Purging of the wells and collection of ground water samples will then be performed in accordance with the generic Field Sampling Plan. Ground water samples will be analyzed for TCL VOCs and SVOCs, TAL metals, and total cyanide (Table 3-2).

Approximately one month following ground water sampling, another round of water level measurements and NAPL evaluation will be conducted within the well network to further document Site ground water behavior and the potential presence of NAPL on-site.

3.9 RI Data Summary

Upon completion of planned field activities and receipt of all analytical data, an RI data summary will be prepared. All analytical data (except TOC) will be subjected to full data validation to ensure usability; a data usability summary report (DUSR) will be developed. The RI data summary will include the following site information: data summary tables, figures depicting sample locations, geologic cross-sections, summary chemical data presentation, and geologic boring logs. A brief summary of field activities performed, and results of those activities, will be prepared to accompany the summarized information. The data summary package will be submitted to NYSDEC for review and discussion with Niagara Mohawk in order to mutually agree that the Site conceptual model has been completed.

4.0 QA/QC PROGRAM

Appropriate field and laboratory quality assurance/quality control procedures will be implemented as part of the RI program. Investigation QA/QC field procedures will be implemented in accordance with the Generic QAPP (Appendix B) and will include proper decontamination protocols, documentation, and collection of QA/QC samples including field duplicates, field blanks, trip blanks, etc. Summary of QA/QC samples and analyses, based on the planned RI scope of work, is provided in Table 3-2.

5.0 PROJECT SCHEDULE

Total estimated duration of the planned RI scope of work is approximately six months from the date of NYSDEC approval of the RI Work Plan. Figure 5-1 presents a detailed project schedule. Summary of the primary schedule elements is provided below:

▪ Commencement of Field Work	Within approximately 30 days of NYSDEC Plan approval
▪ Field Program Duration	Six to eight weeks
▪ RI Data Summary	Within 120 days of field work completion

TABLES

TABLE 3-1: Sample Location Rationale

Sample ID	Location	Planned Depth (feet bgs)	Location Rationale
Bedrock Borings/Monitoring Wells			
BMW-1	Adjacent to former southern holder and tar well, in the south-western portion of the Site	60 feet (well depth TBD)	Located north of the southern holder foundation, and east of the former tar well, where tar impacts were detected during the SC. Provide additional characterization of overburden soils. Perform down-hole geophysical survey to characterize bedrock structure/characteristics. Evaluate potential for bedrock impacts on primary MGP and near two confirmed impacted areas, which are potential sources of observed seeps along the riverbank. Evaluate the overburden/bedrock contact as a potential migration pathway for DNAPL. Perform packer testing in corehole to determine hydraulic conductivity of the bedrock. Install nested bedrock well pair to characterize ground water quality on the primary MGP site, near confirmed impacted structures.
BMW-2	Located adjacent to existing MW-4, immediately east of the above-grade (northern) holder foundation	30 feet (well depth TBD)	Located downgradient of the former MGP, where substantial surficial tar impacts were noted during the SC. Provide additional characterization of overburden soils. Better characterize tar-related impacts detected in boring SB-4. Evaluate the overburden/bedrock contact and deeper bedrock as a potential migration pathway for DNAPL. Perform down-hole geophysical survey to characterize bedrock structure/characteristics. Install a bedrock well adjacent to the existing overburden well (MW-4) to evaluate ground water quality downgradient of the northern holder.
BMW-3	Located adjacent to existing well MW-3, downgradient of the southern sub-grade holder and former tar well.	20 feet (well depth TBD)	Located downgradient of the former MGP and adjacent to the former Power House, where substantial surface and subsurface indications of tar were detected during the SC. Further characterize tar-related impacts detected in exploratory test pits and existing MW-3. Evaluate the overburden/bedrock contact and shallow bedrock as potential pathways for DNAPL migration. Perform down-hole geophysical survey to characterize bedrock structure/characteristics. Install a bedrock well adjacent to the existing overburden well (MW-3) to evaluate ground water quality downgradient of several source areas.

TABLE 3-1: Sample Location Rationale

Sample ID	Location	Planned Depth (feet bgs)	Location Rationale
Overburden Soil Borings			
SB-13	Located south of the former Power House foundation	10 feet	Located downgradient of the former MGP and adjacent to the former Power House, where substantial surface and subsurface indications of tar were detected during the SC. Determine the potential presence of DNAPL downgradient from the primary MGP facilities. Evaluate the overburden/bedrock contact and shallow bedrock as potential pathways for DNAPL migration. Collect soil samples to characterize overburden soils
SB-14 and SB-15	Located in the fill area north of the primary MGP Site	20 feet	Located on the Niagara Mohawk-owned fill area north of the primary MGP facilities, where extensive evidence of municipal debris and industrial type materials was noted during the SC. Evaluate overburden soils for potential presence of MGP residuals (e.g., purifier waste). Determine the nature of fill material, presence of MGP versus other industrial residuals. Determine soil quality through analysis of selected soil samples.
Surface Soils			
SS-12 through SS-26	Located on a grid, along the site embankment between the primary MGP and the former Power House	0.2 feet	Samples will be located on a 50-foot grid to delineate surface soil quality in an area demonstrated during the SC to be impacted.
Sediment			
SED-1	Located along the riverbank, upstream location from Site (100 feet)	Surface	Sediment sample to be collected south of the Site within the Salmon River to determine upstream sediment quality. Collect and archive split-sample for potential fingerprint analysis.
SED-2	Located along the riverbank adjacent to the former Power House	Surface	Located along the Site shoreline to determine the presence/absence of site-related impacts to shallow sediments near the location of visible tar seeps in exposed bedrock. Collect and archive split-sample for potential fingerprint analysis.

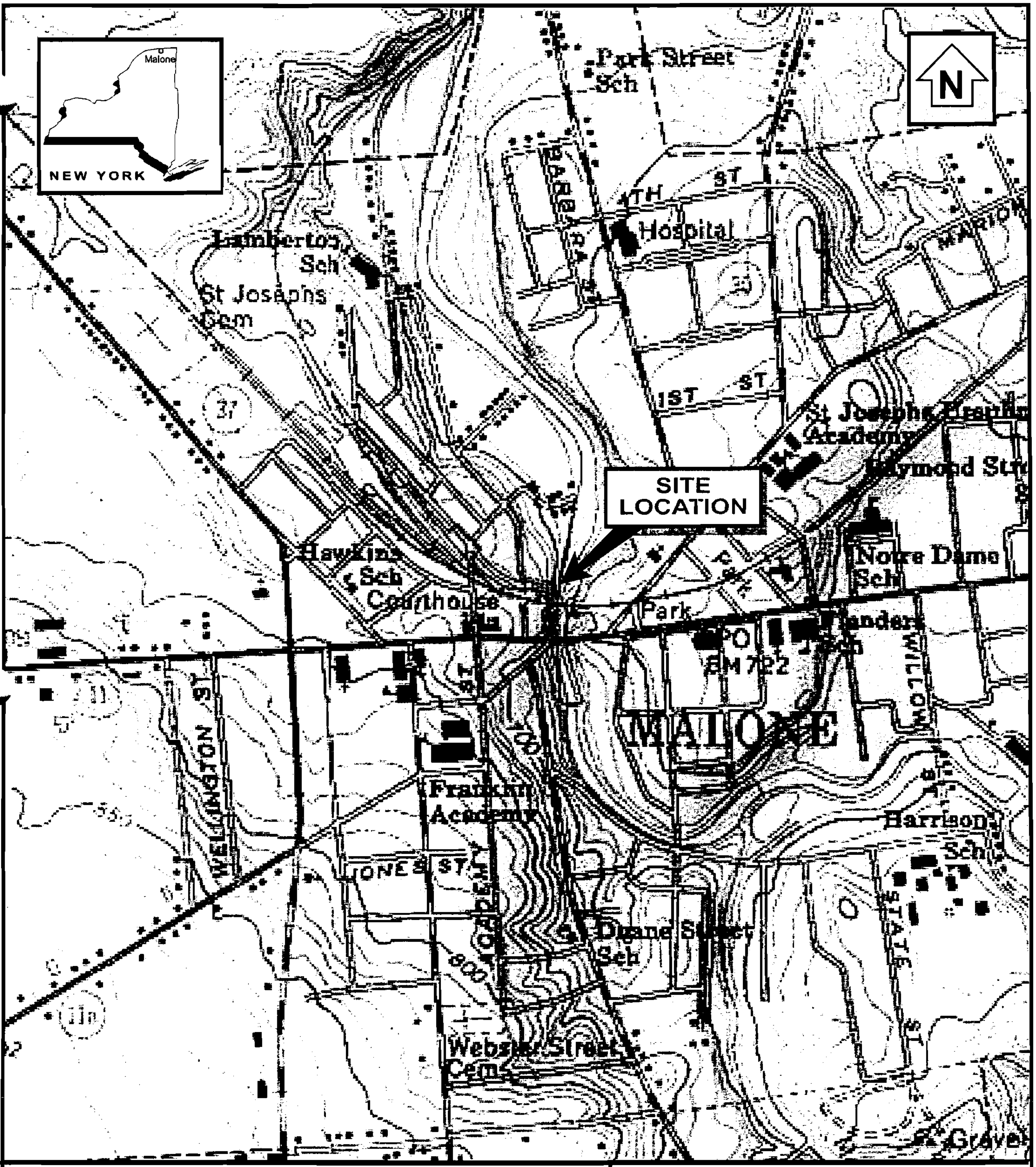
TABLE 3-1: Sample Location Rationale

Sample ID	Location	Planned Depth (feet bgs)	Location Rationale
SED-3	Located along the riverbank, downstream from Site (100 feet)	Surface	Sediment sample to be collected north of Site within the Salmon River to determine downstream sediment quality. Collect and archive split-sample for potential fingerprint analysis.
SED-4	Sewer manhole located west of Power House foundation	Surface	Sediment sample to be collected from dark-stained material within the bottom of the manhole to determine if MGP residuals are present within the on-site, former sewer line.
Surface Water			
SW-1	Adjacent to storm sewer outfall, north of the primary site	Surface	Located within the surface drainage swale extending from the sewer outfall, where distinct discoloration of sediments was noted during the SC. Determine the nature of storm sewer discharge and the potential for impacts from surrounding fill material.

TABLE 3-2: SUMMARY OF RI ANALYTICAL PROGRAM

Field Task	Matrix	Laboratory Analyses	Number of Primary Samples	Trip Blanks	Field Duplicates	Equipment/ Field Blanks	MS/MSD	Total
Surface Soil Sampling	Soil	TCL VOCs, TCL SVOCs, TAL metals, Total CN and TOC	15	0	1	1	1/1	**19**
Soil Boring Sampling	Soil	BTEX, PAHs, TAL metals, Total CN and TOC	16	0	1	1	1/1	**20**
Sediment Sampling	Sediment	TCL VOCs, TCL SVOCs, TAL metals, Total CN and TOC	3	0	1	1	1/1	**7**
		Fingerprint Analysis (Pending preliminary results)	Up to 2	0	0	0	0/0	(2)
Surface Water Sampling	Water	TCL VOCs, TCL SVOCs, TAL metals and Total CN	1	1	0	0	1/1	**4**
Ground water Sampling (2 rounds)	Water	TCL VOCs, TCL SVOCs, Total CN and TAL metals	6	1	1	1	1/1	**11**
	Water		6	1	1	1	1/1	**11**
Total Sample Analyses:			**47**	**3**	**5**	**5**	**6/6**	**72**

FIGURES



0 1000
SCALE FEET

0 1/2
SCALE MILE

1:24000

BASE CREATED WITH TOPO™ © 1996 WILDFLOWERS PRODUCTIONS, www.topo.com
7.5' USGS TOPOGRAPHIC MAP

TRC
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5 Waterside Crossing
Windsor, CT 06095
(860) 298-9692

FORMER MGP SITE
MALONE, NEW YORK

FIGURE 2-1
SITE LOCATION MAP

Date: 02/05 **Project No.** 40478-1000-00013

Legend:

●	Found Iron 5/8" Rebar
— — —	Property Line
	Utility Pole
◌	Historic MGP Structure

General Notes:

1) This survey is referenced horizontally to the North American Datum of 1983 (NAD83) and projected on the New York State Plane Coordinate System (East Zone) and vertically to the North American Vertical Datum of 1988 (NAVD88).

2) North arrow as shown indicates Grid North referenced to NAD83 and projected on the New York State Plane Coordinate System (East Zone).

3) Base information taken from drawing by Thew Associates, PLLC title: " Map Showing Existing Topography Former MGP Facility Niagara Mohawk Power Corporation Malone, New York" project number CK2727A-03-03

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NIAGARA MOHAWK – A NATIONAL GRID COMPANY
FORMER MGP SITE
MALONE, NEW YORK

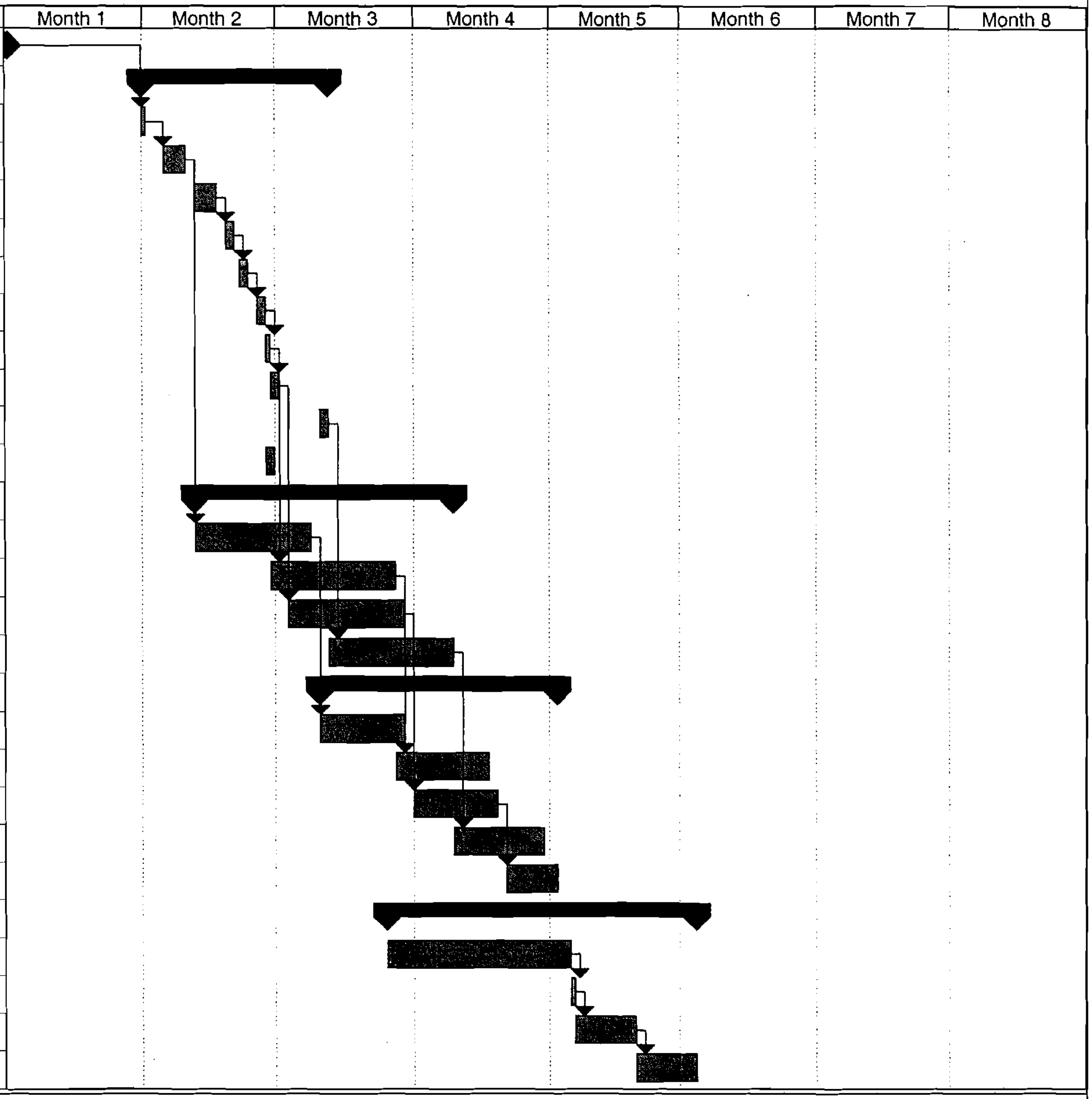
FIGURE 2-2
SITE PLAN

Date: 11/04
Project No. 40478-1000-00013

\40478\00013\Plater-1

FIGURE 5-1: F ect Schedule
Remedial Investigation
Malone (Amsden St.) Former MGP Site

Task Name	Duration
RI Work Plan Approval by NYSDEC	0 days
Field Investigation	**30 days**
Field Mobilization	1 day
Advance Soil Borings	5 days
Bedrock Coring	5 days
Down-hole Geophysical Survey	2 days
Complete Monitoring Well Installation	2 days
Develop Monitoring Wells	2 days
Collect Surface Water and Sediment Samples	1 day
Collect Surface Soil Samples	2 days
Groundwater Sampling	2 days
Survey	2 days
Laboratory Analysis	**42 days**
Subsurface Soil Sample Analysis	20 days
Surface Water/Sediment Sample Analysis	20 days
Surface Soil Sample Analysis	20 days
Groundwater Analysis	20 days
Data Validation/DUSR	**40 days**
Subsurface Soil Data Validation	15 days
Surface Water/Sediment Data Validation	15 days
Surface Soil Data Validation	15 days
Groundwater Data Validation	15 days
Prepare DUSR	10 days
Preliminary Data Package	**51 days**
Prepare Preliminary RI Data Package	30 days
Submit Data Package to NM	1 day
NM submits comments/Package Revisions	10 days
Submit Preliminary RI Data to NYSDEC	10 days



Note: Task durations presented as working days.

Task ▨ Milestone ◆ Summary ▬

APPENDIX A

GENERIC FIELD SAMPLING PLAN FOR SITE INVESTIGATIONS AT NON-OWNED FORMER MGP SITES

GENERIC
FIELD SAMPLING PLAN

FOR

SITE INVESTIGATIONS

AT

NON-OWNED FORMER MGP SITES

Prepared for:

Niagara Mohawk, A National Grid Company
300 Erie Boulevard West
Syracuse, New York

Prepared by:

Foster Wheeler Environmental Corporation
One Park Place
300 South State Street, Suite 620
Syracuse, New York

NOVEMBER 2002

Site Specific
Revisions Attached: Supplement No. ___ Date ___

GENERIC
FIELD SAMPLING PLAN
TABLE OF CONTENTS

SECTION TITLE **PAGE NO.**

GENERIC
FIELD SAMPLING PLAN
TABLE OF CONTENTS (Cont'd)

Section 1 - Tables

Section 2 - Figures

Section 3 - Attachments

1.0 INTRODUCTION

This generic Field Sampling Plan (GFSP) has been prepared for Niagara Mohawk, a National Grid Company (NM) in response to the Voluntary Cleanup Order (VCO) (Index No. DO 0001 0011) between NM and the New York State Department of Environmental Conservation (NYSDEC). This document is intended to provide guidance for implementation of various types of environmental sampling activities that may be utilized during Site Investigation and/or Remedial Investigations, Interim Remedial Measures, Feasibility Studies, Remedial Designs, and/or Remedial Actions at Non-owned Former MGP sites. The numbers and types of environmental samples to be collected are identified in the detailed respective Site-Specific Work Plans, to which this document is appended. If any discrepancy occurs between the Site-Specific Work Plan and the Generic Work Plan/Field Sampling Plan then the Site-Specific Work Plan will govern.

During the performance of any investigation, references in all work products to dense nonaqueous phase liquids (DNAPL) and/or other MGP impacted media (i.e. soil, water, sediments, etc.) will be made using the terminology and descriptions presented in the U.S.EPA documents entitled ***Ground Water Issue - Dense Nonaqueous Phase Liquids*** (Huling and Weaver; March 1991) and included as Attachment B.

2.0 GENERAL FIELD GUIDELINES

2.1 Underground Utilities

All underground utilities, including electric, telephone, cable TV, sewers, water, natural gas, etc., will be identified prior to any drilling and subsurface sampling. Underground Facilities Protective Organization (UFPO) will be contacted by phone at least 72 hours prior to field activities so their underground utilities can be marked at the Site. Other potential on-site hazards such as sharp objects, known subsurface structures, overhead power lines, and building hazards will be identified during the Site reconnaissance visit.

2.2 Sample Identification

Each sample will be given a unique identification as shown in Table 1. With this type of identification, no two samples will have the same label. Labels or tags identified as shown in Table 1 will be attached to each sample container. Labels or tags will be rendered waterproof by either covering the label with clear plastic wrapping tape or utilizing waterproof material for the tag or label.

2.3 Sampling Equipment

The following is a general list of equipment, which may be necessary for sample collection:

- Stainless steel spoons and bowls for mixing soil and sediment samples;
- Appropriate sample containers (and coolers) provided by the laboratory;
- Sample bottles (kept closed and in the laboratory-shipped coolers until the samples are collected);
- Reagent-grade preservatives and pH paper or meter (or pre-preserved sample containers) for aqueous samples;
- Chain-of-Custody labels, tags, seals, and record forms;
- Logbook, field sampling records, and indelible ink markers;
- Laboratory grade decontamination detergents (such as Alconox, Liquinox, etc.), reagent-grade solvents, and deionized, organic-free water to be used for decontaminating equipment between sampling stations;
- Squirt Bottles;
- Ruler and measuring tape;
- Garbage bags;
- Paper towels and/or baby wipes;
- Buckets, wash basins, and scrub brushes to be used for decontaminating equipment;

- Digital camera or camera and film to document sampling procedures and sample locations;
- Stakes and flagging tape and/or spray paint to identify sampling locations;
- Shipping labels and forms;
- Knife;
- Vermiculite or other packing/shipping material for sample bottles;
- Strapping tape;
- Clear plastic tape;
- Duct tape;
- Aluminum Foil;
- Reclosable plastic bags;
- Ice;
- Portable field instruments, which may include but not be limited to a pH meter, conductivity meter, turbidity meter, dissolved oxygen (DO) meter or multi-parameter flow through cell, photoionization detector (PID), and water level indicator;
- Combustible gas indicator (CGI);
- Poly-sheeting;
- Driller's jars (for archiving samples);
- Polypropylene or stainless steel bailers;
- Poly propylene rope and/or Teflon line; and
- Submersible, peristaltic and/or centrifugal pump and associated tubing.

Other sampling materials and equipment may be utilized as warranted by field conditions encountered at time of sampling and media to be sampled. Appropriate health and safety equipment and PPE, as per the Generic Environmental Health and Safety (EHS) Plan (Volume II) will be used.

2.4 Field Records

The Project Manager will control all field logbooks. Each field logbook will receive a serialized number and be issued to the field operations leader (FOL). Field logbooks will be maintained by the FOL and other team members while in the field to provide a daily record of significant events, observations, and measurements during the field investigation. All entries will be signed and dated at the bottom of each page.

Information pertinent to the field investigation and/or sampling activities will be recorded in the logbooks. The logbooks will be bound with consecutively numbered pages. Entries in the logbook will include, at a minimum, the following information:

- Name and title of author, date and time of entry, and physical/environmental/weather conditions during field activity;
- Purpose of sampling activity;
- Location of sampling activity;
- Name and address of field contact;
- Name and title of field crew members;
- Name and title of any Site visitors;
- Sample media (soil, sediment, groundwater, etc.);
- Sample collection method;
- Number and volume of sample(s) collected;
- Description of sampling point(s);
- Volume of groundwater removed before sampling;
- Preservatives used;
- Date and time of collection;
- Sample identification number(s);
- Sample distribution (e.g., laboratory);
- Field observations;
- Any field measurements made, such as pH, temperature, turbidity, conductivity, water level, etc.;
- References for all maps and photographs of the sampling site(s);
- Information pertaining to sample documentation such as:
    - Bottle lot numbers
    - Dates and method of sample shipments
    - Chain-of-Custody Record numbers
    - Overnight Shipping Air Bill Number

All original data recorded in Field Logbooks, Sample Tags, and Chain-of-Custody records will be written with waterproof ink. None of these accountable, serialized documents will be destroyed.

If an error is made on an accountable document assigned to one individual, that individual will make all corrections simply by crossing a single line through the error, placing the initials of the individual making the correction and date next to the crossed out information and entering the correct information. The erroneous information will not be erased. All field personnel will be instructed as to the proper field logging techniques for maintaining the integrity of the documentation.

3.0 EQUIPMENT DECONTAMINATION

3.1 Drill Rig and Backhoe Decontamination

A decontamination pad will be constructed of high-density polyethylene sheeting, no less than 10-millimeters thick, on a prepared surface sloped to a sump. The sump must also be lined and of sufficient volume to contain at least 20 gallons of decontamination water. The size of the pad shall be of sufficient size to contain the fluids generated during the decontamination of on-site equipment. The decontamination pad will be no larger than the back of the drill rig, since the back of the drill rig will be the largest piece of equipment anticipated on-site. Sides of the pad will be bermed so that all decontamination water is contained. Upon completion of all field activities, the decontamination pad will be properly decommissioned. To accomplish decommissioning, all free liquids will be removed from the surface of the High Density Polyethylene (HDPE) sheeting, including the sump area, and allowed to air dry. The HDPE sheeting will then be cut to manageable size, folded or rolled, and placed in the waste container (usually a roll-off container or 55-gallon drum). The earthen material or wood timbers used to construct the containment berm will be inspected to ascertain if the material has come in contact with decontamination liquids during use. If they have, the materials will be disposed in the waste container for subsequent disposal at an appropriate facility. If the materials have not been in contact with decontamination liquids, they may be reused.

All equipment used in intrusive work including backhoe, drilling rig, augers, bits, tools, split-spoon samplers and tremie pipe will be cleaned with a high-pressure hot water or steam cleaning unit and scrubbed with a wire brush to remove dirt, grease, and oil before beginning field work and before leaving the project Site upon completion of the last sampling activity. All tools, drill rods, and augers will be placed on sawhorses or polyethylene plastic sheets following steam cleaning. Direct contact with the ground will be avoided. The back of the drill rig and all augers, rods, and tools will be decontaminated between each drilling location according to the above procedures. The backhoe bucket, arm, and any other part of the equipment, which may have contacted excavated soil, will be decontaminated between each test pit location. Tools, augers, and rods will be decontaminated between drilling monitoring wells.

Decontamination water collected in the sump of the decontamination pad will be at a minimum removed from the sump at intervals less than 90% of its capacity and prior to rain events. The liquids will be pumped to a 55-gallon drum and stored in an appropriate satellite storage area. All waste handling will be performed in accordance with waste handling regulations.

Unless sealed in manufacturers packaging, monitoring well casing and screens will be steam cleaned immediately before installation. The screen and casing shall then be wrapped in polyethylene plastic and transported from the designated decontamination area to the well location.

3.2 Sampling Equipment Decontamination

Prior to sampling, all non-dedicated/non-disposable equipment (i.e., bowls, spoons, and bailers) will be washed with potable water and a laboratory grade detergent (such as Alconox). Decontamination may take place at the sampling location as long as all liquids are contained in pails, buckets, 55-gallon drums, etc. The sampling equipment will then be rinsed with potable water followed by a reagent-grade isopropanol rinse and finally a deionized water rinse. Additionally, all equipment used to collect samples for metals analysis will receive a nitric acid rinse followed by a deionized water rinse. Between rinses, equipment will be placed on polyethylene sheeting. At no time will decontaminated equipment be placed directly on the ground. Equipment will be wrapped in polyethylene plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location, where appropriate.

4.0 SITE RECONNAISSANCE AND SCREENING

The following practices, procedures and methods will be utilized in carrying out all field activities if specified in the Site-Specific Work Plan.

4.1 Site Reconnaissance

Following the contact with UFPO and markout of subsurface utilities at the Site, Site reconnaissance will be performed. The Site reconnaissance will be attended by the NM Project Manager, the Consultant Project Manager and/or the FOL, and representatives of the NYSDEC and/or the NYSDOH. During this task, the NYSDEC-approved sampling locations, as outlined in the Site-Specific Work Plan, will be marked in the field with a wooden stake and/or spray paint. Conflicts with the NYSDEC-approved sampling locations, based on the utility markout, will be modified during this visit.

Prior to this Site visit, the property owner and/or company representative will be contacted by the NM Project Manager to meet at the Site. The property owner and/or company representative will be asked if subsurface structures exist on the property and will be asked to identify their locations. Subsurface structures will consist, but are not limited to the following: septic tanks, cesspools, underground irrigation lines, water supply wells, vaults, leaching fields, propane, oil, and/or fuel tanks, underground utilities installed by the owner, drainage lines, etc.

4.2 Metal Detector Survey

A metal detector survey may be conducted using the magnetic cable locator model MAC-51B (or equivalent); to locate unidentified underground utilities and possible buried drums or tanks. The area around each proposed subsurface investigation point may be checked with the MAC-51B (or equivalent) prior to any subsurface investigation. Initially, the locator will be tested on known locations of underground utilities to verify that it is functioning properly.

If there is no indication of buried utilities, drums, or tanks, then subsurface sampling will proceed. However, if the locator indicates the presence of a buried object, activities will not proceed in that location until the type of buried object is determined. If the object cannot be identified from surface or shallow digging, a test pit may be required to determine the identity of the buried object. If a test pit is required, the procedure and scope will be reviewed with the NM Project Manager prior to conducting the work.

The NM Project Manager will keep the property owner or company representative informed of planned Site activities.

4.3 PAH Field Screening

PAH screening of soil samples may be used to determine the extent of PAHs in soil and to optimize the location of samples for confirmatory laboratory analysis.

If PAH field screening is conducted at any Site, then adequate facilities will be provided for proper use of the PAH-specific immunoassay test. The individual responsible for conducting the immunoassay test in the field shall receive instruction in the proper use and storage of the test kit. The instructions for the PAH Field Screening Kit are provided as Attachment A of the Generic Quality Assurance Project Plan (QAPP) (Volume II). The test is a simple procedure designed to test any type of soil sample for PAHs. The test uses a semi-quantitative, colorimetric method that incorporates immunoassay technology. The test is performed using tubes, which are coated with a chemical that specifically reacts with PAHs. To perform the test, the standards, samples and reagents are added in a step-wise manner to the coated tubes. The procedure results in a color change within each tube inversely proportional to the concentration of PAHs. The color in the tubes is read by inserting the tubes in a standardized color photometer. The test consists of the following three steps:

1. Sample Preparation: First, PAHs are extracted from the soil using a solvent. The extract is clarified using a disposable 0.45-micron filter tip.
2. Testing: After sample preparation, the PAH standards and the sample and the enzyme are added to the coated tubes. After 10 minutes incubation, the tubes are rinsed and color-developing reagents are added. Within a few minutes, color development occurs in the tubes.
3. Results Interpretation: The color of the sample tube is compared against the color of the standard tube using a photometer to determine if PAHs are present in the sample. The result will indicate concentrations in three ranges; less than 1 ppm, between 1 and 100 ppm, and over 100 ppm.

4.4 PCB Field Screening

Polychlorinated biphenyls (PCBs) screening of soil samples may be used to determine the extent of possible PCBs in soil and to optimize the location of samples for confirmatory laboratory analysis. The field screening may be conducted using a PCB-specific immunoassay test. The individual responsible for conducting the immunoassay test in the field shall receive instruction in the proper use and storage of the test kit. The instructions for the PCB Field Screening Kit are provided as Attachment A of the Generic Quality Assurance Project Plan (QAPP) (Volume II). The test is a simple procedure designed to test any type of soil sample for PCBs. The test uses a semi-quantitative, colorimetric method that incorporates immunoassay technology. The test is performed using tubes, which are coated with a chemical that specifically reacts with PCBs. To perform the test, the standards, samples and reagents are added in a step-wise manner to the coated tubes. The procedure results in a color change within each tube proportional to the concentration of PCB. The color in the tubes is read by inserting the tubes in a comparative photometer. The test consists of the following three steps:

1. Sample Preparation: First, PCBs are extracted from the soil using a solvent. The

extract is clarified using a disposable 0.45-micron filter tip.

2. Testing: After sample preparation, the PCB standards and the sample are added to the coated tubes using dropper bottles. After 10 minutes incubation, the tubes are rinsed and color-developing reagents are added. Within a few minutes, color development occurs in the tubes.

3. Results Interpretation: The color of the sample tube is compared against the color of the standard tube using a photometer to determine the concentration of the sample. The result will indicate concentrations in 3 ranges; less than 5 ppm, between 5 and 50 ppm, and over 50 ppm. Also, with a dilution samples can be tested for over 500 ppm.

PCB specific screening with the eminase test kits will be utilized on-sites, which have historically been associated with either electrical equipment from a certain time period that employed the use of PCB oils or when records may reflect the use of PCBs at that facility. The test kits will be used as part of an overall analytical program, which will include laboratory analysis of on-site soils.

4.5 Private Water Supply Inventory

If off-site groundwater impacts are detected through the sampling program, or if specifically requested by the NYSDEC, than an inventory of private water supply sources within a one-half mile radius around the project Site will be researched. The research will be conducted by contacting the municipal Water Department (if one exists), the municipal engineer, the NYS Department of Health and consulting the *Atlas of Community Water System Sources*, and/or the United States Geologic Society (USGS).

5.0 SUBSURFACE BORING PROTOCOL

5.1 Drilling Methods and Sample Collection

Overburden

Soil borings; in general, will be drilled with hollow-stem augers or flush-joint casing. When advancing a soil boring, re-entry of the split-spoon sampler into the previously sampled interval shall not be permitted. Hollow-stem augers with center plug will be advanced at two-foot intervals, consistent with the split-spoon sampling pace. Alternative methods may be used at the geologist's discretion with the authorization of NM and NYSDEC. Split-spoon sampling will be conducted in accordance with ASTM Specification D-1586-84 for standard penetration test and split barrel sampling, unless otherwise authorized by the field geologist. Split-spoons will be decontaminated after each sample is collected.

A plywood sheet or other suitable basin (during mud or water rotary drilling) will be placed around the augers during drilling to contain soil cuttings/mud drilling and prevent them from contacting the ground surface. Soil cuttings will be placed in a 55-gallon steel drum or a roll-off container for subsequent sampling and disposal. Decontamination water and drilling mud/water will be placed in tanks and/or 55-gallon steel drums for proper disposal.

Boring Completion Methods

All soil borings will be completed by adding cement/bentonite grout, via tremie pipe, from the bottom of the borehole up to the ground surface as the augers are withdrawn. The grout will be mixed in the following relative proportions: 30 gallons of water to three 94-pound bags of cement to 25 pounds granular bentonite.

Geoprobe® Coring

If prescribed in the Site-Specific Work Plan, Geoprobe® coring will be performed in accordance with the manufacturer's specifications. An assembled Geoprobe Macro-Core® open-tube soil sampler, with a one use dedicated liner, will be driven one sampling interval (approximately 4 feet) into the subsurface then retrieved using a Geoprobe® soil probing machine. The collected soil core will be removed from the sampler along with the liner. The field geologist will classify and sample the soil located within the liner. Upon completion, the excess soil will be placed into a 55-gallon drum for disposal and the inner liner properly disposed. After decontamination, the Macro-Core sampler will be reassembled using a new liner. The clean sampler will then be advanced back down the same borehole to collect the next soil core interval.

Upon completion of sampling, the borehole will be grouted from the base of the borehole to ground surface. As the Geoprobe ® piping is removed from the borehole, grout will be place in the Geoprobe ® piping and allowed to flow out, via gravity, into the void left by the piping.

Procedures for geologic logging and field classification will be as presented in Section 5.2.

Shelby Tube Sampling

Shelby tube samples will be collected in accordance with the latest revision of ASTM D/587. When the desired sampling depth is reached, the hollow-stem auger or casing will be cleaned out using whatever method is preferred so as not to disturb the material to be sampled. The Shelby tube will be lowered to the bottom of the borehole, then advanced (pushed) via pressure without rotation by a continuous relatively rapid motion until 24 inches of penetration is achieved. At the discretion of the field geologist, a period of approximately 10 minutes, measured from the time of insertion, will be allowed to provide for sample adhesion to the tube walls. Prior to removal, the tube may be rotated two complete revolutions to shear the bottom of the sample from the native material.

Upon removal, the field geologist will log the tops and bottoms of the sample for soil classification. Samples recovered via Shelby tube will be preserved in conformance with the latest revision of ASTM D 4220. To preserve the natural moisture content of the samples, the tube ends will be sealed with a minimum of 0.50 inch of paraffin wax. Plastic slip caps will be applied at the ends of the sample tube, taped, then dipped and sealed in wax.

Rock Coring

Conventional or wire-line HX or NX coring will be used if rock drilling is specified in the Site-Specific Work Plan. Prior to drilling at such locations, a minimum 4-inch diameter, temporary steel casing or equivalent will be placed or locked into the top of bedrock. Rock coring will be conducted in accordance with the latest version of ASTM D2113. Upon retrieval, the core will be placed in a core box labeled as follows:

Outer Core Box and/or End Panels

1) Project/Site name
2) Site location
3) Boring/well number
4) Box number
5) Core run number and footage interval
6) Date

Inside Core Box Cover (in columns)

1) Boring/well number
2) Run number
3) Depth interval
4) Actual recovery
5) Rock quality degree (RQD) in percent
6) PID screening results where applicable

7) Comments

In addition, a geologist will be on-site during the drilling operations to fully describe each core, including:

1) Color
2) Thickness of bedding
3) Rock type
4) Additional petrographic information
5) Texture
6) Weathering state
7) Structure
8) Detailed description of discontinuities and fillings
9) Formation name
10) Detailed description of visible impacts
11) Miscellaneous observations

Sample descriptions, PID readings, and drilling locations will be recorded in the field logbook.

5.2 Geologic Logging, Soil Classification and Documentation

The field geologist will log borehole geology in the field logbook and on field forms. All samples collected from the borehole will be classified in accordance with ASTM standards D2487 Standard Method for Classification of Soils for Engineering Purposes and D2488 Standard Practice for Description and Identification of Soils or using the Burmeister Method and classifying the soils using the Unified Soil Classification System. The field geologist will be on-site during the drilling operations to classify/log each sample in the field logbook and/or field forms including:

- Site;
- Boring number;
- Interval sampled;
- Date;
- Initials of sampling personnel;
- Drilling Company's Name;
- Soil type;
- Color;
- Feet of recovery;
- Moisture content;
- Texture;

- Grain size and shape;
- Relative density;
- Consistency;
- Visible evidence of residues; and
- Miscellaneous observations (including organic vapor readings).

If no recovery, or limited recovery, is observed in the sample, then a description regarding the lack of sample recovery should be provided on the log of boring, if evidence of an obstruction or equivalent can be identified. If no observable evidence is identified then no opinion or guess should be entered on the log of boring.

Figure 1 presents an example of a log of boring form to be completed. If this form is not utilized, the form used should be approved by the Consultant's Project Manager as well as NM's project manger.

Photo documentation

Photo documentation of the Site activities will be conducted consistently throughout the implementation of the field program. A photographic log will be created and maintained as part of the overall field program. Visually impact materials and/or distinct stratigraphic changes in the soil column will be included in the photographic documentation for the individual Sites.

6.0 MONITORING WELL INSTALLATION AND DEVELOPMENT

Monitoring wells will be installed at the locations identified in the Site-Specific Work Plan. After the completion of drilling and monitoring well installation, all wells will be developed prior to the collection of groundwater samples. The following procedures will be used to install and develop all monitoring wells.

6.1 Monitoring Well Specifications

Monitoring wells installed in unconsolidated deposits that do not penetrate a presumed confining layer will be constructed according to the following specifications:

- PVC or stainless steel 2-inch diameter threaded, flush-joint casing and screens with O-rings will be installed.
- Wells will be screened in the unconsolidated deposits. Screens will be approximately 10 feet in length, and slot openings will be 0.020 inch. Alternatives may be used at the discretion of the field geologist, based on Site-specific geologic conditions.
- A sump, up to 2 feet in length, may be attached to the bottom of the screen to collect dense nonaqueous phase liquids (DNAPLs), if appropriate. A sump will not be installed if DNAPL is not observed in the boring.
- The top of the casing will extend to approximately 2 to 3 feet above ground surface where possible, given Site-specific considerations. Otherwise, flush-mount casings will be used.
- Where appropriate, the annulus around the screens will be backfilled with silica sand (#1 Morie or equivalent), based on Site-specific geologic conditions and screen slot size, to a minimum height of 2 feet above the top of the screen.
- A bentonite pellet/chip seal or slurry (30 gallons water to 25 to 30 lbs. bentonite, or relative proportions) will be placed above the sand pack. The bentonite pellet/chip seal will be installed via gravity and allowed to hydrate for at least 1 hour before placement of grout above the seal. If the bentonite slurry method is used for installation of the seal, then a side discharging tremie pipe will be utilized for the installation of the bentonite seal. Where possible, the bentonite seal will be a minimum of 24-inches in depth, except in those instances where the top of the well screen is in close proximity to the ground surface. In these instances, the well will be completed in accordance with specifications provided by the field geologist, which will incorporate an adequate surface seal into the well design.
- A fine sand pack (Morie 00 or equivalent) approximately 1 foot thick will be placed above and below the bentonite seal to isolate it and to prevent mixing of components.
- The remainder of the annular space will be filled with a cement-bentonite grout up to the ground surface. The grout will be pumped from the bottom up. The grout will be

mixed in the following relative proportions: 30 gallons of water to three 94-pound bags of cement to 25 pounds granular bentonite. The grout will be allowed to set for a minimum of 48 hours before wells are developed.

- Each monitoring well will have an expansion plug or plumbers plug and a 4-inch diameter, steel casing with a hinged, locking cap placed over the monitoring well. The protective casing will extend approximately 2 feet below ground surface and be cemented in place. In some areas, it may be necessary to provide flush mounted casings. All wells will have keyed-alike locks and the keys will be maintained by the NM project manager.
- A concrete surface pad (2 ft x 2 ft x 6-inch) will be sloped to channel water away from the well casing.
- A weep hole will be drilled at the base of the protective standpipe casing to allow any water between the inner and outer casing to drain. If a flush mounted protective casing is installed then a small diameter drainage tube will be installed in the side of the casing discharging to the surrounding subsurface soils.
- The flush mounted monitoring well protective casing will be a minimum 8-inch diameter box or equivalent. All flush mounted well risers will be capped with an expansion plug or plumbers plug.
- The top of the PVC well casing will be permanently marked/notched and surveyed to 0.01 foot, and elevations will be determined relative to a fixed benchmark or datum. The measuring point on all wells, the permanent mark/notch will be on the innermost PVC casing.
- Each outer casing will be permanently labeled using a steel hand stamp or equivalent (i.e. MW-4).

Modification of the above installation procedure will be subject to changes in the field. All field-executed changes will be communicated to the NYSDEC for their discussion and approval, if appropriate.

Based on field conditions and evaluation of the best methodology to ensure the integrity of the seal, the field geologist will select the best method (i.e. bentonite pellet via gravity or bentonite slurry via tremie) to install the bentonite seal above the sand pack.

Figure 3 shows details of an overburden monitoring well construction diagram for wells installed in unconsolidated material. Figure 2 shows details of a monitoring well installed with a flush mounted protective casing.

Figure 4 shows details of a typical double-cased monitoring well construction diagram for wells installed in unconsolidated soils that do penetrate a presumed confining layer. The decision to install double-cased wells will be made on a boring-specific basis by the field geologist. Double-cased wells will be installed when the boring for the monitoring well penetrates a presumed confining layer. The confining layer shall be defined as a minimum five (5) foot thick, predominantly clay unit which has been shown to be laterally continuous across the Site. In the event the field geologist and NM and NYSDEC Project Managers decide a reasonable possibility exists for contamination to be deposited in deeper, clean zones during the drilling and installation of a monitoring well, the well will be double-cased. The purpose of the steel protective casing will be to minimize the possibility that residual contamination is deposited at the depth of the screened interval during the drilling process.

Monitoring wells that penetrate confining layers will be installed according to the following specifications:

- 6-inch inside diameter (ID) steel outer casings will be installed to a depth of at least 2 feet below the lower limit of observed or measured contamination and/or the confining layer. This casing will be grouted in place with cement to inhibit downward migration of contamination.
- The 6-inch casing will be installed through 6.25-inch ID hollow-stem augers. The augers will be filled with grout prior to their removal to ensure the integrity of the borehole and the grout seal. Then, the 6-inch casing will be installed into the grout and hydraulically pushed approximately 1-foot beyond the bottom of the boring. A 3–foot thick grout plug will be installed at the base of the 6-inch diameter pipe through which the borehole will be advanced. Potable water will be tremied to the bottom of the inside of the casing to dilute the grout, thereby allowing the grout to be more easily pumped out of the casing. The grout, pumped out of the casing, will be drummed and staged with other investigation-derived waste (IDW).
- The cement-bentonite grout remaining in the annulus between the casing and the formation will be allowed to set for at least 24 hours before drilling is continued. The drilling will then continue using 4-inch diameter flush-joint spin casing and potable water. All lubricant water will be containerized.
- The well will be constructed of 2-inch diameter PVC or stainless steel riser pipe and screen, sand pack, bentonite seal, grout, and surface casing as specified for single cased monitoring wells discussed above and in accordance with NYSDEC requirements. The bentonite seal may consist of pellets or a bentonite slurry mixture in proportions relative to 30 gallons of water to 25-30 pounds of bentonite. The grout mix will consist of 30 gallons water to three 94-pound bags of cement and 25 pounds of granular bentonite.

Monitoring wells to be installed as open holes in bedrock will be installed according to the following specifications:

- Advance each boring to the top of the bedrock surface. Borehole advancement will be conducted using 6¼-inch inner diameter (ID) continuous flight hollow-stem augers in 2-foot intervals, to permit the continuous collection of subsurface soil samples with carbon steel split-spoon samplers in accordance with Section 5.1. Confirmation of the bedrock surface depth will be based upon split-spoon and hollow stem auger refusal.

- Overbore the borehole to a 12-inch diameter borehole, in which to install a temporary 10-inch carbon steel overburden casing to bedrock, utilizing an appropriately sized tri-cone roller bit or thin wall bit. A 3–foot thick grout plug will be installed at the base of the 10-inch diameter pipe through which the borehole will be advanced, if appropriate.
- Subsequent to temporary casing installation, continue borehole advancement into the bedrock to a depth of 5 feet below the bedrock surface, first using the rock coring method for logging (see Section 5.1) and then overboring with a 9-inch outer diameter (OD) tri-cone roller bit via the water rotary method.
- Set a permanent 6-inch carbon steel casing 5-feet into the competent bedrock by the spin casing method.
- Backfill the annular space around the well casing with bentonite/cement slurry to the surface. The ratio of cement to bentonite for grouting will be approximately 30 gallons of water to three 94-pound bags of cement to every 25 pounds of granular bentonite.
- Remove the 10-inch temporary casing during pressure grouting. Allow grout to cure for at least 24 hours.
- Continue coring and then drilling in the borehole to the maximum anticipated total depth (i.e. 10 feet below the point where groundwater was encountered) and/or the depth where fracture zones indicate sufficient yield, first using the rock coring method and then overboring utilizing the water rotary method and a 5-inch OD tri-cone roller bit or equivalent.
- Complete the open hole monitoring well with a protective locking stick-up or flushmount box installed in a concrete pad as per Section 6.1.
- If the borehole extends to a depth greater than 25 feet below the bottom of the surface casing (due to depth and/or yield of groundwater), construct the monitoring well using 10 feet of 2-inch diameter Schedule 40 PVC or Schedule 5 stainless steel wire wound screen (0.010-inch slot or a slot size appropriate to the formation) and 2-inch diameter Schedule 40 PVC or Schedule 5 stainless steel riser pipe. For non-flushmounted wells, at least 2 to 3 feet of riser pipe must extend above the ground surface. Flushmounted wells will only be installed in high traffic areas, such as roadways, sidewalks, etc.
- Backfill the annular space to a minimum height of 2 feet above the top of screen with a sand pack. The sand pack shall be Morie #1 silica sand or equivalent (based on Site-specific geologic conditions and screen slot size). The remaining annular space will be filled with bentonite/cement grout up to the ground surface. The ratio of cement to bentonite for grouting will be approximately 30 gallons of water to three 94-pound bags of cement to every 25 pounds of granular bentonite.

- Complete the constructed monitoring well as described with a protective locking stickup or flushmount box installed in a concrete pad as per Section 6.1.

Modification of the above installation procedure will be subject to changes in the field. All field-executed changes will be communicated to the NYSDEC for their discussion and approval, if appropriate.

Characteristics of each newly installed well will be recorded on the appropriate well construction diagram. Each well will be identified with a well number placed on the inside of the well cap and on the outside of the protective casing or outside flush-mount cover. Each separate source of potable water used for the drilling process will be sampled once for TCL/TAL compounds.

6.2 Monitoring Well Development

After a minimum of 24 hours after completion, the monitoring wells will be developed by one or a combination of the following techniques:

- Surging;
- Bailing;
- Using a centrifugal pump and dedicated polyethylene tubing;
- Positive displacement pumps and dedicated polyethylene tubing, and/or
- Other methods recommended by the field geologist and approved by the NM and NYSDEC Project Managers.

Development water will initially be monitored for organic vapors with a PID. In addition, the development water will be observed for the presence of non-aqueous phase liquids (NAPLs) or sheens. The development water will be contained in a tank and/or 55-gallon steel drums on-site. The purge water will be disposed of in accordance with NYSDEC requirements. The wells will be developed until the water in the well is reasonably free of visible sediment (<50 NTU if possible) or until pH, temperature and specific conductivity stabilize, assuming a minimum of 10 well volumes of water has been removed from the monitoring well during development. In no case will well development exceed 8 hours per well. Following development, wells will be allowed to recover for at least one week before groundwater is purged and sampled. All monitoring well development will be overseen by a field geologist and recorded in the field logbook.

6.3 In-Situ Hydraulic Conductivity Testing

In-situ hydraulic conductivity testing may be performed on selected monitoring wells as indicated in the Site-Specific Work Plan to obtain estimates of groundwater velocities and potential groundwater recovery rates for the aquifer. The objective of the hydrogeologic testing is to determine the hydraulic properties of the aquifer in the vicinity of the Site.

Slug tests may be conducted in selected monitoring wells utilizing the rising or falling head slug test technique. Rising head tests can be performed in unconfined and confined aquifers. Falling head tests should only be performed in confined aquifers. The slug tests will be performed by subjecting water-bearing units in the screened interval to a stress caused by the sudden displacement of the water level within the well. The rising head tests will be conducted as follows:

- Slugs and other downhole equipment will be decontaminated before and after each test by methods described in Section 3.2.
- Prior to conducting each slug test, the static water level in the well will be measured to the nearest 0.01 foot. Water levels will be measured during the test with an electric sounder (water level indicator) and with pressure transducers attached to a data logger, thereby providing water level measurements by two independent devices.
- A weighted slug of known volume will be inserted gently into the well below the water table. The water level will be measured until the water level returns to static conditions.
- The slug will be suddenly withdrawn from the well and the water level recovery will be monitored at appropriate intervals until recovery is complete and stabilized.
- Wells, which were bailed dry during development, may not be able to provide meaningful data through slug tests. Tests will be terminated in wells which do not recover significantly (>80% of static level) within a certain amount of time, at the discretion of the field geologist. These wells will be bailed dry and their recovery measured with an electronic water level indicator.

The falling head tests will be conducted as follows:

- Slugs and other downhole equipment will be decontaminated before and after each test by methods described in Section 3.2.
- Prior to conducting each slug test, the static water level in the well will be measured to the nearest 0.01 foot. Water levels will be measured during the test with an electronic sounder (water level indicator) and with pressure transducers attached to a data logger, thereby providing water level measurements by two independent devices.
- A weighted slug of known volume will be quickly inserted into the well below the water table. The water level will be measured until the water level returns to static conditions.
- The test will be terminated in wells which do not recover significantly (>80% of static level) within an unspecified time, at the discretion of the field geologist.

The slug test data will be analyzed using the Cooper, Bredehoeft, and Papadopulos (1967) type curve method or the Bouwer and Rice (1976, 1989) method. The Cooper et al. analysis assumes that the well penetrates a confined aquifer, and the Bouwer and Rice method applies where unconfined conditions are prevalent.

6.4 Well Abandonment

Monitoring wells installed in unconsolidated material will be abandoned in the following manner:

- Remove the protective casing and concrete pad.
- Over drill the well casing using hollow-stem augers or casing to at least one foot below the depth of the boring/well as indicated in the soil boring log.
- Remove the well casing from the hole. If the casing cannot be removed while the augers are in place, cutoff the casing at least two feet, and if possible five feet, below the ground surface.
- Add cement/bentonite grout via tremie pipe from the bottom of the augers as the augers are withdrawn.
- If the well casing cannot be overdrilled and removed, the well casing will be filled with cement/bentonite grout from the bottom up using a tremie pipe. The grout mixture will be as specified for the well installation (see Section 6.1).
- Add grout to the point where the casing was cut off. From that point up to ground surface, backfill with native soil material surrounding the boring/well.

Monitoring wells installed in Consolidated (bedrock) or open holes will be abandoned in the following manner:

- Remove the protective casing and concrete pad.
- Add cement/bentonite grout via tremie pipe from the bottom of the well up to the ground surface. The grout mixture will be as specified for the well installation (see Section 6.1). □
- Add grout to the point where the casing was cut off. From that point up to ground surface, backfill with native soil material surrounding the boring/well.

6.5 Packer Testing

Attachment A presents the packer test procedures to be used in the event the hydraulic conductivity of a discrete bedrock zone is required for the purpose of determining the well screen interval of bedrock wells. Down-hole packer equipment will be decontaminated following the procedures in the FSP (see Section 3.1) prior to use at each location and prior to demobilization.

7.0 TEST PIT EXCAVATIONS

When specified in the Site-Specific Work Plan, test pits will be excavated using a rubber-tired or track backhoe. In the event deep excavations are anticipated, a track hoe will be utilized. Locations of test pits, if proposed in the Site-Specific Work Plan, will be finalized in the field, based on the location of potential source areas and existing underground utilities. If the prospective test pit location is covered by asphalt or concrete, the area will be saw cut prior to excavation. During excavation activities, personnel will stand upwind of the excavation area to the extent possible. Air monitoring will be conducted in accordance with the Generic EHS Plan (Volume II). Test pit materials will be logged, as well as photographed for future reference. Material removed from the test pit will be placed on polyethylene sheeting. Should sampling of excavated material be performed, samples will be collected with a decontaminated or a new disposable sampling tool, or equivalent, from the center of the backhoe bucket. Upon completion, the material from the test pit will be placed back in the excavation in the reverse order in which it was excavated. The location and size of the test pit will be measured and described in the field logbook.

Visually clean soils, such as surface soils, will be segregated from soils that may be impacted. The visually clean soils will be used to cover the impacted soils/source materials when placed back in the excavation. At a minimum, the top two feet of back filled soil will be visually clean. If the original (top) two feet of soil is impacted or some portion of it is impacted then the soil will be replaced and/or supplemented with certified clean fill. Test pits will be backfilled as soon as possible after completion and in general prior to the cessation of activities at the end of the day. The closure of individual test pits, prior to work cessation at the end of the day, will be performed on a case by case basis utilizing criteria for the maintenance of safe working and overall Site conditions. For gravel roadways and parking areas, the backfill will be tamped down in 18-inch lifts. A 6-inch layer of clean run-of-crush gravel will be tamped in-placed as the final lift. For test pits located in asphalt-covered areas, the surface will be replaced with cold or hot asphalt mix, compacted by rolling, and trimmed flush with the adjoining surface. Test pits located in grass covered areas will be returned to original grade and reseeded. Following restoration of the excavation, the test pit will be staked/marked to facilitate subsequent location by surveying crews.

7.1 Underground Utilities

Potential for encountering underground utilities is part of any subsurface investigation, where test pitting will be utilized as part of the investigation. When performing test pitting in areas of suspected live underground utilities, the test pits will be advanced by hand digging to a depth of five (5) feet below ground surface to confirm the location of the live utility. If investigation of abandoned underground utilities is required, then the parameters of the investigation will be specified in the Site-Specific Work Plan.

If an abandoned under ground pipe/structure, associated historically with the former MGP operations, is encountered during the test pitting operation, then excavation activity will cease until the pipe or underground structure can be adequately investigated. The investigation of the piping will include the description of the pipe/structure construction, material, condition, orientation, dimension, and contents of the pipe/structure, if possible. If the piping/structure interior can not be readily accessed then penetration of the underground utility may be necessary. Penetration of any underground utility should be conducted with the utmost care and consideration given for the utilization of proper tools (spark proof, beryllium coated, etc) for the task at hand. Once the interior of the pipe is accessible then a sample will be taken of the pipe contents, and sent to a laboratory for analysis.

If prior to initiation of test pitting activities, a live underground utility is identified in the area of anticipated test pitting, then the live underground line, if feasible, will be shut down. Consideration must be given to impacts to the facility operations prior to shutting down any active utility. (See the lockout tag out procedure section of the Generic HSP).

If during test pitting activities an unexpected live underground utility is encountered, excavation will cease, the orientation and dimensions of the underground utility will be recorded, and if possible, the live utility will be shielded from damage and test pitting will continue. If shielding is not possible then the test pit will be back filled and a new test pit attempted in the general vicinity of the initial location. When performing excavation activities next to a live underground utility, care will be taken not to undermine or impact the operation of the live underground utility. If a pipe or underground utility is accidentally severed, the owner of the utility, then NM, will immediately be notified. Liquid flows or electricity will be shut off immediately and appropriate repairs initiated as soon as possible. If a release of liquid occurs, the Consultant PM will notify NM who will then notify NYSDEC. All appropriate response actions will be implemented.

8.0 GROUNDWATER SAMPLING

The following is a step-by-step sampling procedure to be used to collect groundwater samples from the monitoring wells. Well sampling procedures will be recorded on the form shown in Figure 5. Sample management is detailed in the Generic QAPP (Volume II).

- Groundwater samples will not be collected until, at minimum, one week following well development.
- Prior to sampling, measure the static water level from the surveyed well elevation mark on the top of the PVC or stainless steel casing with a decontaminated water level probe. The elevation of nearby surface water bodies will also be recorded using bulkheads, culverts, or other convenient structures as reference points in which the elevation is known. These relative measurements will be used to aid with interpreting the relationship between observed surface water and groundwater fluctuations. Record time, date, and measurement to nearest 0.01 foot and record in the field logbook.
- Decontaminate all field test equipment and meter probes prior to use on-site.
- Prior to collecting a round of groundwater elevations an oil/water interface probe will be used to determine the presence of LNAPL and DNAPL in the well.
- A round of groundwater elevations will be collected prior to the start of sample collection. The measurement at each well location will be made from the top of the PVC or stainless steel casing with a water level probe. The measurements will be made in as short a time frame as practical to minimize temporal fluctuations in hydraulic conditions.
- Place a plastic sheet on the ground to prevent contamination of the bailer rope and/or the tubing associated with the purging (pump) equipment.
- Purge the well by removing a minimum of 3 well volumes or at least one volume of saturated sand pack, whichever is greater or use the low flow sampling procedures below. Purging will be conducted with a teflon, stainless steel or disposable polyethylene bailer, or a centrifugal, submersible, peristaltic, or whale pump and dedicated polyethylene tubing, or other methods at the discretion of the field geologist, and with the prior approval of NM and NYSDEC. Purging of the well to stabilized parameters may be performed at between 100 to 500ml/min. If the well goes dry before the required volumes are removed, the well may be sampled when it recovers sufficiently.
- Collect volatile organic analyte (VOA) or BTEX samples with Teflon, stainless steel or dedicated polyethylene bailers lowered by a dedicated polypropylene and/or Teflon line or other methods as indicated. TCL SVOCs, PAHs, pesticide/PCBs, TAL metals, natural attenuation parameters, and other non-conventional parameters may be collected with Teflon, stainless steel, or dedicated polyethylene bailer or a

submersible, or peristaltic pump using the low-flow sampling technique. Low flow well sampling will be at a rate less than or equal to 100ml/min.

Low-flow sampling procedures may be utilized to collect samples for metals analysis if sample turbidity is excessive. Low flow sampling will be performed according to USEPA (1998) guidance. The pump should be capable of throttling to a low flow rate suitable for sampling.

- Measure temperature, pH, turbidity, DO, and conductivity, at 5 to 10 minute intervals. When the parameters stabilize over 3 consecutive readings, sampling may commence. Record results in the field logbook prior to sample collection.
- Fill sample containers for VOCs or BTEX first. Sample containers for SVOCs and other analytes are then filled.
- After all samples are collected, dispose of polypropylene line and bailer, or other dedicated disposable sampling equipment.

9.0 SURFACE WATER SAMPLING

Surface water samples will be collected at the locations indicated in the Site-Specific Work Plan. Sample management is detailed in the Generic QAPP (Volume II). A decontaminated stainless steel or glass cup may be used to collect the water for these samples or the sample bottles may be directly dipped into the water. At no time will a sample jar, which contains preservative, be submerged in the sampling media. The sample should be collected from mid-depth by submersing the sampling device or sample container to a mid-depth position and opening the container and allowing it to fill. If this methodology does not work effectively then an alternative sampling device (i.e. bacon bomb etc) can be utilized. The stainless steel or glass cup will be decontaminated following the procedures outlined in Section 3.2. Surface water samples will be collected downstream first, and then progressing in an upstream direction. If sediment sampling is to be performed in conjunction with surface water sampling at corresponding locations, the surface water sample will be collected prior to the sediment sample.

Surface water flow measuring techniques will vary greatly based upon the existing field conditions. A discussion regarding the investigative techniques for collection of surface water flow measurements will be discussed in detail in the Site-Specific Work Plan.

All Field data will be recorded in the logbook and on the sample log sheet (Figure 6).

10.0 SURFACE SOIL SAMPLING

Surface soil samples will be collected at the locations indicated in the Site-Specific Work Plan. Sample management is detailed in the Generic QAPP (Volume II). Samples will be collected using decontaminated stainless steel equipment or disposable sampling equipment. If the selected sampling location is in a vegetated area, the vegetation will be removed over a one square foot area prior to sample collection. The sample will be collected from within the top 2-inches of the exposed ground surface. Samples will be collected by hand digging into the soil with a pre-cleaned stainless steel trowel or a disposable sampling tool. All samples selected for laboratory analysis will be placed in the appropriate containers provided by the laboratory. Sample containers for volatile organic analysis will be filled first. Next, a sufficient amount of the remaining soil will be homogenized by mixing the sample in a decontaminated stainless steel bowl with a decontaminated steel trowel or disposable scoop. This composite sample will be analyzed for all remaining parameters identified in the Site-Specific Work Plan.

All samples collected for analysis will be placed immediately into laboratory sample jars and properly stored in a cooler with ice to 4°C before transport to the laboratory.

Duplicate samples will be collected at the frequency detailed in the Generic QAPP by alternately filling two sets of sample containers. Composite samples may be required to obtain a sufficient soil volume.

In addition, surface soil samples will be described by including:

- Site;
- Location number;
- Interval sampled;
- Date;
- Initials of sampling personnel;
- Soil type;
- Color;
- Moisture content;
- Texture;
- Grain size and shape;
- Relative density;
- Consistency;
- Visible evidence of residues; and
- Miscellaneous observations (including organic vapor readings).

11.0 SUBSURFACE SOIL SAMPLING

11.1 Samples for Laboratory Analysis

Subsurface soil samples selected for laboratory analysis will be obtained from a standard 2-foot split-spoon or Geoprobe ® samplers and placed in the appropriate containers provided by the laboratory. The soil samples will be collected from the 2-foot sampling interval (assuming full recovery) of the split-spoon. Additionally, the Geoprobe ® methodology will utilize the standard 2-foot sampling interval. Sample containers for volatile organic analysis will be filled first. Samples for volatile analysis will be collected or biased toward the collection of that portion of the sample that exhibits the highest PID reading or as otherwise detailed in the Site-Specific Work Plan. Next, a sufficient amount of the remaining soil will be homogenized by mixing the sample in a decontaminated stainless steel bowl with a decontaminated stainless steel trowel or disposable scoop.

All samples collected for analysis will be placed immediately into sampling containers provided by the laboratory and properly stored on ice to 4°C before transport to the laboratory. Sample management is detailed in the Generic QAPP (Volume II). In addition, a geologist will be on-site during the drilling operations to fully describe each sample including:

- Soil type and sorting;
- Color;
- Feet of recovery;
- Moisture content;
- Texture;
- Grain size and shape;
- Relative density;
- Consistency;
- Visible evidence of residues; and
- Miscellaneous observations.

Duplicate samples will be collected at the frequency detailed in the Generic QAPP by alternately filling two sets of sample containers.

11.2 Geotechnical Testing

When identified in the Site-Specific Work Plan, laboratory geotechnical testing will be performed on selected soil samples in accordance with appropriate ASTM standards. Geotechnical analysis will be performed on soil samples collected in Shelby tubes or in glass sampling containers including, but not limited to, the following tests: grain size and sieve analysis, total organic carbon, permeability, specific gravity, Atterberg Limits, porosity, moisture content, and bulk density.

12.0 SEDIMENT SAMPLING

Proposed sediment sampling locations are identified in the Site-Specific Work Plan. Sample management is detailed in the Generic QAPP (Volume II). Sample locations in surface waterways will be marked along the bank prior to sampling. For all sample locations, the distance from the waterline to the sample location will be measured and recorded in the field logbook. Sediment samples will be collected from the furthest downstream point, progressing toward the furthest upstream sampling location. Following the completion of sampling the sediment locations will be marked along the shoreline for subsequent location by a survey crew.

12.1 Shallow Sediment Samples

Shallow sediment samples collected in shallow water will be collected with a Wildco core sampler, clam shell, lexane tubes, hand auger, vibracore or split-spoon sampler. Where possible, rocks and vegetative material will be discarded, and care will be taken to retain fine materials, which tend to disperse when disturbed. Sampling personnel will stand downstream of the sampling point to minimize disturbance of the bottom sediments during collection. Equipment will be decontaminated between samples following procedures outlined in Section 3.2. Field data will be recorded on the field sampling records. Surface sediment samples will be collected from a depth interval of 0 to 6 inches (0 to 15 cm) using these same procedures as outlined above. Sediments, which are located near shore and are not submerged, will be collected with a decontaminated trowel or disposable sampling tool.

12.2 Deep Water Sediment Samples

Sediment sampling in deeper water and samples requiring retrieval from deeper depths will be obtained using a barge-mounted drilling system or similar watercraft. Either a tripod and cat-head assembly or a Vibracore system will be used on the barge to advance the sampling apparatus into the bottom sediments. The tripod and cat-head assembly will be equipped either with a five-foot long "California" split-spoon sampler or a standard 2-foot long split-spoon sampler for sample collection. Split spoon samplers can be fitted with a sediment sampling head or shoe to ensure adequate recovery of the sample. To keep the hole open for subsequent samples and to minimize cross-contamination, 3-inch spin casing will be advanced, with plug, into the sediment. The spin casing will be advanced in 2-foot increments prior to sampling. The sediment sampler will then be pushed ahead or below the base of the 3-inch spin casing. The spin casing will be pumped free of sediment after each sample is collected. When the casing is free of sediment, it will be advanced 2 additional feet in preparation for the next sample collection.

The Vibracore uses a vibrating motion to advance a barrel and flexible plastic liner to achieve sample collection. A "core catcher" retains the sediment sample upon retrieval. Samples will be obtained by cutting the plastic liner longitudinally using a knife, then the sediment samples will be placed in sampling jars, based on sampling interval compensating for compression.

Sediment samples will be visually classified for texture and screened for the evolution of organic vapors with a PID. Samples will be collected or biased toward the collection of that portion of the sample that exhibits the highest PID reading or as otherwise detailed in the Site-Specific Work Plan. The sediment samples will be collected from the 2-foot sampling interval (assuming full recovery) of the split-spoon. Visible staining or contamination will be noted in the field logbook.

12.3 Sediment Probing

When identified in the Site-Specific Work Plan, sediment probing will be utilized to evaluate the presence of NAPL in the stream bedding. The near-shore sediment probing will be performed on a Site by Site basis. The use of standard visual observance techniques to evaluate the possible presence of sheens on the adjacent water bodies, with out disturbance of the sediments, will be conducted as part of the initial Site Investigation. The Sediment probing activities can be used to supplement the information collected during the initial Site investigation by focusing the probing activities in the area of the observed sheens.

Implementation of a sediment probing investigation will involve the use of multiple sections of 3/8-inch to ½-inch threaded rod and associated threaded female couplings. The threaded rod will be pushed into the sediment at multiple locations in an attempt to disturb the near surface sediments as well as deeper sediments. Upon detection of any sheen a stake will be located along the shoreline to provide a marker for the subsequent location by a survey crew, if require by the Site-Specific Work Plan. Sediment probing can also be used to provide information on the depth of competent material below the soft surface sediments.

Personnel will stand downstream of the sampling point to minimize disturbance of the bottom sediments prior to utilizing the probe. Equipment will be decontaminated prior to use in the stream and post use, following procedures outlined in Section 3.2. Field data regarding the location, depth, odor, and description of the sheen will be recorded on the field logbook.

Sediment probing in deeper water and samples requiring retrieval from deeper depths will be obtained by utilizing a rowboat or similar watercraft.

13.0 AIR MONITORING

13.1 Ambient Air Monitoring

Air monitoring will be conducted with a photoionization detector (PID) and combustible gas indicator (CGI) during all drilling and intrusive activities. The PID will be used to monitor for organic vapors in the breathing zone, borehole, and along the Site's perimeter and to screen samples for analysis. The CGI measures the concentration of combustible gas or vapor in air, indicating the results as a percentage of the lower explosive limit (LEL) of the calibration gas. Action levels are identified in the Generic EHS Plan (Volume II).

PID and CGI readings will be recorded in the field logbook and on the soil-boring log during drilling activities. The PID and CGI are calibrated at least once each day and more frequently if needed with the manufacturer specified calibration gas. The detailed procedures for the PID and CGI operation and calibration are included in the Generic EHS Plan (Volume II).

13.2 Perimeter Air Sampling

Perimeter air sampling may be required during field activities at the Site. Air sampling may be required during test pit excavation and/or during soil excavation/removal associated with an IRM. The basis for such sampling will be outlined in the Site-Specific Work Plan.

Prior to the collection of air samples, air-sampling stations, commonly one (1) upgradient and two (2) downgradient, will be set up at the Site perimeter. The location of these stations is based on daily wind direction during the field activities. A sample station would be setup so that the sample media (Summa canister, high volume sampler, whole air sampler or absorbent tube, etc.) would draw in air from approximately 2 to 4 feet above the ground surface. The sampling media would remain in place a maximum 24-hour period before it is shipped overnight to a laboratory for testing. Air samples are commonly analyzed for BTEX via Method TO-15 (summa canister using a whole air sampler) or TO-17 (using an absorbent tube) and PAHs via Method TO-13 (using a high volume sampler).

13.3 Building Interior Air Sampling for Volatile Organic Compounds (VOC)

When identified in the Site-Specific Work Plan, building air sampling will be performed in the on-site buildings during follow up investigations. Interior air sample collection will be performed in the basement and on the first floor of buildings potentially impacted by on-site contaminants. Various collection techniques will be used based on the type of contamination anticipated and the requirements set forth in the USEPA ERT SOP # 1704, #2121, and # 2119. Interior air sampling will also conform with NYSDOH indoor Air and Analysis guidance and the off-site Laboratory will have the New York State Environmental Laboratory Approval Program (ELAP) certification.

The following procedure will be used for air sampling of VOCs, based on USEPA ERT SOP

#1704:

I. *Subatmospheric Pressure Sampling Using a Fixed Orifice, Capillary, or Adjustable Micrometering Valve*

- Complete the appropriate information on the Canister Sampling Data Field Sheet.
- A canister, which is evacuated to 0.05 mm Hg and fitted with a flow restricting device, is opened to the atmosphere which contains the VOCs for sampling. The pressure differential causes the sample to flow into the canister.
- This technique can be used to collect grab samples having a duration of 10 to 30 seconds or time-integrated samples having a duration of 12 to 24 hours. The sampling duration is depends on the degree to which the flow is restricted.
- As the pressure approaches atmospheric pressure, a critical orifice flow regulator will cause a decrease in the flow rate.
- Record data on an appropriate data sheet and/or in the field logbook.

The following procedure will be used for air sampling of VOCs, and is based on USEPA ERT SOP #1704:

ii. *Subatmospheric Pressure Sampling or Pressurized Sampling Using a Mass Flow Controller/Vacuum Pump Arrangement (Andersen Sampler Model 87-100)*

- Complete the appropriate information on the Canister Sampling Data Field Sheet.
- Open a canister, which is evacuated to 0.05 mm Hg and connected in line with the sampler, to the atmosphere, which contains the VOCs for sampling.
- A whole air sample will be drawn into the system through a stainless steel inlet tube by a direct drive blower motor assembly. A small portion of this whole air sample is drawn from the inlet tube by a specially modified inert vacuum pump in conjunction with a mass flow controller.
- The initially evacuated canister is filled by the action of the flow controlled pump to near atmospheric pressure (subatmosphereic pressure sampling) or a positive pressure

not to exceed 25 psig (pressurized sampling).

- A digital time program is used to pre-select sample duration and start and stop times.

- Record data on an appropriate data sheet and/or in the field logbook.

The following procedure will be used for air sampling of SVOCs and/or pesticides/PCBs, and is based on USEPA ERT SOP #2121:

- Using a calibrated sampler, place the sampler in the desired location. The polyurethane foam (PUF) sampler should be in the breathing zone in order to prevent elevated results. It should be located in an unobstructed area, at a distance of twice the height of any obstruction to air flow but no closer than two meters to the obstacle.

- Assemble the sampling system by attaching the legs and magnehelic panel to the platform. Connect the motor to the platform, making sure that the gasket is placed between the motor and the platform. Plug the motor into the timer located on the magnehelic panel. Connect the magnehelic to the venturi with tubing. Adjust the exhaust hose to face downwind of the sampler.

- Put on clean surgical gloves.

- Place the loaded sampling module into the quick release fitting and engage by locking the two levers down securely. Remove the metal cover.

- Record the pump number, location, sample start time, time/counter at the start, and other pertinent information on an appropriate data sheet and/or in the field logbook.

- Plug in the unit. If necessary, adjust the magnehelic gauge by turning the ball valve in order to achieve the reading required to reach the target flow rate. Wait approximately two minutes for the magnehelic reading to stabilize.

- Allow the sampling system to operate for the predetermined duration. If the sampling system is in use for more than 24 hours, the initial calibration should be audited every 24 hours. If the resultant value for the check is +/- 7 percent of the initial calibration, the sampling system must be recalibrated.

The following procedure will be used for air sampling of metals, and is based on USEPA ERT SOP #2119:

- Assemble the sampling trains with clean filter cassettes. Verify the pump calibration by removing the inlet plug from the cassette, attaching a rotameter with Tygon tubing and turning on the sampling pump. Check to make sure all the connections are tight.
- Record the actual flow rate on an appropriate data sheet and/or in the field logbook. Replace the inlet plug until ready to sample.
- Set the sampling pump timer (low volume pumps) for the predetermined sampling time, or record the elapsed timer on the data sheet/logbook. This will be determined based on the type of pump being used.
- Deploy sampling pumps at sampling locations. Remove the cassette cap or inlet plug from the cassette. Sampling for elements can be conducted with the cassettes open-faced (cassette cap removed) or closed-faced (only inlet port plug removed). Open-faced is preferred because it allows even loading of the filter cassette and should be used whenever high particulate concentrations are expected in order to allow greater particulate loading of the filter. Closed-faced sampling is performed when there is a possibility that the sample may be shaken and particulates may be lost.
- Turn on the sampling pump and let it run for the predetermined sampling period.
- After the sampling period is over, verify the sampling period by reading the sample run time (low volume pumps) or by checking the elapsed time on the counter (medium volume pumps). Record the length of sampling time on the data sheet and/or in the field logbook. Turn off the pump.
- Verify the pump calibration by attaching a rotameter with Tygon tubing and turning on the sampling the inlet plug.
- Remove the sampling cassette from the sampling train and insert the outlet plug. Calculate sample volume.

14.0 GEOPHYSICAL AND SOIL GAS SURVEYS

When specified in the Site-Specific Work Plan, geophysical and soil gas surveys will be carried out at the site with the primary objective being to delineate areas of possible subsurface impacts from former MGP operations. Delineation of impacted areas will allow for a more focused and efficient sampling program during subsequent phases. Sampling locations may be located downgradient of potential historical MGP operations areas to determine if these areas act as contaminant sources. Also, boring locations can be adjusted to avoid large subsurface metallic bodies, thereby minimizing the potential for release of hazardous material from buried containers, and avoiding the expense associated with multiple boring attempts due to subsurface refusal. Furthermore, additional valuable subsurface information may be derived from this study, including:

- Delineation of underground structures(i.e. holder, and tar well);
- Mapping of existing site utilities and former MGP utilities; and,
- Detection of underground storage tanks (USTs) and/or other potential contaminant source areas.

If potential historical MGP operations areas prove to act as contaminant sources, the results of the geophysical investigation may also provide important information necessary for an Interim Removal action.

14.1 Geophysical Survey GPR and TDEMI

Two geophysical methods can be used for the geophysical survey: Time-domain Electromagnetic Induction (TDEMI) and ground penetrating radar (GPR). TDEMI can detect ferrous and non-ferrous metallic objects, such as a single 55-gallon drum, at a depth of up to 3 m (10 ft) bgs; GPR can detect both metallic and non-metallic subsurface targets at depths varying from several centimeters up to 20 m (65 ft bgs) or more, dependent upon frequency of induced waves, soil conductivity, and presence of extremely reflective interfaces. GPR can also be utilized to locate void spaces, detect disturbed soil or differential fill, and map Site Stratigraphy.

The TDEMI system utilized at the site will be the Geonics EM61 High Sensitivity Metal Detector or similar equipment. The EM61 is a one-person portable system designed primarily for industrial site assessment. The EM61 is relatively insensitive to nearby surface cultural interferences such as buildings, powerlines, and fences, and has the ability to record digital data at 0.17 second intervals, which translates to a spatial sample density of approximately 0.17 m (0.55 ft) along the ground surface.

The GPR system utilized at the site will be the Geophysical Survey Systems, Inc. (GSSI) SIR-2, or equivalent and will be equipped with both 200 and 500 MHZ antennas. The GSSI SIR-2 is a monostatic GPR system, in which a single antenna is used as the transmitter and receiver. The antennas are shielded to ensure a high proportion of the energy produced is focused into the subsurface, decreasing noise from surrounding fences, buildings, and other features. The GPR reflection section is displayed in real time as data is acquired, and an analog record is output by an in-the-field printer. Data is also digitally logged to a high-capacity drive at a rate of 32 scans/second, which translates to a spatial sample density of approximately 0.03 m (0.1 ft) along the ground surface.

Geophysical Survey Ground Penetrating Radar (GPR) and Time-Domain Electromagnetic Induction (TDEMI)

The geophysical investigation will encompass all areas suspected of former MGP operations. The survey area will be run over both paved and vegetative cover and will be divided into four (4) subplots ranging in size from 0.2 to 0.5 acres. The EM61 data will be acquired using a Leica system 530 Global Positioning System (GPS), or equivalent equipment, for navigational control. GPS data will be captured in one second intervals, utilizing the real-time kinematic (RTK) mode, which provides centimeter-grade positional accuracy. GPR data will be acquired along a pre-established orthogonal grid system, with line and station spacing appropriate for detection of targets of interest.

Concurrent with geophysical data acquisition, cultural features maps will be developed which will detail the location of potential interferences such as buildings, fences, utilities, etc. These maps will be utilized in the interpretation stage to more accurately assess the significance of geophysical anomalies observed in the data.

TDEMI data will be processed and interpreted using manufacturer-supplied software. TDEMI data will be interpolated to accurate State Name Planar coordinates with appropriate shifts and filters applied, and data extrapolated to a regularly spaced grid system using accepted mathematical methods. These data will then be displayed as high-resolution color maps. Proprietary software will then be utilized to isolate and characterize subsurface anomalies potentially related to steel structures or buried drums.

GPR data will be processed and interpreted using WINRAD and/or GRADIX software packages or equivalent. Processing may include "rubber sheeting" of data to appropriate coordinates, application of appropriate gains and filters, display of color-coded GPR sections, and advanced processing techniques, such as migration and deconvolution. Diffraction hyperbolas or other discrete anomalies will be identified and characterized and compared with locations of EM61 anomalies. GPR anomalies, which occur in areas free of EM61 anomalies can be attributed to non-metallic targets, and may be associated with plastic barrels.

A final report including description of data collected, maps of the geophysical data, and interpretation of these data will be included in the Final Report.

Geophysical Survey Ground Penetrating Radar (GPR) and Time-Domain Electromagnetic Induction (TDEMI) Procedure

The geophysical survey will be conducted using the following procedure:

1. Clear the surface of the area to be surveyed (performed by clearing and grubbing subcontractor). This may include cutting underbrush to a height less than 0.3m (1 foot), removing trees less than 7.5 cm (3 inches) in diameter, removing brush, and mowing grasses greater than 0.6m (2 feet) in height. A sweep for metal objects on the ground surface will be conducted, and surficial metal identified will be noted and removed from the area of investigation.

2. Establish survey control within the investigation area. Survey markers will be installed both within and around the boundary of the survey area, and these points will be utilized to establish and calibrate the GPS base station.

3. Acquire data from each instrument from a test line prior to commencement of each day's activities. This test line will be performed over a known subsurface object or over a pre-placed object (such as a steel pipe).

4. Obtain GPS reading at a known survey point.

5. Begin survey at the southwest corner of the investigation area (or a subdivision of the investigation area) and progress northward (or eastward) until the area boundary or a major obstruction is encountered. TDEMI data will be acquired at a sampling rate of approximately 6 samples per second, which translates to a sample density of 1 sample every 0.17 meters (0.55 feet) based on an average walking pace. GPS data will be acquired concurrently with TDEMI data, at a rate of [1 sample] per second. GPR readings will be acquired at a sampling rate of approximately 32 scans per second, which translates to a sample density of 1 sample every 0.03 meters (0.1 feet) based on an average walking pace.

6. After reaching the grid boundary or obstruction, reverse direction, and acquire survey data in the opposite direction along a parallel line at the following line spacing: 1 meter (3 ft) for TDEMI readings and 2-meters (6 ft) for GPR readings.

7. Continue acquiring data in opposing directions, until the entire investigation area has been covered.

8. Acquire several lines of TDEMI data over a known linear metallic object placed upon the

ground surface. This procedure will allow for accurate time shifting of geophysical data necessary for merging the geophysical and GPS data.

9. Acquire data from the test line subsequent to each day's activities, for quality assurance comparison.

10. Obtain GPS reading at known survey point for QA comparison.

14. 2 Geophysical Survey Magnetometer and FDEMI

A geophysical investigation to delineate areas of possible subsurface impacts can be performed by utilizing two geophysical methods: magnetometry and frequency-domain electromagnetic induction (FDEMI).

Geophysical data will be collected using two instruments: a Geometrics G-858G magnetometer (configured as a vertical gradiometer and including a continuous-recording base station) and a Geonics EM31-MK2 ground conductivity meter or equivalent equipment. Positional data will be verified by utilizing a Leica System 530 GPS system, or equivalent, for navigational control. GPS data will be captured at one second intervals, utilizing the real-time kinematic (RTK) mode, which provides centimeter-grad positional accuracy.

Geophysical Survey Magnetometry and Frequency-Domain Electromagnetic Induction (FDEMI) Procedure

The geophysical survey will be conducted using the following data collection procedure:

1. Clear the surface of the area to be surveyed (performed by clearing and grubbing subcontractor). This may include cutting underbrush to a height less than 1 foot, removing trees less than 3 inches in diameter, removing brush, and mowing grasses greater than 2 feet in height. A sweep for metal objects on the ground surface will be conducted, and surficial metal identified will be noted and removed from the area of investigation.

2. Establish survey control within the investigation area. Survey markers will be installed both within and around the boundary of the survey area, and these points will be utilized to establish positional control, as well as calibrate the GPS base station.

3. Acquire data from a test line prior to commencement of each day's activities. This test line will be performed over a known subsurface object or over a pre-placed object (such as a steel pipe).

4. Set up magnetometer base station.

5. Begin survey at the southwest corner of the investigation area (or a subdivision of the investigation area) and progress northward (or eastward) until the area boundary or a major obstruction is encountered. Magnetometry data will be acquired at a sampling rate of approximately 10 samples per second, which translates to a sample density of 1 sample every 0.1 meters (0.33 feet) based on an average walking pace. FDEMI conductivity readings will be acquired at a sampling rate of approximately 2.5 samples per second, which translates to a sample density of 1 sample every 0.4 meters (1.3 feet) based on an average walking pace. GPS data will be acquired concurrently with geophysical data, at a rate of 1 sample per second.

6. After reaching the boundary or obstruction, reverse direction, and acquire survey data in the opposite direction along a parallel line at the following line spacing: 1 meter for magnetometer readings and 2 meters for conductivity readings.

7. Continue acquiring data in opposing directions, until the entire investigation area has been covered.

8. Acquire several lines of geophysical data for a known linear metallic object placed upon the ground surface. This procedure will allow for accurate time shifting of geophysical data necessary for merging the geophysical and GPS data.

9. Repeatedly (at least 3 times per day) revisit a calibration station and collect data with the EM31, in order to provide for an instrument drift correction.

10. Acquire data from the test line subsequent to each day's activities, for quality assurance comparison.

The geophysical data will be processed and interpreted using manufacturer-supplied software. Data will be interpolated to NYS State Plane coordinates, filtered as appropriate, extrapolated to a grid system, and displayed on maps of the Site.

14.3 Downhole Geophysics

Downhole gamma-ray geophysical logging, if required in the Site Specific Work Plan, will be conducted by a utilizing existing wells or soil borings as they are completed. Gamma-ray logging may be conducted in cased as well as uncased boreholes, and, because clays typically contain a higher percentage of gamma emitting minerals, can be useful for identification and correlation of clayey zones. The gamma-ray log can provide information on stratigraphic changes in the subsurface soils.

1. Be certain that the well has ample clearance for the gamma probe to pass without obstruction or binding. A dummy cylinder with the same diameter as the gamma log tool may be lowered downhole as a test for obstructions. Downhole may be performed if significant uncertainty exists. Wear appropriate health and safety equipment.

2. Set the tripod over the wellhead and park the mobile unit at a convenient location.

3. Slowly and carefully lower the probe to the bottom of the well with the logger recording the counts per second (cps) of gamma radiation. The descent is a "dry" run until the well bottom is attained.

4. Set the plotter so the gamma-ray logging is recorded on a graph. Set the upward speed at a constant rate. Bring the probe to the surface.

5. If the graph is successfully plotted, perform appropriate decontamination on the probe and the line and proceed to the next logging location.

14.4 Soil Gas Survey

A soil gas survey, if required by the Site-Specific Work Plan, will be performed around the Site to delineate areas of possible subsurface impacts and potential source areas. A sampling grid of approximately 100 feet by 100 feet or depending on the size of the investigation area, will be utilized across a majority of the Site, with soil gas samples collected at the grid nodes. Additional soil gas samples will be collected at 25 foot by 25 foot grid nodes in the vicinity of the potential test pit locations, and at any other additional areas determined during the field investigation (e.g., elevated levels present during real-time sampling, etc.). Actual sampling locations will be adjusted in the field to ensure sample targeting of all suspected areas of subsurface impacts. A field gas chromatograph (GC) will be used to determine sample screening concentrations of volatile organic compounds (VOCs). Water table, barometric, and temperature changes can vary the results.

The FOL or his designee, will be present on-site during active soil gas collection activities. The following soil gas survey activities will occur:

- Location of the soil gas survey locations;

- Comparison of the field GC data with applicable quality assurance data to determine acceptability of results;

- Determination of the need for additional or a reduction in the number of soil gas survey points;
- Supervision of the topographic surveying to locate the sampling points;
- Review of the data analysis and evaluation from the soil gas survey report; and
- Recommendation for movement of the proposed field investigation sampling locations based on the soil gas survey results.

Soil Gas Survey Procedure

1. Record ambient air temperature and barometric pressure.

2. Drill a hole into the soil either by hand auger, rotary hammer, or driven rod (as conditions dictate), to roughly 4 to 5 feet in depth. The depth may be reduced based upon conditions at the Site at the time of sampling; all changes will be noted on Field Change Requests (see Section 13.0 of the QAPP).

3. Insert a probe, slightly smaller in diameter than the borehole, into the hole, and the hole will be sealed by packing soil around the expansion bulb at the probe top. The probe assembly will be selected by the soil gas crew and FOL, to provide the best probe assembly for the Site conditions. A typical assembly would consist of a 1/4-inch O.D. stainless steel probe, approximately 5-feet in length, and Teflon tubing, with a reducing tee and cap attached to the fitting.

4. Ensure/test vacuum with a gauge attached to the probe.

5. Extract soil gas through the probe via a vacuum pump connected to the tubing. Purge approximately 3 to 5 sample volumes prior to sampling to remove any introduced ambient contamination.

6. Remove the soil gas sample with a 500 uL gas-tight syringe or equivalent device, inserted into the tubing in front of the pump. This volume is adequate for achieving the required detection limit of 25 ug/L. If necessary, due to field conditions, the sample can be stored in a pressurized container.

7. Immediately inject the sample into the calibrated GC (see Step 8), and plot the chromatogram. Identify and quantify, based on standard peaks, any contaminants present in the soil gas

sample.

8. Calibrate the GC prior to sample analysis. Initial instrument calibration should consist of a minimum of 3 concentration points (5 points are preferred), to demonstrate the working range and linearity. Linearity will be assumed if the ratio of the area response to the amount injected is constant over the working range (i.e., less than 20 percent Relative Standard Deviation). In addition, an initial verification of a less than 25 ug/L detection limit shall be run.

9. Check the sample probe for contamination between each sample location, by drawing ambient air through the probe via the pump, and checking that the response is not greater than background levels. If necessary, decontaminate the probes using methanol and deionized water, and then air drying.

Calibration standards will be run at the beginning and end of each sampling day, and a method blank shall be analyzed every 12 hours and after any highly contaminated samples to check for carry-over. In addition, an environmental field duplicate will be chosen and analyzed every 20 samples.

15.0 FIELD INSTRUMENTS

All field analytical equipment will be calibrated immediately prior to each day's use and more frequently if required. A calibration log will be created on which all equipment calibration will be recorded. Further details on calibration, precision, accuracy, etc. are provided in the Generic QAPP (Volume II). The calibration procedures will conform to manufacturer's standard instructions. This calibration will ensure that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. If an equipment malfunction is identified during calibration then the malfunctioning equipment will be replaced or repaired within 24-hours or applicable fieldwork will be terminated as necessary until the malfunctioning equipment is repaired or replaced. Records of all instrument calibration will be maintained by the Field Operations Leader (FOL) and will be subject to audit by the Project Quality Assurance Manager (PQAM). Copies of all of the instrument manuals will be maintained on-site by the FOL.

15.1 Portable Photoionization Detector

The photoionization detector (PID) will be equipped with a minimum 10.6 eV lamp. The PID should be capable of ionizing and detecting compounds with an ionization potential of less than 10.6 eV. This accounts for up to 73% of the volatile organic compounds on the NYSDEC ASP Target Compound List. Calibration will be performed at the beginning and end of each day of use with a standard calibration gas specified by the manufacturer. If the unit experiences abnormal perturbation or erratic readings, additional calibration will be required. All calibration data will be recorded in field logbooks and on calibration log sheets to be maintained on-site by the FOL.

A battery check will be completed at the beginning and end of each working day. If erratic readings are experienced, the battery will be checked for proper voltage. This information will also be recorded in field logbooks and on the calibration log sheets.

15.2 pH Meter

Calibration of the pH meter will be performed at the start of each day of use, and after very high or very low readings. National Institute of Standards and Technology - traceable standard buffer solutions, which bracket the expected pH range, will be used. The standards will most likely be pH of 7.0 and 10.0 standard units. The use of the pH calibration and slope knobs will be used to set the meter to display the value of the standard being checked. The pH meter readings during calibration must be within 0.1 of the reference solution. The calibration data will be recorded on calibration sheets maintained on-site by the FOL.

15.3 Specific Conductivity Meter

Calibration checks using the conductivity standard will be performed at the start of each day of use, after five to ten readings or after very high or low readings. The portable conductivity meter will be calibrated on a daily basis using a reference solution specified by the manufacturer. Readings must be within 5 percent to be acceptable. The thermometer of the meter will be calibrated against the field laboratory thermometer on a weekly basis.

15.4 Turbidity Meter

Calibration using a turbidity standard will be performed at the start of each day of use and after very high or low readings. The portable turbidity meter will be calibrated using a reference solution specified by the manufacturer. The turbidity reading must be within ±2 NTU of the standard to be acceptable.

15.5 DO Meter

Calibration using a DO standard will be performed at the start of each day of use. The portable DO meter will be calibrated using a calibration solution specified by the manufacturer. The DO reading must be within 5% of the standard to be acceptable.

15.6 Combustible Gas Indicator

Calibration of the CGI will conform to the procedures prescribed in the Generic Environmental Health and Safety Plan (Volume II). Calibration will occur at the start of each day of use.

16.0 MANAGEMENT OF INVESTIGATION DERIVED WASTE

During the implementation of field activities, investigation derived wastes (IDW) will be generated at the Site. These IDWs will include the following: soil drilling mud/water, development and purge water, decontamination wash water, PPE, polysheeting, spent decontamination fluids, etc. Following the generation of these IDWs, they will be properly containerized in 55-gallon drums, frac tanks, agricultural poly tanks, and/or roll-off containers. PPE will be bagged and placed in 55-gallon drums. The containers will be properly labeled with the date of generation, the Site name, client name and address, contents of the containers, etc. Upon generation the IDW will be immediately containerized. The containers will be secured at the end of each day at the Site. The containers will be segregated on-site in a temporary fenced area and signs stating "Do Not Enter" will be posted on the fencing. Upon completion of the field activities, the containers will be sampled for disposal characteristics. IDW materials will be removed from the Site and shipped to an approved facility. Waste handling procedures and regulations will be strictly adhered to during all phases of waste handling.

17.0 REFERENCES:

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TABLES

Table 1
METHOD FOR IDENTIFYING AND LABELING SAMPLES

LLLL*	LL*	NN*	NN/NNNN*
Site	Sample Type	Sample Location	Depth/Time

Site :

Sample Type: Monitoring Well (MW), Surface Soil (SS), Subsurface Soil (SB), Sediment (SD), Surface Water (SW), Waste Water (WW), Solid Waste (WA)

Sample Number: Number referenced to a sample location map illustrated in the Site-Specific Work Plan.

* L = Letter
* N = Number

FIGURES

Figure 1

LOG OF BORING

(Page 1 of 1)

PROJECT:
PROJECT NO.:
LOCATION:

DATE STARTED: :
DATE COMPLETED: :
GEOLOGIST: :
DRILLER: :
DRILLING METHOD: :

GW DEPTH: :
ELEVATION: :

Depth in feet	RECOVERY	USCS	GRAPHIC	DESCRIPTION	TIME	DATE	PID (ppm)	Sample I.D.	COMMENTS
0									
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
14									
15									
16									
17									
18									
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34									
35									
36									

Notes:

LOG OF BORING

(Page 1 of 1)

PROJECT:
PROJECT NO.:
LOCATION:

DATE STARTED: :
DATE COMPLETED: :
GEOLOGIST: :
DRILLER: :
DRILLING METHOD: :

GW DEPTH: :
ELEVATION: :

Depth in feet	RECOVERY	USCS	GRAPHIC	DESCRIPTION	TIME	DATE	PID (ppm)	Sample I.D.	COMMENTS
0									
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
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36									

Notes:

FOSTER WHEELER

10-18-2001 P:\Front Street\Boring Logs\Blank BOR

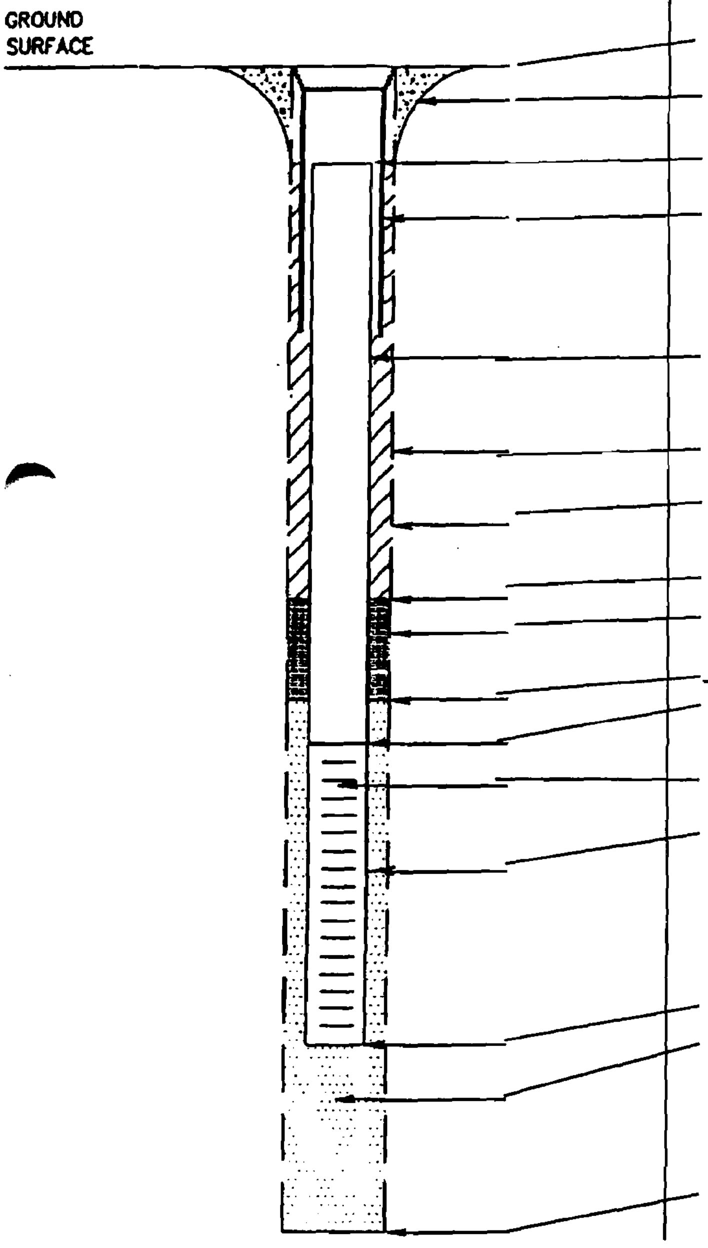
Figure 2

UNCONSOLIDATED MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO. ____________

PROJECT ____________
PROJECT NO. ____________
DATE ____________ BORING NO.: ____________
ELEVATION ____________
LOGGED BY: ____________

DRILLER ____________
DRILLING METHOD ____________
DEVELOPMENT METHOD ____________



ELEVATION OF TOP OF SURFACE CASING: ________
TYPE OF SURFACE SEAL: ____________
GROUND SURFACE ELEVATION: ________
ELEVATION OF TOP OF RISER: ________

I.D. OF SURFACE CASING: ____________
TYPE OF SURFACE CASING: ____________

RISER PIPE I.D. ____________
TYPE OF RISER PIPE: ____________

BOREHOLE DIAMETER: ____________

TYPE OF BACKFILL: ____________

ELEVATION/DEPTH TOP OF SEAL: ________
TYPE OF SEAL: ____________

ELEVATION/DEPTH TOP OF SAND PACK: ________
ELEVATION/DEPTH TOP OF SCREEN: ________

TYPE OF SCREEN: ____________
SLOT SIZE X LENGTH: ____________
TYPE OF SAND PACK: ____________

ELEVATION/DEPTH BOTTOM OF SCREEN: ________
ELEVATION/DEPTH BOTTOM OF SAND PACK: ________
TYPE OF BACKFILL BELOW OBSERVATION WELL: ____________

ELEVATION/DEPTH OF HOLE:

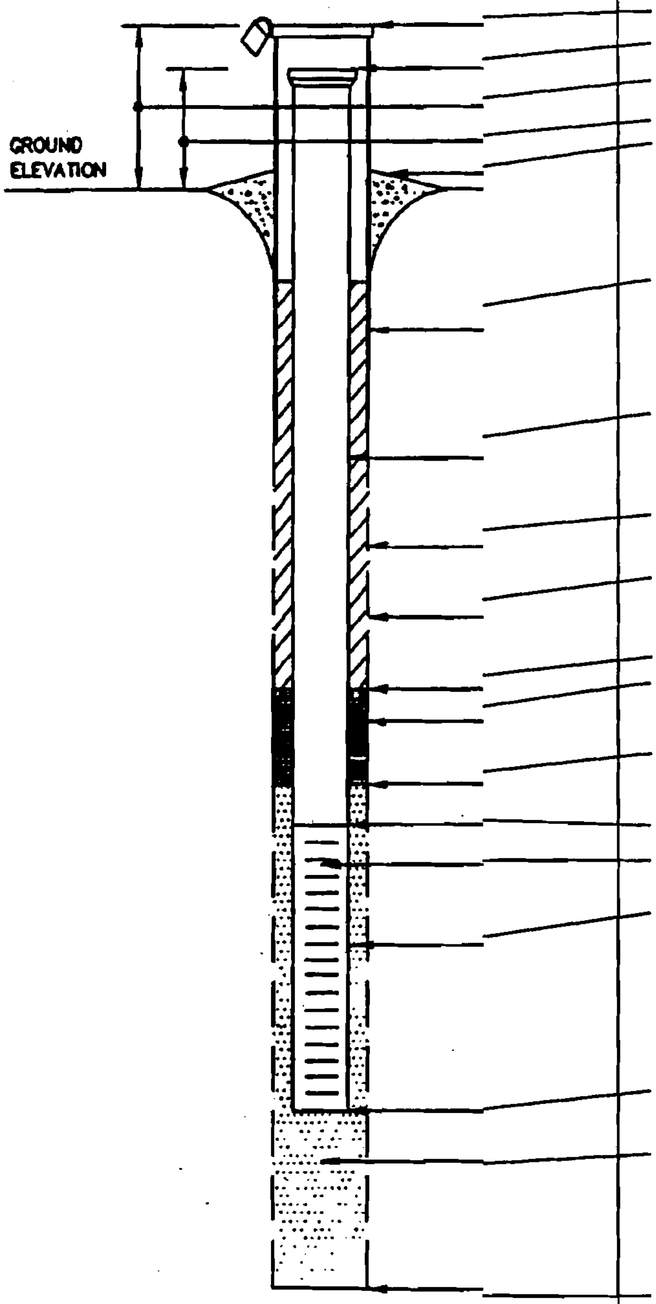
Figure 3

OVERBURDEN
MONITORING WELL
CONSTRUCTION DIAGRAM

WELL NO. ____________

ROJECT ____________
ROJECT NO. ____________
ATE ____________ BORING NO.: ____________
LEVATION ____________
IELD GEOLOGIST ____________

DRILLER ____________
DRILLING
METHOD ____________
DEVELOPMENT
METHOD ____________



ELEVATION OF TOP OF SURFACE CASING: ____________
ELEVATION OF TOP OF RISER PIPE: ____________
STICK-UP TOP OF SURFACE CASING: ____________
STICK-UP RISER PIPE: ____________
TYPE OF SURFACE SEAL: ____________

I.D. OF SURFACE CASING: ____________
TYPE OF SURFACE CASING: ____________

____

RISER PIPE I.D. ____________
TYPE OF RISER PIPE: ____________

BOREHOLE DIAMETER: ____________

TYPE OF BACKFILL: ____________

____
ELEVATION/DEPTH TOP OF SEAL: ____________
TYPE OF SEAL: ____________

____
DEPTH TOP OF SAND PACK: ____________

ELEVATION/DEPTH TOP OF SCREEN: ____________
TYPE OF SCREEN: ____________
SLOT SIZE X LENGTH: ____________
TYPE OF SAND PACK: ____________

____

ELEVATION/DEPTH BOTTOM OF SCREEN: ____________
ELEVATION/DEPTH BOTTOM OF SAND PACK: ____________
TYPE OF BACKFILL BELOW OBSERVATION
WELL: ____________

____
ELEVATION/DEPTH OF HOLE: ____________

NOT TO SCALE

NOT TO SCALE

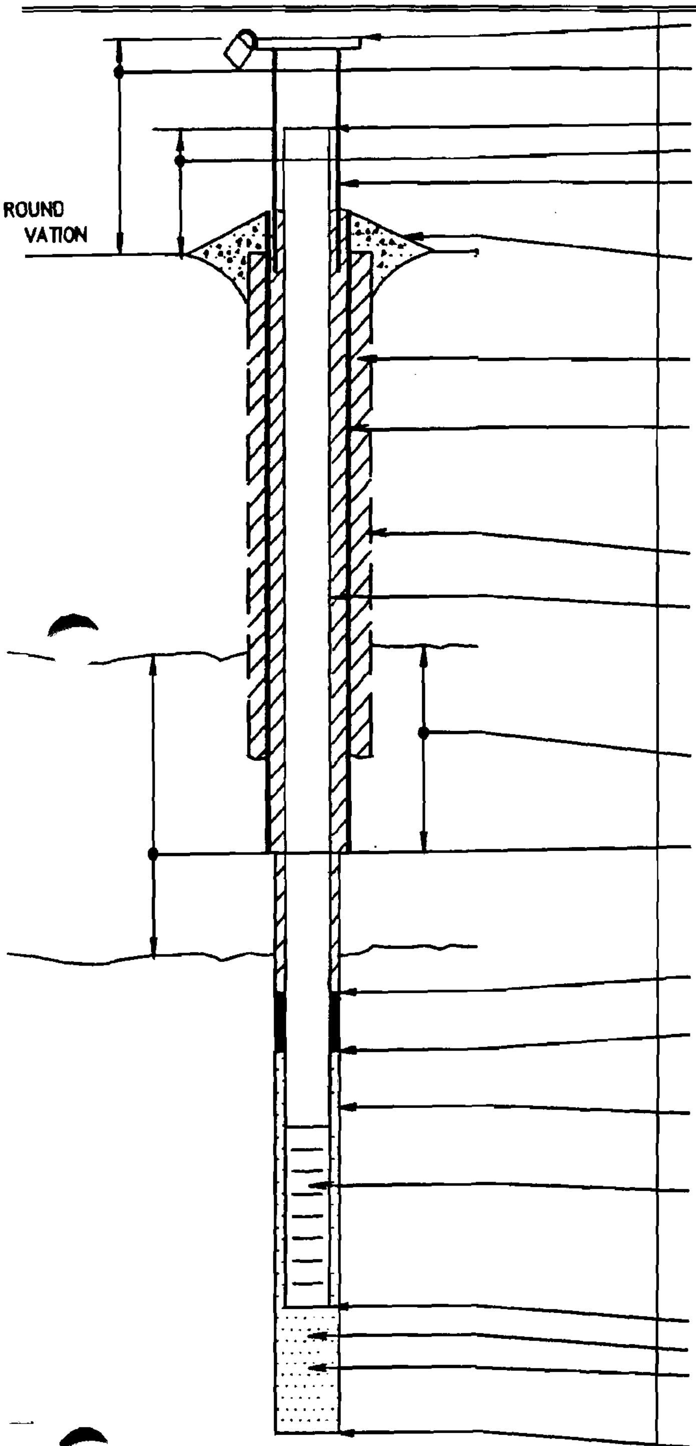
Figure 4

DOUBLE CASED MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO. _____

ROJECT _____
ROJECT NO. _____
TE _____ BORING NO.: _____
EVATION _____
IELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION OF TOP OF CASING: _____
STICK-UP OF CASING ABOVE GROUND SURFACE _____
ELEVATION OF TOP OF RISER PIPE: _____
STICK-UP RISER PIPE: _____
I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____
TYPE OF SURFACE SEAL: _____
_____

TYPE OF BACKFILL: _____
I.D. OF UPPER AQUIFER CASING: _____
TYPE OF UPPER AQUIFER CASING: _____

BOREHOLE DIAMETER/DEPTH: _____

I.D.OF RISER: _____
TYPE OF RISER: _____

DEPTH CASING IS SET IN CONFINING LAYER: _____

APPROXIMATE THICKNESS OF CONFINING LAYER: _____

ELEVATION/DEPTH TOP OF SEAL: _____
TYPE OF SEAL: _____
DEPTH TOP OF SAND PACK: _____
TYPE OF SAND PACK: _____
BOREHOLE DIAMETER: _____

TYPE OF SCREEN: _____
SLOT SIZE X LENGTH: _____
I.D. OF SCREEN: _____

ELEVATION/DEPTH BOTTOM OF SCREEN: _____
ELEVATION/DEPTH BOTTOM OF SAND PACK: _____
TYPE OF BACKFILL BELOW OBSERVATION WELL: _____
ELEVATION/DEPTH OF HOLE _____

(NOT TO SCALE)

Figure 5

WELL PURGE DATA SHEET

PROJECT NAME: ______________________

PROJECT No.: ______________________

DATE: ______________________

Well I.D.: ________________

Casing Volume

Well Diameter (d) = ________ ft

Well Radius (r_w) = ________ ft

Well Depth (TD) = ________ ft

Static Water Level (WL)= ________ ft

Height of Water in Well (T):

T = TD (ft) - WL (ft)

T = ______ - ______

T = ______ ft

Gallons of Water per Well Volume (Casing):

$V_C = 0.163 \times T(\text{ft}) \times r_w(\text{in})^2$

$V_C = 0.163 \times \_\_ \times \_\_^2$

$V_C =$ ______ gallons

Filter Pack Volume

Borehole Diameter (d_b) = ________ ft

Borehole Radius (r_b) = ________ ft

Depth to Top of Filter Pack (D_f) = ______ ft

P = estimated porosity of filter pack

Height of Water in Filter Pack (T_F)

$T_F = TD - WL^1 (\text{or } TFP^2)$

$T_F =$ ______ - ______

$T_F =$ ______ ft

Gallons of Water per Filter Pack Volume

$V_F = (0.163 \times r_b^2 - 0.163 \times r_w^2) \times T_F \times P$

$$V_T = V_C + V_F$$

Total Volume Purged: **Design =** ______ **gallons**

Actual = ______ **gallons**

Water Quality:

	pH (SU)	Spec. Conduct (umhos/cm)	Temp. (°C)	Eh (mV)	D.O. (ml/L)
Initial					
Volume 1					
Volume 2					
Volume 3					
Volume 4					
Volume 5					

Purge Method: ____ Suction Pump ____ Submersible Pump ____ Bailer ____ Other__________

Notes/Observations: ____

____

____

~~FWENC~~ Sampler(s) Present: ______________________________________

1. From Top of Inner Casing
2. Top of Filter Pack - used if entire filter pack saturated

Figure 6

SAMPLE LOG SHEET

I. SAMPLE IDENTIFICATION

Project: ______ Project No.:
Client: ______ Project Manager: ______
Sample Name/Number: ______ Date: ______ Time: ______ Hrs
Sampling Location/Depth: ______ Type: ______ Grab ______ Composite
Sample Matrix: ______ Surface Water ______ Groundwater ______ Sediment
______ Soil ______ Waste
______ Other (Specify) ______

Sampled By: ______

II. SAMPLE SOURCE

______ Well
______ Drum
______ Bldg/Structures
______ Test Pit/Trench
______ Outfall
______ Boring
______ Tank
______ Other (Specify)
______ Leachate
______ River/Stream
______ Impoundment
______

Source Description ______

III. FIELD OBSERVATIONS/MEASUREMENTS

Appearance/Color: ______
Volatile Organic Analysis (VOA): ______ HNU ______ OVA ______ Other
VOA Readings: Off Sample ______ Respiratory Zone ______
LEL/O_2/H_2S Readings: LEL ______ O_2 ______ H_2S ______
Radioactivity (mR/hr): ______
pH: ______ Conductivity: ______ Temperature: ______
Salinity: ______ Other: ______
Observations: ______

IV. SAMPLE DISPOSITION

Preservation: ______
Laboratory Name: ______
Laboratory Location: ______ On-Site ______ Off-Site
Forwarded to Laboratory: Date: ______ Time: ______ Hrs
Laboratory Sample No.: ______
Chain of Custody No.: ______ Airbill No.: ______

V. ADDITIONAL REMARKS

ATTACHMENTS

ATTACHMENT A

GROUNDWATER ISSUE – DENSE NONAQUEOUS PHASE LIQUIDS

Environmental Protection Agency

Research and Development

Office of Solid Waste and Emergency Response

EPA/540/4-91-002
March 1991

EPA Ground Water Issue

DENSE NONAQUEOUS PHASE LIQUIDS

Scott G. Huling[*] and James W. Weaver[**]

Background

The Regional Superfund Ground Water Forum is a group of EPA professionals representing EPA's Regional Superfund Offices, committed to the identification and the resolution of ground water issues impacting the remediation of Superfund sites. The forum is supported by and advises the Superfund Technical Support Project. Dense nonaqueous phase liquids is an issue identified by the Forum as a concern of Superfund decision-makers. For further information contact Scott G. Huling (FTS:743-2313), Jim Weaver (FTS:743-2420), or Randall R. Ross (FTS: 743-2355).

Introduction

Dense nonaqueous phase liquids (DNAPLs) are present at numerous hazardous waste sites and are suspected to exist at many more. Due to the numerous variables influencing DNAPL transport and fate in the subsurface, and consequently, the ensuing complexity, DNAPLs are largely undetected and yet are likely to be a significant limiting factor in site remediation. This issue paper is a literature evaluation focusing on DNAPLs and provides an overview from a conceptual fate and transport point of view, DNAPL phase distribution, monitoring, site characterization, remediation, and modeling.

A nonaqueous phase liquid (NAPL) is a term used to describe the physical and chemical differences between a hydrocarbon liquid and water which result in a physical interface between a mixture of the two liquids. The interface is a physical dividing surface between the bulk phases of the two liquids, but compounds found in the NAPL are not prevented from solubilizing into the ground water. Immiscibility is typically determined based on the visual observation of a physical interface in a water- hydrocarbon mixture. There are numerous methods, however, which are used to quantify the physical and chemical properties of hydrocarbon liquids (31).

Nonaqueous phase liquids have typically been divided into two general categories, dense and light. These terms describe the specific gravity, or the weight of the nonaqueous phase liquid elative to water. Correspondingly, the dense nonaqueous phase liquids have a specific gravity greater than water, and the light nonaqueous phase liquids (LNAPL) have a specific gravity less than water.

Several of the most common compounds associated with DNAPLs found at Superfund sites are included in Table 1. These compounds are a partial list of a larger list identified by a national screening of the most prevalent compounds found at Superfund sites (65). The general chemical categories are halogenated/non-halogenated semi-volatiles and halogenated volatiles. These compounds are typically found in the following wastes and waste-producing processes: solvents, wood preserving wastes (creosote, pentachlorophenol), coal tars, and pesticides. The most frequently cited group of these contaminants to date are the chlorinated solvents.

DNAPL Transport and Fate - Conceptual Approach

Fate and transport of DNAPLs in the subsurface will be presented from a conceptual point of view. Figures have been selected for various spill scenarios which illustrate the general behavior of DNAPL in the subsurface. Following the conceptual approach, detailed information will be presented explaining the specific mechanisms, processes, and variables which influence DNAPL fate and transport. This includes DNAPL characteristics, subsurface media characteristics, and saturation dependent parameters.

Unsaturated Zone

Figure 1 indicates the general scenario of a release of DNAPL into the soil which subsequently migrates vertically under both the forces of gravity and soil capillarity. Soil capillarity is also responsible for the lateral migration of DNAPL. A point is reached at which the DNAPL no longer holds together as a continuous phase, but rather is present as isolated residual globules. The fraction of the hydrocarbon that is retained by capillary forces in the porous media is referred to as residual

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Superfund Technology Support Center for Ground Water

**Robert S. Kerr Environmental Research Laboratory
Ada, Oklahoma**

Technology Innovation Office
Office of Solid Waste and Emergency Response, US EPA, Washington, D.C.

Walter W. Kovalick, Jr., Ph.D.
Director

Table 1. Most prevalent chemical compounds at U.S. Superfund Sites (65) with a specific gravity greater than one.

Compound	Density [1]	Dynamic[2] Viscosity	Kinematic Viscosity[3]	Water[4] Solub.	Henry's Law Constant[5]	Vapor[6] Pressure
Halogenated Semi-volatiles						
1,4-Dichlorobenzene	1.2475	1.2580	1.008	8.0 E+01	1.58 E-03	6 E-01
1,2-Dichlorobenzene	1.3060	1.3020	0.997	1.0 E+02	1.88 E-03	9.6 E-01
Aroclor 1242	1.3850			4.5 E-01	3.4 E-04	4.06 E-04
Aroclor 1260	1.4400			2.7 E-03	3.4 E-04	4.05 E-05
Aroclor 1254	1.5380			1.2 E-02	2.8 E-04	7.71 E-05
Chlordane	1.6	1.1040	0.69	5.6 E-02	2.2 E-04	1 E-05
Dieldrin	1.7500			1.86 E-01	9.7 E-06	1.78 E-07
2,3,4,6-Tetrachlorophenol	1.8390			1.0 E+03		
Pentachlorophenol	1.9780			1.4 E+01	2.8 E-06	1.1 E-04
Halogenated Volatiles						
Chlorobenzene	1.1060	0.7560	0.683	4.9 E+02	3.46 E-03	8.8 E+00
1,2-Dichloropropane	1.1580	0.8400	0.72	2.7 E+03	3.6 E-03	3.95 E+01
1,1-Dichloroethane	1.1750	0.3770	0.321	5.5 E+03	5.45 E-04	1.82 E+02
1,1-Dichloroethylene	1.2140	0.3300	0.27	4.0 E+02	1.49 E-03	5 E+02
1,2-Dichloroethane	1.2530	0.8400	0.67	8.69 E+03	1.1 E-03	6.37 E+01
Trans-1,2-Dichloroethylene	1.2570	0.4040	0.321	6.3 E+03	5.32 E-03	2.65 E+02
Cis-1,2-Dichloroethylene	1.2480	0.4670	0.364	3.5 E+03	7.5 E-03	2 E+02
1,1,1-Trichloroethane	1.3250	0.8580	0.647	9.5 E+02	4.08 E-03	1 E+02
Methylene Chloride	1.3250	0.4300	0.324	1.32 E+04	2.57 E-03	3.5 E+02
1,1,2-Trichloroethane	1.4436	0.1190	0.824	4.5 E+03	1.17 E-03	1.88 E+01
Trichloroethylene	1.4620	0.5700	0.390	1.0 E+03	8.92 E-03	5.87 E+01
Chloroform	1.4850	0.5630	0.379	8.22 E+03	3.75 E-03	1.6 E+02
Carbon Tetrachloride	1.5947	0.9650	0.605	8.0 E+02	2.0 E-02	9.13 E+01
1,1,2,2-Tetrachloroethane	1.6	1.7700	1.10	2.9 E+03	5.0 E-04	4.9 E+00
Tetrachloroethylene	1.6250	0.8900	0.54	1.5 E+02	2.27 E-02	1.4 E+01
Ethylene Dibromide	2.1720	1.6760	0.79	3.4 E+03	3.18 E-04	1.1 E+01
Non-halogenated Semi-volatiles						
2-Methyl Napthalene	1.0058			2.54 E+01	5.06 E-02	6.80 E-02
o-Cresol	1.0273			3.1 E+04	4.7 E-05	2.45 E-01
p-Cresol	1.0347			2.4 E+04	3.5 E-04	1.08 E-01
2,4-Dimethylphenol	1.0360			6.2 E+03	2.5 E-06	9.8 E-02
m-Cresol	1.0380	21.0	20	2.35 E+04	3.8 E-05	1.53 E-01
Phenol	1.0576		3.87	8.4 E+04	7.8 E-07	5.293E-01
Naphthalene	1.1620			3.1 E+01	1.27 E-03	2.336E-01
Benzo(a)Anthracene	1.1740			1.4 E-02	4.5 E-06	1.16 E-09
Flourene	1.2030			1.9 E+00	7.65 E-05	6.67 E-04
Acenaphthene	1.2250			3.88 E+00	1.2 E-03	2.31 E-02
Anthracene	1.2500			7.5 E-02	3.38 E-05	1.08 E-05
Dibenz(a,h)Anthracene	1.2520			2.5 E-03	7.33 E-08	1 E-10
Fluoranthene	1.2520			2.65 E-01	6.5 E-06	E-02 E-06
Pyrene	1.2710			1.48 E-01	1.2 E-05	6.67 E-06
Chrysene	1.2740			6.0 E-03	1.05 E-06	6.3 E-09
2,4-Dinitrophenol	1.6800			6.0 E+03	6.45 E-10	1.49 E-05
Miscellaneous						
Coal Tar	1.028(7)	18.98(7)				
Creosote	1.05	1.08(8)				

---

[1] g/cc
[2] centipoise (cp), water has a dynamic viscosity of 1 cp at 20°C.
[3] centistokes (cs)
[4] mg/l
[5] atm-m³/mol
[6] mm Hg
[7] 45° F (70)
[8] 15.5°C, varies with creosote mix (62)

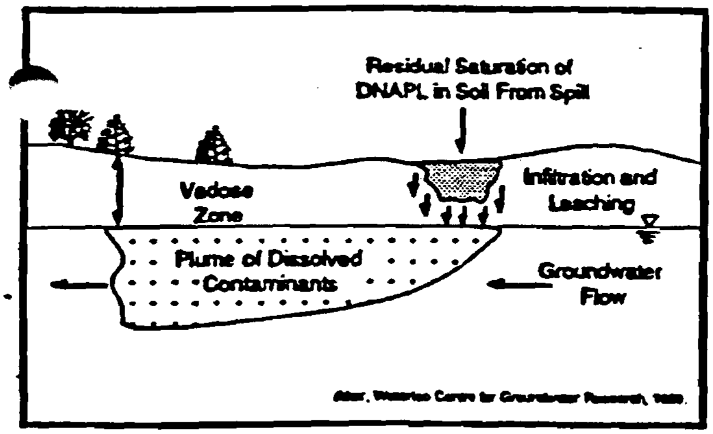

Figure 1. The entire volume of DNAPL is exhausted by residual saturation in the vadose zone prior to DNAPL reaching the water table. Soluble phase compounds may be leached from the DNAPL residual saturation and contaminate the ground water.

saturation. In this spill scenario, the residual saturation in the unsaturated zone exhausted the volume of DNAPL, preventing it from reaching the water table. This figure also shows the subsequent leaching (solubilization) of the DNAPL residual saturation by water percolating through the unsaturated zone (vadose zone). The leachate reaching the saturated zone results in ground-water contamination by the soluble phase components of the hydrocarbon. Additionally, the residual saturation at or near the water table is also subjected to [illegible]hing from the rise and fall of the water table (seasonal, sea [illegible]l, etc.).

Increasing information is drawing attention to the importance of the possibility that gaseous-phase vapors from NAPL in the unsaturated zone are responsible for contaminating the ground water and soil (18,47). It is reported that the greater "relative vapor density" of gaseous vapors to air will be affected by gravity and will tend to sink. In subsurface systems where lateral spreading is not restricted, spreading of the vapors may occur as indicated in Figure 2. The result is that a greater amount of soils and ground water will be exposed to the DNAPL vapors and may result in further contamination. The extent of contamination will depend largely on the partitioning of the DNAPL vapor phase to the aqueous and solid phases.

DNAPL Phase Distribution - Four Phase System

It is apparent from Figures 1 and 2 that the DNAPL may be present in the subsurface in various physical states or what is referred to as phases. As illustrated in Figure 3, there are four possible phases: gaseous, solid, water, and immiscible hydrocarbon (DNAPL) in the unsaturated zone. Contaminants associated with the release of DNAPL can, therefore, occur in four phases described as follows:

1. Air phase - contaminants may be present as vapors;
2. Solid phase - contaminants may adsorb or partition onto the soil or aquifer material;
3. Water phase - contaminants may dissolve into the water according to their solubility; and

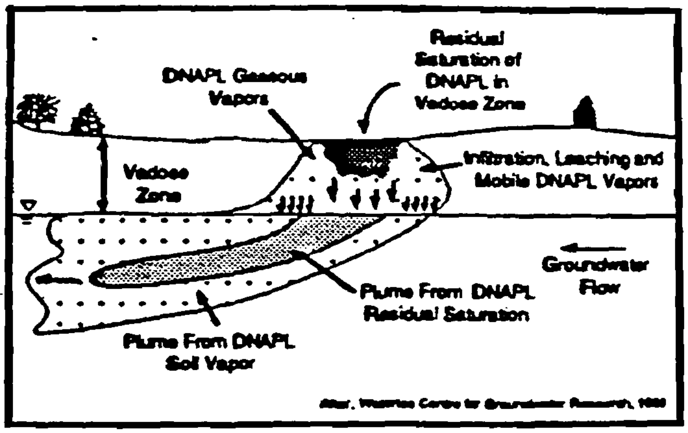

Figure 2. Migration of DNAPL vapors from the spill area and subsequent contamination of the soils and ground water.

4. Immiscible phase - contaminants may be present as dense nonaqueous phase liquids.

The four phase system is the most complex scenario because there are four phases and the contaminant can partition between any one or all four of these phases, as illustrated in Figure 4. For example, TCE introduced into the subsurface as a DNAPL may partition onto the soil phase, volatilize into the soil gas, and solubilize into the water phase resulting in contamination in all four phases. TCE can also partition between the water and soil, water and air, and between the soil and air. There are six pathways of phase distribution in the unsaturated zone. The distribution of a contaminant between these phases can be represented by empirical relationships referred to as partition coefficients. The partition coefficients, or the distribution of the DNAPL between the four phases, is highly site-specific and highly dependent on the characteristics of both the soil/aquifer matrix and the DNAPL. Therefore, the distribution between phases may change with time and/or location at the same site and during different stages of site remediation.

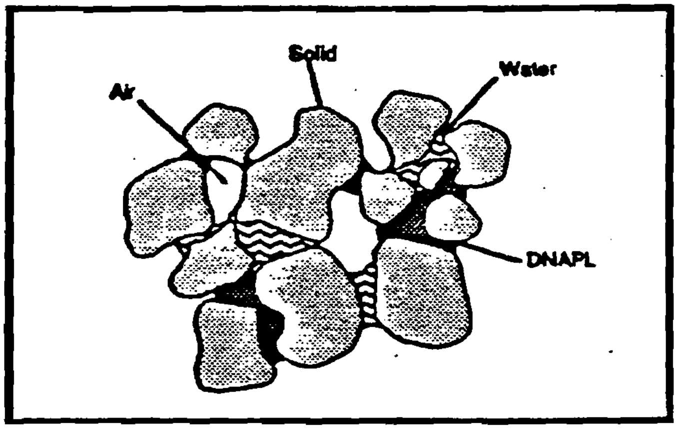

Figure 3. A DNAPL contaminated unsaturated zone has four physical states or phases (air, solid, water, immiscible). The contaminant may be present in any one, or all four phases.

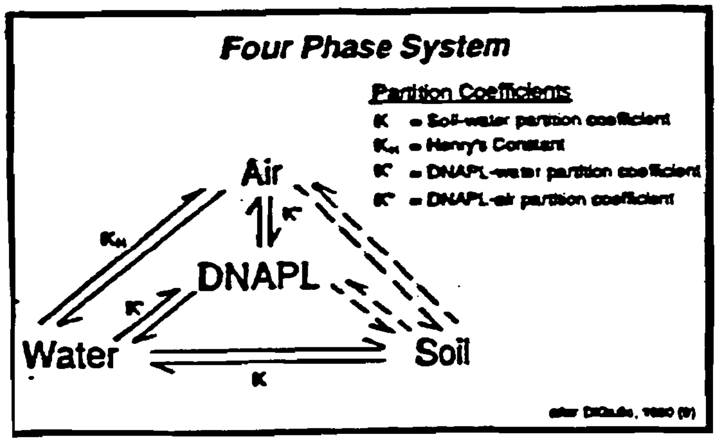

Figure 4. Distribution of DNAPL between the four phases found in the vadose zone.

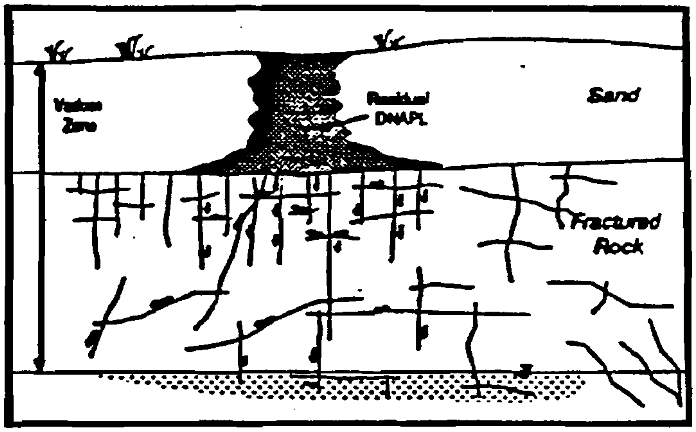

Figure 5. DNAPL spilled into fractured rock systems may follow a complex distribution of the preferential pathways.

The concept of phase distribution is critical in decision-making. Understanding the phase distribution of a DNAPL introduced into the subsurface provides significant insight in determining which tools are viable options with respect to site characterization and remediation.

DNAPL represented by residual saturation in the four phase diagram is largely immobile under the usual subsurface pressure conditions and can migrate further only: 1) in water according to its solubility; or 2) in the gas phase of the unsaturated zone (47). DNAPL components adsorbed onto the soil are also considered immobile. The mobile phases are, herefore, the soluble and volatile components of the DNAPL n the water and air, respectively.

he pore space in the unsaturated zone may be filled with one r all three fluid phases (gaseous, aqueous, immiscible). The resence of DNAPL as a continuous immiscible phase has the otential to be mobile. The mobility of DNAPL in the ubsurface must be evaluated on a case by case basis. The aximum number of potentially mobile fluid phases is three. imultaneous flow of the three phases (air, water, and nmiscible) is considerably more complicated than two-phase ow (46). The mobility of three phase flow in a four-phase ystem is complex, poorly understood, and is beyond the cope of this DNAPL overview. The relative mobility of the two hases, water and DNAPL, in a three-phase system is resented below in the section entitled "Relative Permeability."

enerally, rock aquifers contain a myriad of cracks (fractures) f various lengths, widths, and apertures (32). Fractured rock ystems have been described as rock blocks bounded by screte discontinuities comprised of fractures, joints, and ear zones which may be open, mineral-filled, deformed, or y combination thereof (61). The unsaturated zone overlying ese fractured rock systems also contain the myriad of eferential pathways. DNAPL introduced into such formations gure 5) follow complex pathways due to the heterogeneous stribution of the cracks, conduits, and fractures', i.e., eferential pathways. Transport of DNAPL may follow non-arcian flow in the open fractures and/or Darcian flow in the rous media filled fractures. Relatively small volumes of APL may move deep, quickly into the rock because the retention capacity offered by the dead-end fractures and the immobile fragments and globules in the larger fractures is so small (32). Currently, the capability to collect the detailed information for a complete description of a contaminated fractured rock system is regarded as neither technically possible nor economically feasible (61).

Low permeability stratigraphic units such as high clay content formations may also contain a heterogeneous distribution of preferential pathways. As illustrated in Figure 6, DNAPL transport in these preferential pathways is correspondingly complex. Typically, it is assumed that high clay content formations are impervious to DNAPL. However, as DNAPL spreads out on low permeable formations it tends to seek out zones of higher permeability. As a result, preferential pathways allow the DNAPL to migrate further into the low permeable formation, or through it to underlying stratigraphic units. It is apparent from Figures 5 and 6 that the complexity of DNAPL transport may be significant prior to reaching the water table.

Saturated Zone

The second general scenario is one in which the volume of DNAPL is sufficient to overcome the fraction depleted by the residual saturation in the vadose zone, as illustrated in Figure 7. Consequently, the DNAPL reaches the water table and contaminates the ground water directly. The specific gravity of DNAPL is greater than water, therefore, the DNAPL migrates into the saturated zone. In this scenario, DNAPL continues the vertical migration through the saturated zone until the volume is eventually exhausted by the residual saturation process or until it is intercepted by a low permeable formation where it begins to migrate laterally.

DNAPL Phase Distribution - Three Phase System

Due to the lack of the gaseous phase, the saturated zone containing DNAPL is considered a three-phase system consisting of the solid, water, and immiscible hydrocarbon (Figure 8). Contaminant distribution in the three-phase system is less complex than the four-phase system. Again, this is highly dependent on the characteristics of both the aquifer

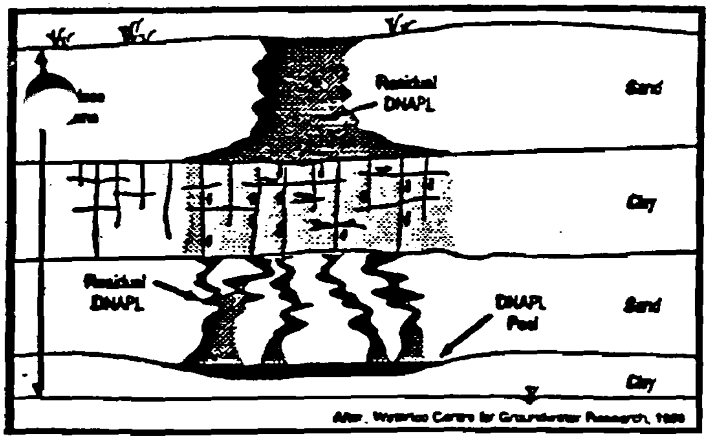

Figure 6. DNAPL spilled into a low permeable formation may follow a complex distribution of preferential pathways. The volume of DNAPL is exhausted in the vadose zone prior to reaching the water table.

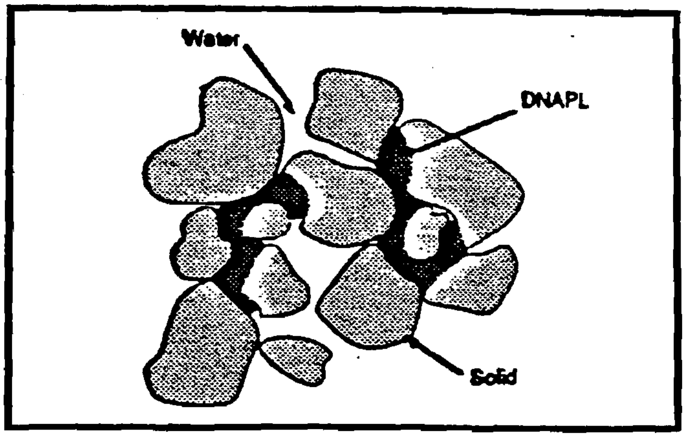

Figure 8. A DNAPL contaminated saturated zone has three phases (solid, water, immiscible). The contaminant may be present in any one, or all three phases.

matrix and the DNAPL. Figure 9 indicates the three phases and the transfer of the mass of contaminant between the phases. In this scenario, there are only three pathways of phase distribution in the saturated zone.

Note that when the DNAPL is represented by residual saturation in the three-phase system, the mobile phase of the contaminant is the water soluble components of the DNAPL and the immobile phases are the residual saturation and the adsorbed components of the DNAPL associated with the aquifer material. The main mobilization mechanism of the residual saturation is removal of soluble phase components into the ground water. When the DNAPL is present as a continuous immiscible phase, it too is considered one of the mobile phases of the contaminant. While the continuous phase DNAPL has the potential to be mobile, immobile continuous phase DNAPL may also exist in the subsurface. Although the saturated zone is considered a three-phase system, gaseous vapors from DNAPL in the unsaturated zone does have the potential to affect ground-water quality, as was indicated earlier in Figure 2.

Assuming the residual saturation in the saturated zone does not deplete the entire volume of the DNAPL, the DNAPL will continue migrating vertically until it encounters a zone or stratigraphic unit of lower permeability. Upon reaching the zone of lower permeability, the DNAPL will begin to migrate laterally. The hydraulic conductivity in the vertical direction is typically less than in the horizontal direction. It is not uncommon to find vertical conductivity that is one-fifth or one-tenth the horizontal value (4). It is expected that DNAPL spilled into the subsurface will have a significant potential to migrate laterally. If the lower permeable boundary is "bowl shaped", the DNAPL will pond as a reservoir (refer to Figure 10). As illustrated in Figure 11, it is not uncommon to observe a perched DNAPL reservoir where a discontinuous impermeable layer; i.e., silt or clay lens, intercepts the vertical migration of DNAPL. When a sufficient volume of DNAPL has been released and multiple discontinuous impermeable layers exist, the DNAPL may be present in several perched reservoirs as well as a deep

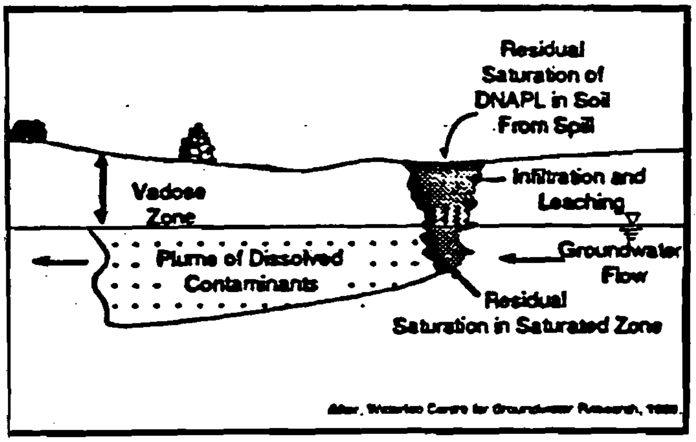

Figure 7. The volume of DNAPL is sufficient to overcome the residual saturation in the vadose zone and consequently penetrates the water table.

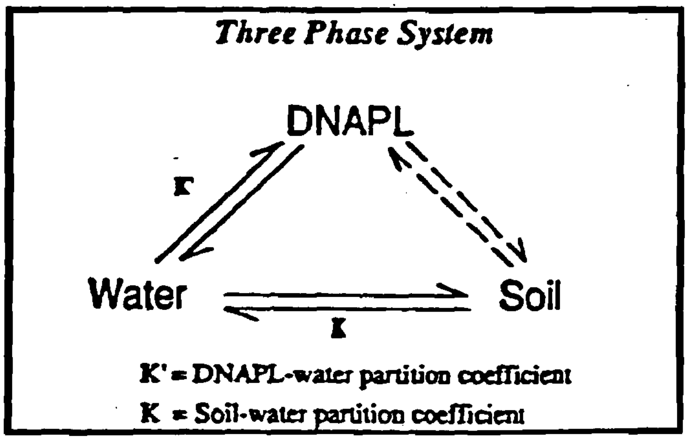

Figure 9. Distribution of DNAPL between the three phases found in the saturated zone.

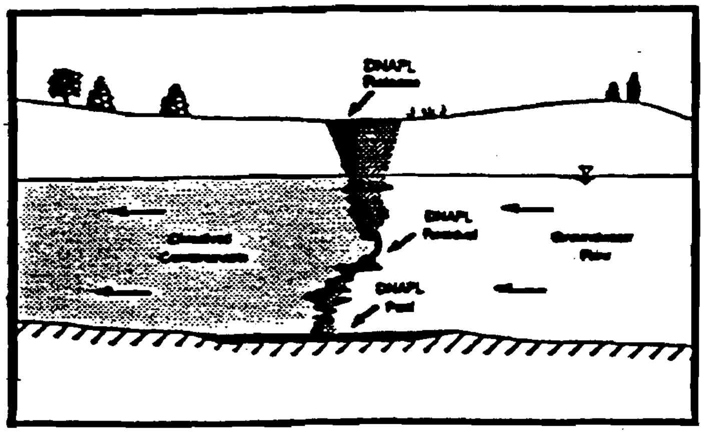

Figure 10. Migration of DNAPL through the vadose zone to an impermeable boundary.

reservoir (refer to Figure 12). Lateral migration continues until either the residual saturation depletes the DNAPL or an impermeable depression immobilizes the DNAPL in a reservoir type scenario. Soluble-phase components of the DNAPL will partition into the ground water from both the residual saturation or DNAPL pools. The migration of DNAPL vertically through the aquifer results in the release of soluble-phase components of the DNAPL across the entire thickness of the aquifer. Note, that ground water becomes contaminated as it flows through, and around, the DNAPL contaminated zone.

As indicated earlier, DNAPL will migrate laterally upon reaching a stratigraphic unit of lower permeability. Transport of DNAPL will therefore be largely dependent on the gradient of the stratigraphy. Occasionally, the directional gradient of an impermeable stratigraphic unit may be different than the direction of ground-water flow as illustrated in Figure 13a. This may result in the migration of the continuous phase DNAPL in a direction different from the ground-water flow. Nonhorizontal stratigraphic units with varying hydraulic conductivity may also convey DNAPL in a different direction than ground-water flow, and at different rates (refer to Figure 13b). Determination of the direction of impermeable stratigraphic units will therefore provide useful information concerning the direction of DNAPL transport.

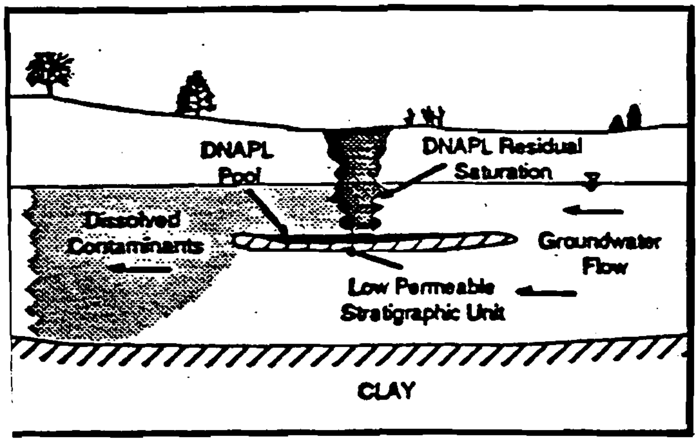

Figure 11. Perched DNAPL reservoir.

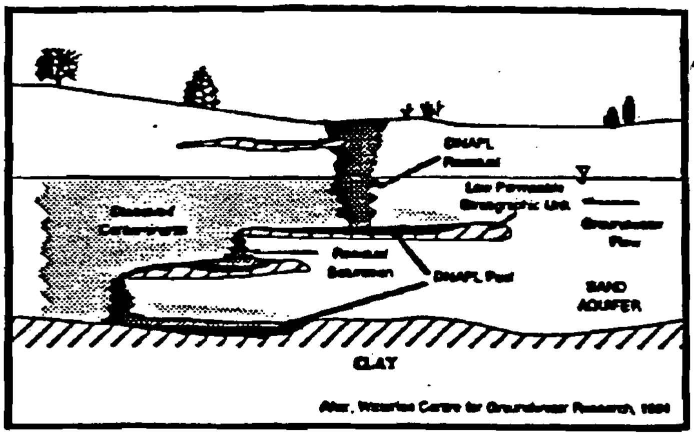

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Figure 12. Perched and deep DNAPL reservoirs.

Similar to the unsaturated zone, the saturated zone also contains a complex distribution of preferential pathways from cracks, fractures, joints, etc. DNAPL introduced into such formations correspondingly follow the complex network of pathways through an otherwise relatively impermeable rock material. Other pathways which may behave as vertical conduits for DNAPL include root holes, stratigraphic windows, disposal wells, unsealed geotechnical boreholes, improperly sealed hydrogeological investigation sampling holes and monitoring wells, and old uncased/unsealed water supply wells (72). Transport of the DNAPL may migrate very rapidly in these open conduits or follow Darcian flow in the surrounding porous media or porous media filled fractures. A relatively small volume of DNAPL can move deep into a fractured system due to the low retentive capacity of the fractured system. Consequently, fractured clay or rock stratigraphic units, which are often considered lower DNAPL boundary conditions, may have preferential pathways leading to lower formations, as depicted in Figure 14. Careful inspection of soil cores at one Superfund site indicated that DNAPL flow mainly occurred through preferential pathways and was not uniformly distributed throughout the soil mass (8). Due to the complex

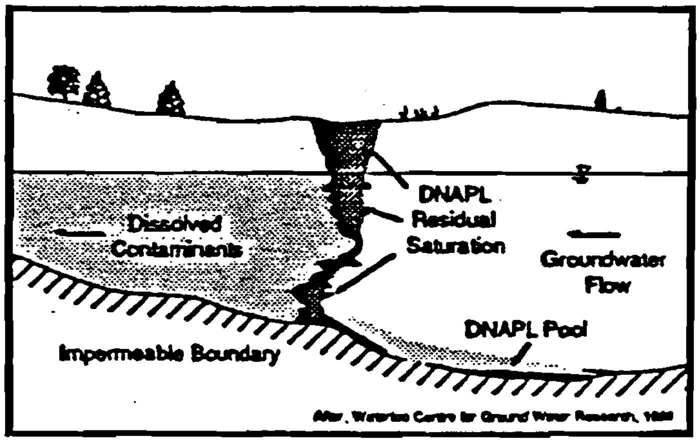

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Figure 13a. Stratigraphic gradient different from ground water gradient results in a different direction of flow of the ground water and continuous phase DNAPL.

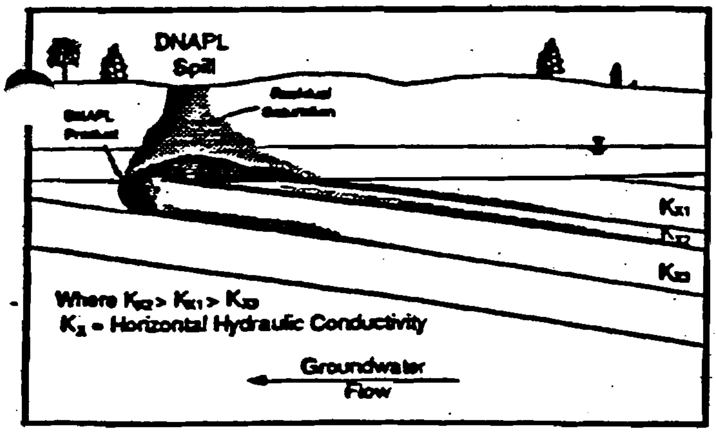
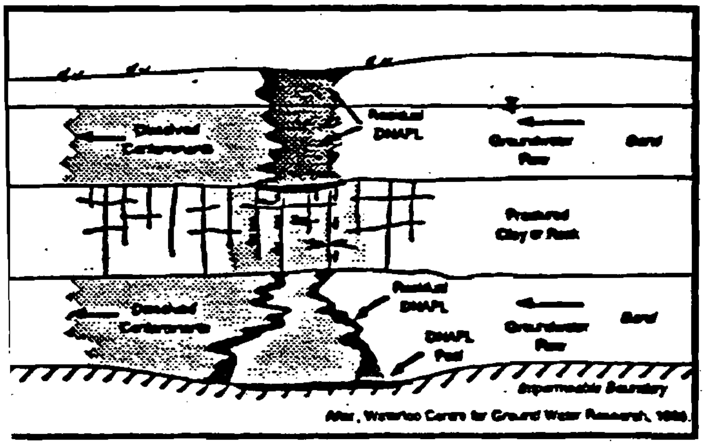


Figure 13b. **Non-horizontal stratigraphic units with variable hydraulic conductivity may convey DNAPL in a different direction than the ground water flow direction.**

distribution of preferential pathways, characterization of the volume distribution of the DNAPL is difficult.

Important DNAPL Transport and Fate Parameters

There are several characteristics associated with both the subsurface media and the DNAPL which largely determine the fate and transport of the DNAPL. A brief discussion of these parameters is included to help identify the specific details of DNAPL transport mechanisms. Several of the distinctive DNAPL phenomena observed on the field-scale relates back to phenomena at the pore-scale. Therefore, it is important to understand the principles from the pore-scale level to develop an understanding of field-scale observations, which is the scale at which much of the Superfund work occurs in. A more complete and comprehensive review of these parameters is available (2,36,71).



After, Waterloo Centre for Ground Water Research, 1989.

Figure 14. **DNAPL transport in fracture and porous media stratigraphic units.**

DNAPL Characteristics

Density

Fluid density is defined as the mass of fluid per unit volume, i.e. g/cm³. Density of an immiscible hydrocarbon fluid is the parameter which delineates LNAPL's from DNAPL's. The property varies not only with molecular weight but also molecular interaction and structure. In general, the density varies with temperature and pressure (2). Equivalent methods of expressing density are specific weight and specific gravity. The specific weight is defined as the weight of fluid per unit volume, i.e. lb/ft³. The specific gravity (S.G.) or the relative density of a fluid is defined as the ratio of the weight of a given volume of substance at a specified temperature to the weight of the same volume of water at a given temperature (31). The S.G. is a relative indicator which ultimately determines whether the fluid will float (S.G.< 1.0) on, or penetrate into (S.G.>1.0) the water table. Table 1 contains a list of compounds with a density greater than one that are considered DNAPL's. Note, however, that while the specific gravity of pentachlorophenol and the non-halogenated semi-volatiles is greater than 1.00, these compounds are a solid at room temperature and would not be expected to be found as an immiscible phase liquid at wood preserving sites but are commonly found as contaminants. Pentachlorophenol is commonly used as a wood preservant and is typically dissolved (4-7%) in No. 2 or 3 fuel oil.

Viscosity

The viscosity of a fluid is a measure of its resistance to flow. Molecular cohesion is the main cause of viscosity. As the temperature increases in a liquid, the cohesive forces decrease and the absolute viscosity decreases. The lower the viscosity, the more readily a fluid will penetrate a porous media. The hydraulic conductivity of porous media is function of both the density and viscosity of the fluid as indicated in equation [1]. It is apparent from this equation that fluids with either a viscosity less than water or fluids with a density greater than water have the potential to be more mobile in the subsurface, than water.

$$K = \frac{k \rho g}{\mu} \quad \text{where,} \qquad [1]$$

K = hydraulic conductivity
k = intrinsic permeability
ρ = fluid mass density
g = gravity
μ = dynamic (absolute) viscosity

Results from laboratory experiments indicated that several chlorinated hydrocarbons which have low viscosity (methylene chloride, perchloroethylene, 1,1,1-TCA, TCE) will infiltrate into soil notably faster than will water (47). The relative value of NAPL viscosity and density, to water, indicates how fast it will flow in porous media (100% saturated) with respect to water. For example, several low viscosity chlorinated hydrocarbons (TCE, tetrachloroethylene, 1,1,1-TCA, Methylene Chloride, Chloroform, Carbon Tetrachloride, refer to Table 1) will flow 1.5-3.0 times as fast as water and higher viscosity compounds including light heating oil, diesel fuel, jet fuel, and crude oil (i.e. LNAPL's) will flow 2-10 times slower than water (45). Both coal tar and creosote typically have a specific gravity greater than one and a viscosity greater than water. It is interesting to note that the viscosity of NAPL may change with time (36). As fresh crude oils lose the lighter volatile components from evaporation, the oils become more viscous as the heavier components compose a larger fraction of the oily mixture resulting in an increase in viscosity.

Solubility

When an organic chemical is in physical contact with water, the organic chemical will partition into the aqueous phase. The equilibrium concentration of the organic chemical in the aqueous phase is referred to as its solubility. Table 1 presents the solubility of several of the most commonly found DNAPL's at EPA Superfund Sites. The solubility of organic compounds varies considerably from the infinitely miscible compounds, including alcohols (ethanol, methanol) to extremely low solubility compounds such as polynuclear aromatic compounds.

Numerous variables influence the solubility of organic compounds. The pH may effect the solubility of some organic compounds. Organic acids may be expected to increase in solubility with increasing pH, while organic bases may act in the opposite way (31). For example, pentachlorophenol is an acid which is ionized at higher pH's. In the ionized form, pentachlorophenol would be more soluble in water (59). Solubility in water is a function of the temperature, but the strength and direction of this function varies. The presence of dissolved salts or minerals in water leads to moderate decreases in solubility (31). In a mixed solvent system, consisting of water and one or more water-miscible compounds, as the fraction of the cosolvent in the mixture increases, the solubility of the organic chemical increases exponentially (12). In general, the greater the molecular weight and structural complexity of the organic compound, the lower the solubility.

Organic compounds are only rarely found in ground water at concentrations approaching their solubility limits, even when organic liquid phases are known or suspected to be present. The observed concentrations are usually more than a factor of 10 lower than the solubility presumably due to diffusional imitations of dissolution and the dilution of the dissolved organic contaminants by dispersion (74). This has also been attributed to: reduced solubility due to the presence of other soluble compounds, the heterogeneous distribution of DNAPL n the subsurface, and dilution from monitoring wells with long ntake lengths (10). Detection of DNAPL components in the subsurface below the solubility should clearly not be nterpreted as a negative indicator for the presence of DNAPL.

n a DNAPL spill scenario where the DNAPL or its vapors are n contact with the ground water, the concentration of the oluble phase components may range from non-detectable up o the solubility of the compound. The rate of dissolution has een expressed as a function of the properties of the DNAPL omponents (solubility), ground water flow conditions, oncentration differential between the actual and solubility, and he contact area between the DNAPL and the ground water 10). The contact area is expected to be heterogeneous and ifficult to quantify. Additionally, as the time of contact ncreases between the DNAPL and the water, the oncentration in the aqueous phase increases.

Vapor Pressure

The vapor pressure is that characteristic of the organic chemical which determines how readily vapors volatilize or evaporate from the pure phase liquid. Specifically, the partial pressure exerted at the surface by these free molecules is known as the vapor pressure (30). Molecular activity in a liquid tends to free some surface molecules and this tendency towards vaporization is mainly dependent on temperature. The vapor pressure of DNAPL's can actually be greater than the vapor pressure of volatile organic compounds. For example, at 20 C, the ratio of the vapor pressures of TCE and benzene is 1.4 (1).

Volatility

The volatility of a compound is a measure of the transfer of the compound from the aqueous phase to the gaseous phase. The transfer process from the water to the atmosphere is dependent on the chemical and physical properties of the compound, the presence of other compounds, and the physical properties (velocity, turbulence, depth) of the water body and atmosphere above it. The factors that control volatilization are the solubility, molecular weight, vapor pressure, and the nature of the air-water interface through which it must pass (31). The Henry's constant is a valuable parameter which can be used to help evaluate the propensity of an organic compound to volatilize from the water. The Henry's law constant is defined as the vapor pressure divided by the aqueous solubility. Therefore, the greater the Henry's law constant, the greater the tendency to volatilize from the aqueous phase, refer to Table 1.

Interfacial Tension

The unique behavior of DNAPLs in porous media is largely attributed to the interfacial tension which exists between DNAPL and water, and between DNAPL and air. These interfacial tensions, result in distinct interfaces between these fluids at the pore-scale. When two immiscible liquids are in contact, there is an interfacial energy which exists between the fluids resulting in a physical interface. The interfacial energy arises from the difference between the inward attraction of the molecules in the interior of each phase and those at the surface of contact (2). The greater the interfacial tension between two immiscible liquids; the less likely emulsions will form; emulsions will be more stable if formed, and the better the phase separation after mixing. The magnitude of the interfacial tension is less than the larger of the surface tension values for the pure liquids, because the mutual attraction of unlike molecules at the interface reduces the large imbalance of forces (31). Interfacial tension decreases with increasing temperature, and may be affected by pH, surfactants, and gases in solution (36). When this force is encountered between a liquid and a gaseous phase, the same force is called the surface tension (66).

The displacement of water by DNAPL and the displacement of DNAPL by water in porous media often involves a phenomena referred to as immiscible fingering. The lower the interfacial tension between immiscible fluids, the greater the instability of the water:DNAPL interface and thus the greater the immiscible fingering (27). The distribution of the fingering effects in porous media has been reported to be a function of the density, viscosity, surface tension (27) and the displacement velocity

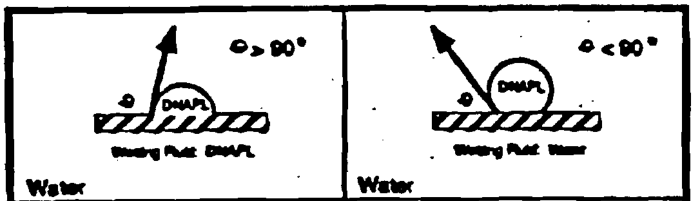
(13) of the fluids involved as well as the porous media heterogeneity (28).

Wettability

Wettability refers to the relative affinity of the soil for the various fluids - water, air, and the organic phase. On a solid surface, exposed to two different fluids, it can be inferred from the contact angle (66), also referred to as the wetting angle, refer to Figure 15. In general, if the wetting angle is less than 90 degrees, the fluid is said to be the wetting fluid. In this scenario, water will preferentially occupy the smaller pores and will be found on solid surfaces (14). When the wetting angle is near 90 degrees, neither fluid is preferentially attracted to the solid surfaces. If the wetting angle is greater than 90 degrees, the DNAPL is said to be the wetting fluid. The wetting angle is an indicator used to determine whether the porous material will be preferentially wetted by either the hydrocarbon or the aqueous phase (71). Wettability, therefore, describes the preferential spreading of one fluid over solid surfaces in a two-fluid system. The wetting angle, which is a measure of wettability, is a solid-liquid interaction and can actually be defined in terms of interfacial tensions (71). Several methods have been developed to measure the wetting angle (36,71). In most natural systems, water is the wetting fluid, and the immiscible fluid is the non-wetting fluid. Coal tar may be the exception (i.e. contact angle greater than 90 degrees), which is mainly attributed to the presence of surfactants (70). The wetting fluid will tend to coat the surface of grains and occupy smaller spaces (i.e. pore throats) in porous media, the non-wetting fluid will tend to be restricted to the largest openings (47).

The wetting angle depends on the character of the solid surface on which the test is conducted. The test is conducted on flat plates composed of minerals which are believed representative of the media, or on glass. Contact angle measurements for crude oil indicates that the wetting angles vary widely depending on the mineral surface (53). Soil and aquifer material are not composed of homogeneous mineral composition nor flat surfaces. The measured wetting angle can only be viewed as a qualitative indicator of wetting behavior.

The reader is recommended to refer to reference No. 82 for review of the basic principles and for various techniques to measure the following DNAPL parameters: density, viscosity, interfacial tension, solubility, vapor pressure, and volatility.



Fluid Relationships:

System	Wetting Fluid	Non-Wetting Fluid
air:water	water	air
air: DNAPL	DNAPL	air
water:DNAPL	water	DNAPL
air:DNAPL:water	water>organic>air [1]	

[1] Wetting fluid order

After, Waterloo Centre for Groundwater Research, [illegible]

gure 15. Wetting angle and typical wetting fluid relationships.

Subsurface Media Characteristics

Capillary Force/Pressure

Capillary pressure is important in DNAPL transport because it largely determines the magnitude of the residual saturation that is left behind after a spill incident. The greater the capillary pressure, the greater the potential for residual saturation. In general, the capillary force increases in the following order; sand, silt, clay. Correspondingly, the residual saturation increases in the same order. Capillary pressure is a measure of the tendency of a porous medium to suck in the wetting fluid phase or to repel the nonwetting phase (2). Capillary forces are closely related to the wettability of the porous media. The preferential attraction of the wetting fluid to the solid surfaces cause that fluid to be drawn into the porous media. Capillary forces are due to both adhesion forces (the attractive force of liquid for the solids on the walls of the channels through which it moves) and cohesion forces (the attraction forces between the molecules of the liquid) (32). The capillary pressure depends on the geometry of the void space, the nature of solids and liquids, the degree of saturation (2) and in general, increases with a decrease the wetting angle and in pore size, and with the increase in the interfacial tension (71). All pores have some value of capillary pressure. Before a non-wetting fluid can enter porous media, the capillary pressure of the largest pores (smallest capillary pressure) must be exceeded. This minimum capillary pressure is called the entry pressure.

In the unsaturated zone, pore space may be occupied by water, air (vapors), or immiscible hydrocarbon. In this scenario, capillary pressure retains the water (wetting phase) mainly in the smaller pores where the capillary pressure is greatest. This restricts the migration of the DNAPL (non-wetting phase) through the larger pores unoccupied by water. Typically, DNAPL does not displace the pore water from the smaller pores. It is interesting to note that the migration of DNAPL through fine material (high capillary pressure) will be impeded upon reaching coarser material (low capillary pressure).

The capillary fringe will obstruct the entry of the DNAPL into the saturated zone. When a sufficient volume of DNAPL has been released and the "DNAPL pressure head" exceeds the water capillary pressure at the capillary fringe (entry pressure), the DNAPL will penetrate the water table. This is why DNAPL is sometimes observed to temporarily flatten out on top of the water table. Similarly, laboratory experiments have been conducted in which DNAPL (tetrachloroethylene) infiltrating through porous media was found to flow laterally and cascade off lenses too fine to penetrate (28), (refer to Figure 11). This was attributed to the inability of the DNAPL to overcome the high capillary pressure associated with the lenses. Logically, when "DNAPL pressure head" exceeds the capillary pressure, the DNAPL will penetrate into the smaller pores. These laboratory experiments are important because they illustrate that small differences in the capillary characteristics of porous media can induce significant lateral flow of non-wetting fluids.

A comprehensive investigation of capillary trapping and multiphase flow of organic liquids in unconsolidated porous media revealed many intricacies of this process in the vadose and saturated zone (66). An important note is that while capillary pressure is rarely measured at hazardous waste sites, the soil texture (sand, silt, clay) is usually recorded during drilling operations and soil surveys. This information, along with soil core analyses will help to delineate the stratigraphy and the volume distribution of NAPL.

Pore Size Distribution/Initial Moisture Content

In natural porous media, the geometry of the pore space is extremely irregular and complex (2). The heterogeneity of the subsurface environment i.e. the variability of the pore size distribution, directly affects the distribution of the capillary pressures along the interfaces between the aqueous and immiscible phases (50). In saturated column experiments, it was observed that NAPL preferentially traveled through strings of macropores, almost completely by-passing the water filled micropores (66). In the same study, a heterogeneous distribution of coarse and fine porous material was simulated. Most of the incoming organic liquid preferentially traveled through the coarse lens material.

In short term column drainage experiments, results indicated that the particle grain size is of primary importance in controlling the residual saturation of a gasoline hydrocarbon (19). Fine and coarse sands (dry) were found to have 55% and 14% residual saturation, respectively. The finer the sand, the greater the residual saturation. During these experiments, the residual saturation was reduced 20-30% in a medium sand and 50% in a fine sand when the sands were initially wet. Soil pore water held tightly by capillary forces in the small pores will limit he NAPL to the larger pores, and thus, result in lower residual saturation. In a similar laboratory (unsaturated) column study, he smaller the grain size used in the experiment, the greater he residual saturation of the NAPL (74). The residual saturation in the saturated column experiments was found to be greater than the unsaturated columns and was independent of the particle size distribution.

These observations follow traditional capillary force theory. Residual saturation resulting from a DNAPL spill in the unsaturated zone is highly dependent on the antecedent moisture content in the porous media. When the moisture ontent is low, the strong capillary forces in the smaller pores will tenaciously draw in and hold the DNAPL. When the moisture content is high, the capillary forces in the smaller ores will retain the soil pore water, and DNAPL residual aturation will mainly occur in the larger pores. Therefore, reater residual saturation can be expected in dryer soils. Correspondingly, NAPL will migrate further in a wetter soil, and isplacement of NAPL from small pores is expected to be more ifficult than from large pores.

Stratigraphic Gradient

DNAPL migrating vertically will likely encounter a zone or tratigraphic unit of lower vertical permeability. A reduction in he vertical permeability of the porous media will induce lateral ow of the DNAPL. The gradient of the lower permeable tratigraphic unit will largely determine the direction in which he DNAPL will flow. This is applicable to both the saturated nd unsaturated zones. As depicted in Figures 13a and 13b, he lateral direction of DNAPL flow may be in a different irection than ground-water flow.

Ground Water Flow Velocity

The ground water flow velocity is a dynamic stress parameter which tends to mobilize the hydrocarbon (39). As the ground water velocity increases, the dynamic pressure and viscous forces increase. Mobilization of DNAPL occurs when the viscous forces of the ground water acting on the DNAPL, exceeds the porous media capillary forces retaining the DNAPL.

Saturation Dependent Functions

Residual Saturation

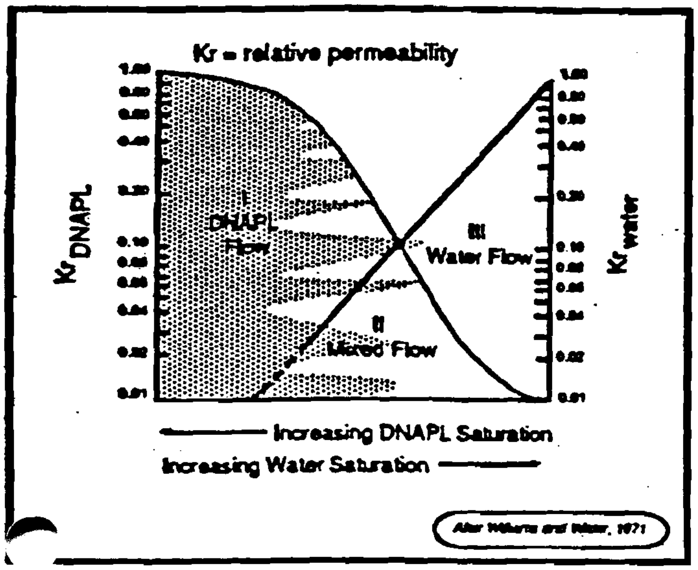
Residual saturation is defined as the volume of hydrocarbon trapped in the pores relative to the total volume of pores (38) and therefore is measured as such (74). Residual saturation has also been described as the saturation at which NAPL becomes discontinuous and is immobilized by capillary forces (36). The values of residual saturation vary from as low as 0.75 - 1.25% for light oil in highly permeable media to as much as 20% for heavy oil (50). Residual saturation values have also been reported to range from 10% to 50% of the total pore space (39,74). Other researchers reported that residual saturation values appear to be relatively insensitive to fluid properties and very sensitive to soil properties (and heterogeneities) (66). Laboratory studies conducted to predict the residual saturation in soils with similar texture and grain size distribution yielded significantly different values. It was concluded that minor amounts of clay or silt in a soil may play a significant role in the observed values.

In the unsaturated zone during low moisture conditions, the DNAPL residual saturation will wet the grains in a pendular state (a ring of liquid wrapped around the contact point of a pair of adjacent grains). During high moisture conditions, the wetting fluid, which is typically water, will preferentially occupy the pendular area of adjacent grains and the hydrocarbon will occupy other available pore space, possibly as isolated droplets. In the saturated zone, the DNAPL residual saturation will be present as isolated drops in the open pores (47). Furthermore, results of laboratory experimentation indicated that residual saturation increased with decreasing hydraulic conductivity in both the saturated and unsaturated zones and that the residual saturation is greatest in the saturated zone. Laboratory experiments indicated that vadose zone residual saturation was roughly one third of the residual saturation in the saturated zone (66). The increase in residual saturation in the saturated zone is due to the following: [1] the fluid density ratio (DNAPL:air versus DNAPL:water above and below the water table, respectively) favors greater drainage in the vadose zone; [2] as the non-wetting fluid in most saturated media, NAPL is trapped in the larger pores; and, [3] as the wetting fluid in the vadose zone, NAPL tends to spread into adjacent pores and leave a lower residual content behind, a process that is inhibited in the saturated zone (36). Thus, the capacity for retention of DNAPLs in the unsaturated zone is less than the saturated zone.

Relative Permeability

Relative permeability is defined as the ratio of the permeability of a fluid at a given saturation to its permeability at 100% saturation. Thus it can have a value between 0 and 1 (71).

Figure 16 illustrates a relative permeability graph for a two fluid phase system showing the relationship between the observed permeability of each fluid for various saturations to that of the observed permeability if the sample were 100% saturated with that fluid (73). The three regions of this graph are explained as follows (71): Region I has a high saturation of DNAPL and is considered a continuous phase while the water is a discontinuous phase, therefore, water permeability is low. Assuming the DNAPL is the non-wetting fluid, water would fill the smaller capillaries and flow through small irregular pores. In Region II, both water and DNAPL are continuous phases although not necessarily in the same pores. Both water and DNAPL flow simultaneously. However, as saturation of either phase increases, the relative permeability of the other phase correspondingly decreases. Region III exhibits a high saturation of water while the DNAPL phase is mainly discontinuous. Water flow dominates this region and there is little or no flow of DNAPL.

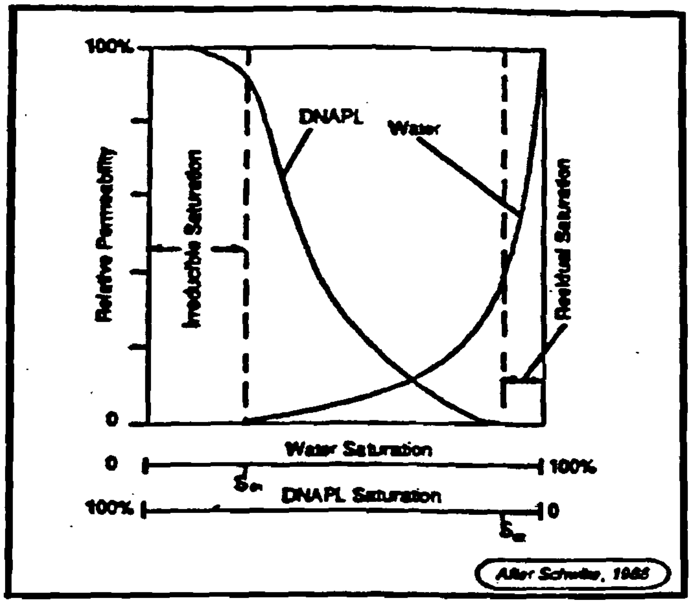


After Williams and Wilder, 1971

Figure 16. Relative permeability graph.

Both fluids flow through only a part of the pore space and thus only a part of the cross section under consideration is available for flow of each fluid. Therefore, the discharge of each fluid must be lower corresponding to its proportion of the cross sectional area (46).

Figure 17 is another relative permeability graph which demonstrates several points. Small increases in DNAPL saturation results in a significant reduction in the relative permeability of water. However, a small increase in water saturation does not result in a significant reduction in DNAPL relative permeability. This figure identifies two points, SO1 and SO2, where the saturation of the DNAPL and the water are greater than 0 before there is a relative permeability for this fluid. The two fluids hinder the movement of the other to different degrees and both must reach a minimum saturation before they achieve any mobility at all (47). These minimum saturations, for the water and DNAPL, are identified as irreducible and residual saturation, respectively.



After Schwille, 1988

Figure 17. The relative permeability curves for water and a DNAPL in a porous medium as a function of the pore space saturation.

Site Characterization for DNAPL

Characterization of the subsurface environment at hazardous waste sites containing DNAPL is complex and will likely be expensive. Specific details associated with the volume and timing of the DNAPL release are usually poor or are not available and subsurface heterogeneity is responsible for the complicated and unpredictable migration pathway of subsurface DNAPL transport. As discussed previously, slight changes in vertical permeability may induce a significant horizontal component to DNAPL migration.

Site characterization typically involves a significant investment in ground-water analyses. Although analysis of ground water provides useful information on the distribution of the soluble components of the DNAPL, the presence of other phases of the DNAPL may go unrecognized. The investigation must, therefore, be more detailed to obtain information concerning the phase distribution of the DNAPL at a site. Site characterization may require analyses on all four phases (aqueous, gaseous, solid, immiscible) to yield the appropriate information (refer to Table 2). In brief, data collected on the various phases must be compiled, evaluated and used to help identify: where the contaminant is presently located; where it has been; what phases it occurs in; and what direction the mobile phases may be going. A comprehensive review of site characterization for subsurface investigations is available (68). Development of monitoring and remediation strategies can be focused more effectively and efficiently after a clear definition of the phase distribution has been completed.

Ground Water

Ground water analyses for organic compounds, in conjunction with ground water flow direction data, has repeatedly been used to: delineate the extent of ground water contamination from DNAPL; determine the direction of plume migration; and

Table 2 - Phase Distribution of DNAPL in the Subsurface

	MATRIX	PHASE
1.	ground water	aqueous - soluble components of DNAPL
2.	soil/aquifer material	solid - adsorbed components of DNAPL on solid phase material
3.	DNAPL	immiscible - continuous phase (mobile), residual saturation (immobile)
4.	soil gas	gaseous - volatile components

to identify probable DNAPL source area(s). While this approach has been used successfully to characterize the distribution of contaminants in the subsurface, there are limitations. For example, since DNAPL and ground water may flow in different directions, as indicated in Figures 13a and 13b, ground water analyses may not necessarily identify the direction of DNAPL migration.

Ground water analyses may be useful to identify probable DNAPL source areas, but, estimating the volume of DNAPL in the subsurface is limited using this approach. Soluble phase components of DNAPL are rarely found in excess of 10% of the solubility even when organic liquids are known or suspected to be present. The concentration of soluble DNAPL components in the ground water is not only a function the amount of DNAPL present, but also the chemical and physical characteristics of the DNAPL, the contact area and time between the ground water and DNAPL, and numerous transport and fate parameters (retardation, biodegradation, dispersion, etc.). One technique has been developed using chemical ratios in the ground water as a means of source identification and contaminant fate prediction (18).

Soil/Aquifer Material

Exploratory Borings

Physical and chemical analyses of soil and aquifer material (drill cuttings, cores) from exploratory borings will provide seful information in the delineation of the horizontal and ertical mass distribution of DNAPL. While simple visual xamination for physical presence or absence of contamination night seem like a worthwhile technique, it can be deceiving nd does nothing to sort out the various liquid phases and their elationship to each other (71). A quantitative approach is ecessary to determine DNAPL distribution.

rill cuttings or core material brought to the surface from xploratory borings can be screened initially to help delineate he depth at which volatile components from the various hases of the hydrocarbon exists. The organic vapor analyzer nd the HNU are small portable instruments that can detect ertain volatile compounds in the air. These methods are used o initially screen subsurface materials for volatile components f DNAPL. Identification of individual compounds and their oncentrations may be confirmed by other, more precise, nalyses.

Analysis of the soil or aquifer material by more accurate means, such as gas chromatography or high pressure liquid chromatography, will take longer but will provide more specific information on a larger group of organic compounds, i.e., volatile/non-volatile, and on specific compounds. This information is necessary to help fix the horizontal and vertical mass distribution of the contaminant and to help delineate the phase distribution. These analyses do not distinguish between soluble, sorbed or free-phase hydrocarbon, however; a low relative concentration indicates that the contaminant may mainly be present in the gaseous or aqueous phases; and a high relative concentration indicates the presence of sorbed contaminant or free phase liquid either as continuous-phase or residual saturation. A more rigorous set of analyses is required to distinguish between the various phases.

Additional tests to identify the presence of NAPL in soil or aquifer core sample are currently undeveloped and research in this area is warranted. Squeezing and immiscible displacement techniques have been used to obtain the pore water from cores (40). Other methods of phase separation involving vacuum or centrifugation may also be developed for this use. A paint filter test was proposed in one Superfund DNAPL field investigation where aquifer cores were placed in a filter/funnel apparatus, water was added, and the filtrate was examined for separate phases. These core analysis techniques have potential to provide valuable field data to characterize NAPL distribution.

Cone Penetrometer

The cone penetrometer (ASTM D3441-86)(69) has been used for some time to supply data on the engineering properties of soils. Recently, the application of this technology has made the leap to the hazardous waste arena. The resistance of the formation is measured by the cone penetrometer as it is driven vertically into the subsurface. The resistance is interpreted as a measure of pore pressure, and thus provides information on the relative stratigraphic nature of the subsurface. Petroleum and chlorinated hydrocarbon plumes can be detected most effectively when the cone penetrometer is used in conjunction with in-situ sensing technologies (48). Features of the cone penetrometer include: a continuous reading of the stratigraphy/permeability; in-situ measurement; immediate results are available; time requirements are minimal; vertical accuracy of stratigraphic composition is high; ground-water samples can be collected in-situ; and the cost is relatively low.

Data from the cone penetrometer can be used to delineate probable pathways of DNAPL transport. This is accomplished by identifying permeability profiles in the subsurface. A zone of low permeability underlying a more permeable stratigraphic unit will likely impede vertical transport of the DNAPL. Where such a scenario is found, a collection of DNAPL is probable and further steps can be implemented to more accurately and economically investigate and confirm such an occurrence. This general approach has successfully been implemented at one Superfund site (8).

DNAPL

Well Level Measurements

In an effort to delineate the horizontal and vertical extent of the DNAPL at a spill site, it is important to determine the elevation of DNAPL in the subsurface. Monitoring DNAPL elevation over time will indicate the mobility of the DNAPL. There are several methods that can be used to determine the presence of DNAPL in a monitoring well. One method relies on the difference in electrical conductivity between the DNAPL and water. A conductivity or resistivity sensor is lowered into the well and a profile is measured. The interface of the DNAPL is accurately determined when the difference in conductivity is detected between the two fluids. This instrument may also be used to delineate LNAPL also. A transparent, bottom-loading bailer can also be used to measure the thickness (and to sample) of DNAPL in a well (36). The transparent bailer is raised to the surface and the thickness of the DNAPL is made by visual measurement.

Several laboratory and field studies have been performed which investigate the anomaly between the actual and measured LNAPL levels in ground-water wells (15,16,24,25). The anomaly between actual and measured NAPL thickness in the subsurface is also applicable to DNAPL, but for different reasons. The location of the screening interval is the key to understanding both scenarios. First, if the well screen interval is situated entirely in the DNAPL layer, and the hydrostatic head (water) in the well is reduced by pumping or bailing, then to maintain hydrostatic equilibrium, the DNAPL will rise in the well (36,44,71) (refer to Figure 18). Secondly, if the well screen extends into the barrier layer, the DNAPL measured thickness will exceed that in the formation by the length of the well below the barrier surface (36) (refer to Figure 19). Both of these scenarios will result in a greater DNAPL thickness in the well and thus a false indication (overestimate) of the actual DNAPL thickness will result. One of the main purposes of the monitoring well in a DNAPL investigation is to provide information on the thickness of the DNAPL in the aquifer. Therefore, construction of the well screen should intercept the ground water:DNAPL interface and the lower end of the screen should be placed as close as possible to the impermeable stratigraphic unit.

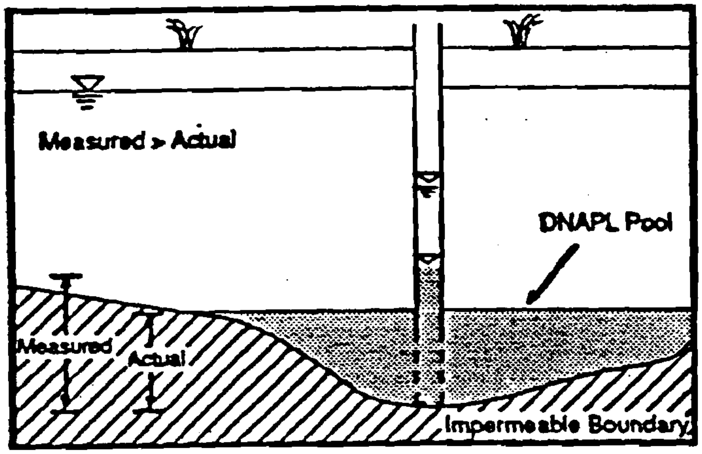


Figure 18. A well screened only in the DNAPL in conjunction with lower hydrostatic head (i.e. water) in the well may result in an overestimation of DNAPL thickness.

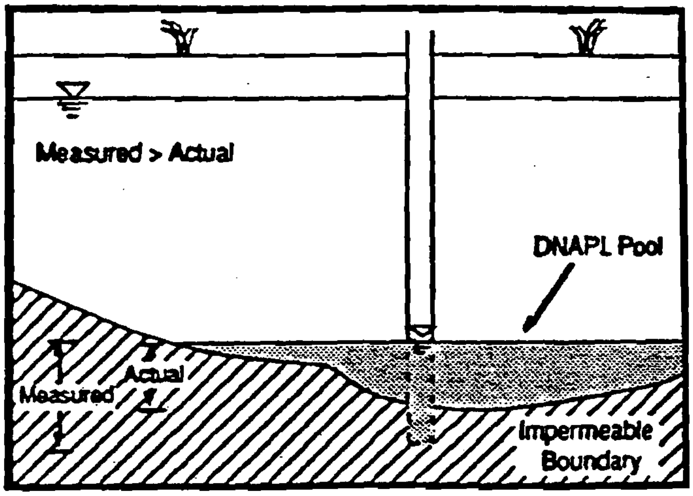


Figure 19. A well screened into an impermeable boundary may result in an over-estimation of the DNAPL thickness.

DNAPL Sampling

Sampling of DNAPL from a well is necessary to perform chemical and physical analyses on the sample. Two of the most common methods used to retrieve a DNAPL sample from a monitoring well are the peristaltic pump and the bailer. A peristaltic pump can be used to collect a sample if the DNAPL is not beyond the effective reach of the pump, which is typically less than 25 feet. The best method to sample DNAPL is to use a double check valve bailer. The key to sample collection is controlled, slow lowering (and raising) of the bailer to the bottom of the well (57). The dense phase should be collected prior to purging activities.

Soil-Gas Surveys

A soil-gas survey refers to the analysis of the soil air phase as a means to delineate underground contamination from volatile organic chemicals and several techniques have been developed (34,52). This investigative tool is mainly used as a preliminary screening procedure to delineate the areal extent of volatile organic compounds in the soil and ground water. This method is quick, less expensive than drilling wells and can provide greater plume resolution (33).

Data from a soil-gas survey is a valuable aid in the development of a more detailed subsurface investigation where ground water monitoring wells and exploratory borings are strategically located for further site characterization. There are limitations to soil-gas surveys (26,52) and data interpretation must be performed carefully (35,49). Soil-gas investigations have mainly been conducted to identify the location of the organic contaminants in ground water. At the time of this publication, the scientific literature did not contain information specifically applicable to the delineation of DNAPL from soil-gas survey data. However, it is surmisable that soil-gas surveys can be used to help delineate DNAPL residual saturation in the unsaturated zone or the location of perched DNAPL reservoirs.

Miscellaneous

The vertical migration of DNAPL in the saturated zone will eventually be challenged by a low permeability stratigraphic unit. According to the principles of capillary pressure, the lower permeability unit will exhibit a greater capillary pressure. Displacement of water by DNAPL requires that the hydrostatic force from the mounding DNAPL exceed the capillary force of the low permeability unit. The Hobson formula is used to compute the critical height calculation to overcome the capillary pressure under different pore size conditions (70).

In an effort to minimize further DNAPL contamination as a result of drilling investigations, precautionary steps should be taken. Penetration of DNAPL reservoirs in the subsurface during drilling activities offers a conduit for the DNAPL to migrate vertically into previously uncontaminated areas. It is very easy to unknowingly drill through a DNAPL pool and the bed it sits on, causing the pool to drain down the hole into a deeper part of the aquifer or into a different aquifer (32). Special attention to grouting and sealing details during and after drilling operations will help prevent cross-contamination.

Precautionary efforts should also be considered when a DNAPL reservoir is encountered during drilling operations. The recommended approach is to cease drilling operations and install a well screen over the DNAPL zone and cease further drilling activities in the well. If it is necessary to drill deeper, construction of an adjacent well is recommended. Alternatively, if it is not necessary to screen off that interval, it is recommended to carefully seal off the DNAPL zone prior to drilling deeper.

Well construction material compatibility with DNAPL should be investigated to minimize downhole material failure. A construction material compatibility review and possible testing will prevent the costly failure of well construction material. The manufacturers of well construction material are likely to have the most extensive compatibility data and information available.

Remediation

Remediation of DNAPL mainly involves physical removal by either pumping or trench-drainline systems. Removal of DNAPL early in the remediation process will eliminate the main source of contaminants. This step will substantially improve the overall recovery efficiency of the various DNAPL phases including the long term pump and treat remediation efforts for soluble components. Remediation technologies such as vacuum extraction, biodegradation, ground water pumping, and soil flushing is mainly directed at the immobile DNAPL and the various phases in which its components occur. Physical barriers can be used in an effort to minimize further migration of the DNAPL.

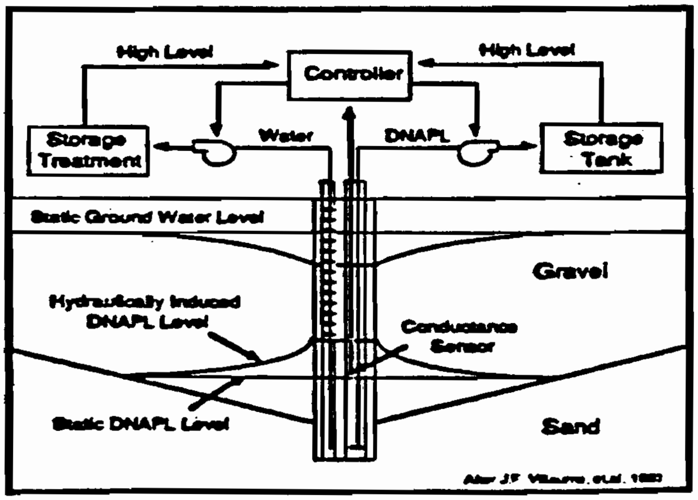
Clean-up of DNAPL can involve sizable expenditures: they are difficult to extract and the technology for their removal is just evolving (43). Historically, field recovery efforts usually proceed with a poor understanding of the volume distribution of the DNAPL. This reflects the difficulties involved in adequate site characterization, poor documentation of the release, and the complexity associated with the DNAPL transport in the subsurface.

Pumping Systems

Pumping represents an important measure to stop the mobile DNAPL from migrating as a separate phase by creating a hydraulic containment and by removal of DNAPL (44). Very simply, DNAPL recovery is highly dependent on whether the DNAPL can be located in the subsurface. The best recovery scenario is one in which the DNAPL is continuous and has collected as a reservoir in a shallow, subsurface impermeable depression. Once the DNAPL has been located and recovery wells are properly installed, pumping of pure phase DNAPL is a possible option but depends largely on site specific conditions which include, but are not limited to: DNAPL thickness, viscosity, and permeability.

Many DNAPL reservoirs in the subsurface are of limited volume and areal extent. Therefore, it can be expected that both the level of DNAPL (saturated thickness) in the well will decline from the prepumping position and the percentage of DNAPL in the DNAPL:water mixture will decrease rather rapidly. Correspondingly, DNAPL recovery efficiency decreases. Field results indicate that recovery wells screened only in the DNAPL layer will maintain maximum DNAPL:water ratios (102). Well diameter was not found to influence long term DNAPL recovery; however, large diameter wells allow high volume pumping for short durations; and small diameter wells result in lower DNAPL:water mixtures and greater drawdown.

An enhanced DNAPL recovery scheme may be used to improve recovery efficiency. An additional well is constructed with a screen interval in the ground water zone located vertically upward from the DNAPL screen intake. Ground water is withdrawn from the upper screen which results in an upwelling of the DNAPL (70), refer to Figure 20. The upwelling of the DNAPL, coal tar in this case, improved the rate (twofold) at which the coal tar was recovered resulting in a more efficient operation. The ground water withdrawal rate must be carefully determined; too much will cause the coal tar from rising excessively and being either mixed (emulsions) with or suppressed by the higher water velocity above; too low will not



After J.F. Villaume, et al. 1983

Figure 20. A DNAPL recovery system where deliberate upwelling of the static coal-tar surface is used to increase the flow of product into the recovery wells.

caused upwelling. An estimate of this upwelling can be c[illegible]lated using the simplified Ghyben-Herzberg Principle u[illegible] ideal conditions (4). Laboratory studies indicated that dimethyl phthalate (1.19 g/cc) recovery rate was doubled or tripled over the conventional, non-upconing, recovery scheme (75). A similar application of this technique was used to increase the level of DNAPL (solvents) in a sandstone bedrock formation (11). Other enhanced DNAPL recovery techniques were implemented utilizing both water flooding and wellbore vacuum. Essentially, this minimized drawdown, allowing a maximum pumping rate of the DNAPL:water mixture. Both techniques offered significant advantages in terms of the rate and potential degree of DNAPL removal (8).

The highly corrosive nature of some DNAPL's may increase maintenance problems associated with the recovery system. A design consideration during any DNAPL recovery program should include a material compatibility review to minimize downhole failures. This is applicable to the well construction material and the various appurtenances of the recovery system. Manufacturers of the construction material would most likely have the best compatibility information available.

While most researchers agree that the residual saturation of immiscible hydrocarbon droplets in porous media are immobile, researchers have investigated the mobility of residual saturation in porous media for enhanced oil recovery and for NAPL remediation at spill sites. Specifically, this includes a complex interplay between four forces (viscous, gravity, capillary, buoyancy). These forces are dependent on both the chemical and physical characteristics of the DNAPL and porous media. The mobilization of residual saturation m[illegible] hinges on either increasing the ground water velocity w[illegible] increases the viscous forces between the residual saturation and the ground water, or decreasing the interfacial tension between the residual saturation and the ground water which decreases the capillary forces.

The capillary number is an empirical relationship which measures the ratio between the controlling dynamic stresses (absolute viscosity and ground water velocity) and static stresses (interfacial tension) of the residual saturation (39). The former are the viscous stresses and the dynamic pressure in the water which tend to move the oil. The latter are the capillary stresses in the curved water/oil interfaces which tend to hold the oil in place. As the capillary number is increased, the mobility of the residual saturation increases. In a laboratory column study, the capillary number had to be increased two orders of magnitude from when motion was initiated to complete displacement of the hydrocarbon in a sandstone core (74). In a glass bead packed column, only one order of magnitude increase was required. However, a higher capillary number was required to initiate mobility. The difference in mobility between the two columns was attributed to the pore geometry, i.e. size, shape.

There are limitations to residual saturation mobilization. The ground water gradient (dh/dl) necessary to obtain the critical capillary number to initiate blob mobilization would be 0.24. To obtain complete NAPL removal would require a gradient of 18 (3). Ground water gradients of this magnitude are unrealistic. Another estimate of the gradient necessary to mobilize carbon te[illegible]loride in a fine gravel and medium sand was 0.09 and 9.[illegible]pectively (74). The former gradient is steep but not unreasonable and the latter gradient is very steep and impractical to achieve in the field. The same researchers concluded from more recent, comprehensive studies, that the earlier predictions were optimistic, and that the gradient necessary to mobilize residual organic liquid is clearly impractical (66). Another limitation is that along with residual saturation mobilization, the NAPL blobs disperse into smaller blobs and that the blob distribution was dependent on the resulting capillary number (6). Recovery of the NAPL residual saturation by pumping ground water may be more feasible where the porous media is coarse and capillary forces are low, i.e. coarse sands and gravel. However, even in this scenario, it is expected that the radius of residual saturation mobilization would be narrow.

It is held in petroleum engineering theory that the only practical means of raising the capillary number dramatically is by lowering the interfacial tension (39) and that this can be achieved by using surfactants (66). Surfactants reduce the interfacial tension between two liquids, and therefore, are injected into the subsurface for enhanced recovery of immiscible hydrocarbons. In laboratory experiments, surfactant flushing solutions produced dramatic gains in flushing even after substantial water flushing had taken place (54). Unfortunately, surfactants can be quite expensive and cost prohibitive in NAPL recovery operations. Surfactants are usually polymeric in nature and a surfactant residue may be left behind in the porous media which may not be environmentally acceptable. Additionally, surfactants may be alkaline and thus effect the pH of the subsurface environment. It has been suggested that such a surfactant may inhibit bacterial metabolism and thus preclude subsequent use of biological technologies at the site. Significant research in this area is currently underway which may uncover information improving the economics and feasibility of this promising technology.

In summary, practical considerations and recommendations in mobilization and recovery of residual saturation include the following: more effective in very coarse porous media i.e. coarse sands and gravel; installation of recovery wells at the source to minimize flow path distance; large volume of water to treat/dispose at the surface; compounds with high interfacial tension or viscosity will be difficult to mobilize; implementation of linear one-dimensional sweeps through the zones of residual saturation (74) and surfactants will optimize recovery.

Pumping the soluble components (aqueous phase) of DNAPL from the immiscible (continuous and residual saturation), solid (sorbed), and gaseous phases has been perhaps one of the most effective means to date to both recover DNAPL from the subsurface and to prevent plume migration. Recovery of soluble components quite often has been the only remediation means available. This is attributed to the inability to locate recoverable DNAPL pools and due to low DNAPL yielding formations. The basic principles and theory of pump and treat technology and the successes and failures have been summarized in other publications (64,67) and is beyond the scope of this publication.

Pumping solubilized DNAPL components from fractured rock aquifers historically has been plagued with a poor recovery efficiency. Although the rock matrix has a relatively small intergranular porosity, it is commonly large enough to allow dissolved contaminants from the fractures to enter the matrix by diffusion and be stored there by adsorption (32). The

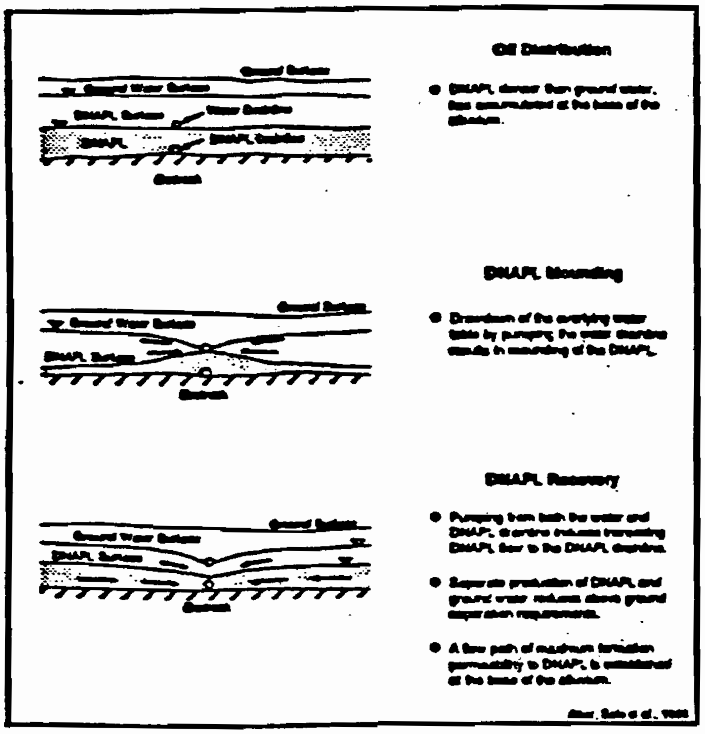


Figure 21. Trench recovery system of DNAPL utilizing the dual drainline concept.

release of these components is expected to be a slow diffusion dominated process. This is because little or no water flushes through dead-end fracture segments or through the porous, impervious rock matrix. Therefore, clean-up potential is estimated to be less than that expected for sand and gravel aquifers.

Trench Systems

Trench systems have also been used successfully to recover DNAPL and are used when the reservoir is located near the ground surface. Trench systems are also effective when the DNAPL is of limited thickness. Recovery lines are placed horizontally on top of the impermeable stratigraphic unit. DNAPL flows into the collection trenches and seep into the recovery lines. The lines usually drain to a collection sump where the DNAPL is pumped to the surface. Similar to the pumping system, an enhanced DNAPL recovery scheme may be implemented using drain lines to improve recovery efficiency. This "dual drain line system" (41) utilizes a drain line located in the ground water vertically upward from the DNAPL line. Ground water is withdrawn from the upper screen which results in an upwelling of the DNAPL which is collected in the lower line, refer to Figure 21. This increases the hydrostatic head of the DNAPL. Excessive pumping of either single or dual drain line systems may result in the ground water "pinching off" the flow of DNAPL to the drain line. An advantage of the dual drain system is that the oil:water separation requirements at the surface are reduced.

Vacuum Extraction

Soil vacuum extraction (SVE) is a remediation technology which involves applying a vacuum to unsaturated subsurface strata to induce air flow. Figure 22 illustrates that the volatile contaminants present in the contaminated strata will evaporate and the vapors are recovered at the surface and treated. Common methods of treatment include granular activated carbon, catalytic oxidation, and direct combustion. SVE can effectively remove DNAPL present as residual saturation. In general, vacuum extraction is expected to be more applicable for the chlorinated solvents (PCE, TCE, DCE) than the polycyclic aromatic compounds (wood preserving wastes, coal tars, etc.). This technology is most effective to remove DNAPL residual saturation and soluble components in the unsaturated zone. When DNAPL is present in perched pools (Figure 12) it is more effective to remove DNAPL in the unsaturated zone prior to the implementation of SVE. The same strategy is applicable in the saturated zone where DNAPL removal by SVE is attempted concomitantly with lowering the water table. Upon lowering the water table, SVE can be used to remove the remnant volatile wastes not previously recovered. Often, the precise location of the DNAPL is unknown; therefore, SVE can be used to remediate the general areas where the presence of DNAPL is suspected. Removal of DNAPL by SVE is not expected to be as rapid as direct removal of the pure phase compound. One advantage of SVE however, is that he precise location of the DNAPL need not be known.

Important parameters influencing the efficacy of SVE concern both the DNAPL and porous media. Porous media specific parameters include: soil permeability, porosity, organic carbon, moisture, structure, and particle size distribution. DNAPL specific parameters include: vapor pressure, Henry's constant, solubility, adsorption equilibrium, density, and viscosity (20). These parameters and their relationships must be evaluated on a site specific basis when considering the feasibility of vacuum extraction and a practical approach to the design, construction, and operation of venting systems (22). Additionally, soil gas surveys which delineate vapor concentration as a function of depth is critical in locating the contaminant source and designing an SVE system.

Historically, SVE has been used to remove volatile compounds from the soil. Recently it has been observed that SVE enhances the biodegradation of volatile and semivolatile organic compounds in the subsurface. While SVE removes volatile components from the subsurface, it also aids in supplying oxygen to biological degradation processes in the unsaturated zone. Prior to soil venting, it was believed that biodegradation in the unsaturated zone was limited due to inadequate concentrations of oxygen (17). In a field study where soil venting was used to recover jet fuel, it was observed that approximately 15% of the contaminant removal was from the result of microbial degradation. Enhanced aerobic biodegradation during SVE increases the cost effectiveness of the technology due to the reduction in the required above ground treatment.

Vacuum extraction is one form of pump and treat except that the fluid is a gas mixture and that it occurs in the unsaturated zone. Therefore, many of the same limitations to pump and treat are also applicable to vacuum extraction. While the application of vacuum extraction is conceptually simple, its success depends on understanding complex subsurface

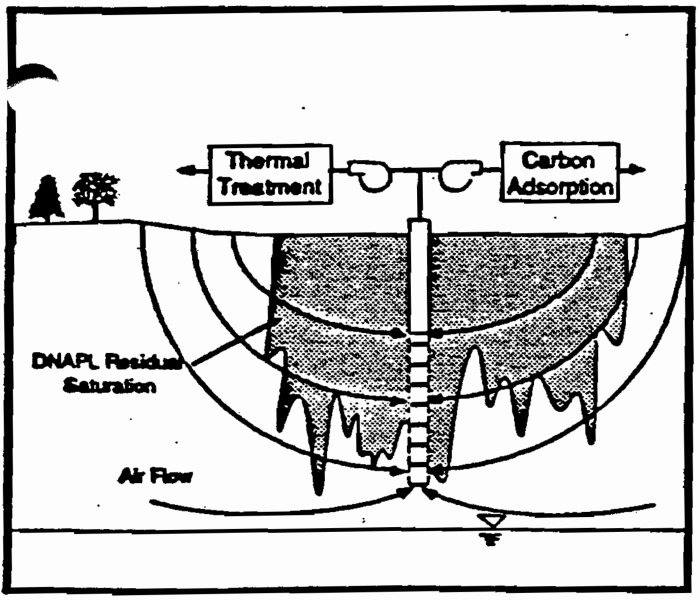


Figure 22. Vacuum extraction of DNAPL volatile components in the unsaturated zone. As shown here, vapors are treated by thermal combustion or carbon adsorption and the air is discharged to the atmosphere.

chemical, physical, and biological processes which provide insight into factors limiting its performance (9).

[illegible]egradation

The potential for biodegradation of immiscible hydrocarbon is highly limited for several reasons. First, pure phase hydrocarbon liquid is a highly hostile environment to the survival of most microorganisms. Secondly, the basic requirements for microbiological proliferation (nutrients, electron acceptor, pH, moisture, osmotic potential, etc.) is difficult if not impossible to deliver or maintain in the DNAPL. A major limitation to aerobic bioremediation of high concentrations of hydrocarbon is the inability to deliver sufficient oxygen. A feasible remediation approach at sites where immiscible hydrocarbon is present is a phased technology approach. Initial efforts should focus on pure phase hydrocarbon recovery to minimize further migration and to decrease the volume of NAPL requiring remediation. Following NAPL recovery, other technologies could be phased into the remediation effort. Bioremediation may be one such technology that could be utilized to further reduce the mass of contaminants at the site. NAPL recovery preceding bioremediation will improve bioremediation feasibility by reducing the toxicity, time, resources, and labor.

Similar to other remediation technologies, a comprehensive feasibility study evaluating the potential effectiveness of bioremediation is critical and must be evaluated on a site specific basis. A comprehensive review of biodegradation of surface soils, ground water, and subsoils of wood preserving wastes, i.e. PAH's (29,37,51,62,63) are available. A comprehensive review of microbial decomposition of c[illegible]ated aromatic compounds is also available (58).

Soil Flushing

Soil flushing utilizing surfactants is a technology that was developed years ago as a method to enhance oil recovery in the petroleum industry. This technology is new to the hazardous waste arena and available information has mainly been generated from laboratory studies. Surfactant soil flushing can proceed on two distinctly different mechanistic levels: enhanced dissolution of adsorbed and dissolved phase contaminants, and displacement of free-phase nonaqueous contaminants. These two mechanisms may occur simultaneously during soil flushing (42).

Surfactants, alkalis, and polymers are chemicals used to modify the pore-level physical forces responsible for immobilizing DNAPL. In brief, surfactants and alkalis reduce the surface tension between the DNAPL and water which increases the mobility. Polymers are added to increase the viscosity of the flushing fluid to minimize the fingering effects and to maintain hydraulic control and improve flushing efficiency. Based on successful laboratory optimization studies where an alkali-polymer-surfactant mixture was used, field studies were conducted on DNAPL (creosote) which resulted in recovery of 94% of the original DNAPL (42). Laboratory research has also been conducted which indicated that aqueous surfactants resulted in orders of magnitude greater removal efficiency of adsorbed and dissolved phase contaminants than water flushing (55).

Depth to contamination, DNAPL distribution, permeability, heterogeneities, soil/water incompatibility, permeability reduction, and chemical retention are important factors when considering soil flushing (42). Prior to this technology being cost effective in the field, surfactant recycling will be necessary to optimize surfactant use (55). Soil flushing is complex from a physical and chemical point of view; is relatively untested in the field; and will likely be challenged regulatorily. Considerable research currently being conducted in this area may result in the increased use of this technology to improve DNAPL recovery in the future.

Thermal methods of soil flushing involve injecting hot water or steam in an effort to mobilize the NAPL. The elevated temperature increases volatilization and solubilization and decreases viscosity and density. A cold-water cap is used to prevent volatilization. The mobile phases of the DNAPL are then recovered using a secondary approach, i.e. pumping, vacuum extraction etc. This approach (Contained Recovery of Oily Wastes) to enhance recovery of DNAPL is currently under EPA's Superfund Innovative Technology Evaluation Program and a pilot-scale demonstration is forthcoming (21). A limitation in the use of thermal methods is that the DNAPL may be converted to LNAPL due to density changes (36). The adverse effects from this are that the DNAPL, existing as a thin layer, becomes buoyant and mobilizes vertically resulting in a wider dispersal of the contaminant. Other limitations involve the high energy costs associated with the elevated water temperature and the heat loss in the formation (36).

Physical Barriers

Physical barriers may be used to prevent the migration of DNAPL's in the subsurface and are typically used in conjunction with other recovery means. One feature of physical barriers is the hydraulic control it offers providing the opportunity to focus remediation strategies in treatment cells. Unfortunately, physical barriers, while satisfactory in terms of ground water control and containment of dissolved-phase plumes, may contain small gaps or discontinuities which could permit escape of DNAPL (7). Chemical compatibility between physical barriers and construction material must agree to insure the physical integrity of the barrier. The history of the performance of these containment technologies is poorly documented and is mainly offered here for completeness of review. A more complete review of these physical barriers is available (5,56).

Sheet piling involves driving lengths of steel that connect together into the ground that form an impermeable barrier to lateral migration of DNAPL. Ideally, the bottom of the sheet pile should be partially driven into an impermeable layer to complete the seal. Slurry walls involve construction of a trench which is backfilled with an impermeable slurry (bentonite) mixture. Grouting is a process where an impermeable mixture is either injected into the ground or is pumped into a series of interconnected boreholes which together form an impermeable boundary. Again, the main feature of these techniques is to physically isolate the DNAPL.

In summary, site characterization and remediation options for sites containing DNAPL are limited. Field results from site characterization and remediation efforts are also limited. This s largely due to the complexity of DNAPL transport and fate in he subsurface; poorly developed techniques currently ıvailable to observe and predict DNAPL in the subsurface, and lue to the fact that this issue has not been widely recognized, ıntil recently. Clearly, there is a growing realization within the cientific and regulatory community that DNAPL is a significant actor in limiting site remediation. Correspondingly, current esearch efforts within the private industrial, and public sectors ıre focusing on both the fundamentals and applications ıspects of DNAPL behavior in subsurface systems. ıdditionally, the number of field investigations reflecting an ıcreased awareness of DNAPLs, is growing.

NAPL Modeling

modeling overview report identified nineteen (numeric and ıalytic) multiphase flow models which are currently available 0). Most of these models were developed for salt water trusion, LNAPL transport, and heat flow. Four models are ıalitatively described as immiscible flow models but do not ıecifically indicate DNAPL. A more recent model has been ıveloped which simulates density driven, three phase flow, at is capable of modeling DNAPL transport (23). Presently, ıry little information is available on DNAPL modeling in the ientific literature.

ıltiphase flow modeling involves modeling systems where ›re than one continuous fluid phase (NAPL, water, gaseous) present. Modeling any subsurface system requires a nceptual understanding of the chemical, physical, and logical processes occurring at the site. Modeling of nultaneous flow of more than one fluid phase requires a nceptual understanding of the fluids and the relationship tween the fluid phases. The significance of multiphase flow er single phase flow is the increased complexity of fluid flow d the additional data requirements necessary for modeling.

As presented earlier, numerous variables strongly influence DNAPL transport and fate, and consequently, the mathematical relationship of these variables is complex. Therefore, it follows that DNAPL modeling presents paramount technical challenges.

Presently, it is exceedingly difficult to obtain accurate field data which quantitatively describes DNAPL transport and fate variables within reasonable economic constraints. DNAPL transport is highly sensitive to subsurface heterogeneities (8,27,28) which compounds the complexity of modeling. Heterogeneities are, by nature, difficult to identify and quantify and models are not well equipped to accommodate the influence of heterogeneities. Additionally, relative permeability and capillary pressure functions must be quantified to identify the relationship between fluids and between the fluids and the porous media. Unfortunately, these parameters are very difficult to measure, particularly in three phase systems. Prior to an investment of time and money to model a given site, a careful evaluation of the specific objectives and the confidence of the input and anticipated output data should be performed. This will help illuminate the costs, benefits, and therefore, the relative value of modeling in the Superfund decision making process.

In summary, DNAPL modeling at Superfund sites is presently of limited use. This is mainly due to: the fact that very little information is available in the scientific literature to evaluate previous work; accurate and quantitative input data is expected to be costly; the sensitivity of DNAPL transport to subsurface heterogeneities; and, the difficulty in defining the heterogeneities in the field and reflecting those in a model. However, multiphase flow models are valuable as learning tools.

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ATTACHMENT B

PACKER TEST PROCEDURE

PACKER TEST PROCEDURES

I. Introduction

Packer testing is a method used to estimate the hydraulic conductivity of discrete bedrock zones within an open-bedrock corehole or open-bedrock well/piezometer. A packer test involves tightly sealing off a selected interval in the bedrock hole, pumping clean water into the test interval under a specified head for a specified duration, and recording the volume of water pumped into the formation during the test duration. To allow interpretation of the flow characteristics (e.g., laminar or turbulent), the rock fracture response (e.g., dilation, washout, or void filling) and the representative conductivity value for the tested bedrock interval, five test increments are performed at three different head conditions. The hydraulic conductivity is calculated based on the observed test pumping rates, the total applied head values, the geometry of the tested interval, and the pattern of pumping rates achieved during each of the five test increments.

The following presents methods for both single and double packer testing.

II. Materials

The equipment used for packer testing consists of two assemblies:

(1) A packer apparatus consisting of inflatable rubber packer(s) and a length of perforated pipe; and
(2) A water system, including a water meter, pressure gauge and valves to adjust and maintain the water pressure and flow.

The following list of equipment to be used for packer testing is meant to serve only as a guide because actual site and borehole conditions may require modifications. The driller may provide much of the equipment. Typical equipment and materials used to perform packer testing include:

- Drill rig to install and remove the packer and water pipe;
- Packer (pneumatic or hydraulically actuated);
- Water pipe, ranging from 1 to 2 inches in diameter, depending on the permeability and surface area of the test section;
- Flow meter of the same diameter as the water pipe above;
- Pump, capacity to approximately 50 gpm;
- Storage tanks of appropriate volume for holding clean water for injection into test interval;
- Two pressure transducers, sized in accordance with the depth of the test interval and the excess injection pressure to be applied during the test;
- Compressed gas cylinders, regulators, and tubing for inflating pneumatic packers or alternative pressure source if hydraulically-actuated packers are used;
- Water swivel or elbow;
- Hose or piping of the same diameter as the water pipe;
- Electronic data logger for recording transducer output;

- Water level indicator or equivalent oil/water interface meter with 0.01 foot increments;
- Stopwatch;
- Constant-head injection data sheets (an example is provided in Figure 1);
- Personal Protective Equipment (PPE) as required by the Site-specific EHS Plan;
- Decontamination supplies (as needed); and
- Field logbook.

III. Packer Apparatus Configurations

Either single-packer or double-packer configurations may be used to perform the packer test. The single-packer test typically is performed after each core run during the drilling of corehole. The packer is seated at the top of the interval of rock core just removed, and the newly exposed section of bedrock is tested. To remove sediment from the corehole wall, the corehole may be bailed, surged or swabbed prior to packer testing. The test should not be initiated, however, until the water level in the drill casing returns to the static level.

Single-packer tests may provide more reliable results than double-packer tests because if water leaks past a single, upper packer, the leak may be discerned by the recognition of a rising water level in the corehole or drill casing above the packer or by the appearance of water in the casing at the ground surface. In contract, if a double-packer configuration is used, leakage past the lower packer may enter a permeable corehole section below the lower packer without being recognized as leakage.

The double-packer configuration is used if discrete rock intervals are to be tested in a previously-drilled long open corehole. Two packers are placed in the corehole and inflated with the perforated portion of the pipe between the packers. The spacing between the packers, corresponding to the test interval length, typically is 5 to 0 feet. Specified bedrock intervals are tested starting from the bottom of the hole and working upwards at intervals selected by the supervising geologist/engineer.

IV. Water System

The water system typically is assembled with a bypass valve and line connected to the main water line before the water meter valve. The purposes of the bypass valve are (1) to dampen the surge of water produced by the action of the pump, thus providing a relatively constant flow rate and water pressure; and (2) to allow a pressure bypass so that relatively low pressures may be applied to the tested rock interval, if appropriate. A surge suppression tank may also be plumbed into the water system before the bypass line to help dampen pump surge affects.

A water meter valve and the water meter follow the bypass valve and line. Flow to the tested rock interval passes through the water meter valve and is recorded by the water meter. The bypass and water meter valves are used simultaneously to maintain the water in the line at the desired pressure. The maximum water pressure for a particular pumping rate is achieved with the meter valve fully opened and the bypass valve fully closed. The bypass valve should be used as much as possible, however, to utilize its surge damping effect.

The remainder of the water system apparatus consists of a check valve, a relief valve and line, a water pressure gauge, and finally a length of riser pipe connecting the perforated pipe and packer assembly to the water supply apparatus. The pressure gauge indicates the water pressure in the apparatus at that location, rather than the pressure applied to the tested rock interval. The total head applied during a test consists of the gauge pressure plus the elevation head (the vertical distance between the pressure gauge and the static water level in the corehole), minus the frictional head loss between the pressure gauge and the perforated pipe where the water exits the apparatus and enters the tested rock interval. The magnitude of frictional head loss depends on the length of riser pipe used and the pumping rate, and is best determined empirically by calibrating the test assembly in the field. Alternately, frictional losses may be estimated based on hydraulics equation such as the Hazen-Williams equation (Meritt, 1983), which relates head loss to pipe geometry and flow rate.

V. Packer Test Apparatus Calibration

The frictional head loss in the riser pipe assembly should be determined in the field by a calibration process to obtain a reliable estimate of the total head applied to the test interval. The calibration is performed by pumping water through the apparatus at a constant pressure and flow rate for a specified duration, typically a few minutes. The gauge pressure, total flow volume, pumping duration, and riser pipe length are recorded, and the procedure is repeated at a different flow rate. The process is repeated at several flow rates that span the representative range of flow rates achievable by the pump.

The calibration is performed with the water system and packer apparatus laid out horizontally along the ground surface. The packer(s) remain deflated during the calibration procedure to avoid rupturing. The perforated section of pipe is supported slightly above the ground surface so that water may drain freely during pumping through the test assembly. The perforated pipe section and the pressure gauge are situated at approximately equal elevation during the calibration to eliminate the elevation head between the pressure gauge and the perforated pipe section. Because the elevation head is zero, the pressure gauge measurements obtained during calibration indicate only the frictional head loss in the pipe assembly.

The calibration process should be repeated and a separate set of gauge pressure versus pumping rate data generated for each total length of riser pipe used during actual packer testing. The calibration procedure may be performed after the appropriate riser-pipe lengths are identified by the performance of packer tests. The data of gauge pressure versus pumping rate are later plotted on a X-Y axis. A best-fit power-law regression curve is calculated for each data set to determine the mathematical relationship between pumping rate and frictional loss. During hydraulic conductivity calculation, frictional head loss for each observed flow rate is estimated from the plot of calibration data corresponding to the length of riser pipe used during the test.

VI. Test Gauge Pressure Calculation

Appropriate test pressures to be used during each of the five test increments are calculated as follows:

(1) Calculate the maximum gauge pressure, to be used during test increment #3 as:

$$P_3 \text{ (psi)} = 0.75 \times \text{Depth of Test Section Midpoint (feet)}$$

(2) Calculate the gauge pressures to be used during the other test increments as:

$P_1 = P_5 = 0.4 \times P_3$ and

$P_2 = P_4 = 0.7 \times P_3$.

VII. Packer Test Procedures

Prior to testing a given bedrock interval, the corehole identification number, the depth of the test interval, the static depth to water in the corehole, the gauge height above ground surface, and the length of riser pipe used in the apparatus are recorded on a packer test data log. After the packer(s) have been seated at the desired interval, the remainder of the test is performed as follows:

1. Open the bypass valve completely with the water meter valve closed.

2. Start the pump or open other water supply.

3. Open the meter valve slowly to allow water to flow and pressure to build. If this valve is completely opened and additional pressure is still needed, it may be obtained by slowly closing off the bypass valve, thus forcing more water through the water meter valve.

4. After the desired pressure for a desired given test increment has been achieved, record the time and volume form the totalizing water meter.

5. To perform a test increment, record the water meter reading at one minute intervals for 5 to 10 minutes of continuous pumping. Check the gauge to ensure the pressure remains constant throughout the test increment, and adjust the flow valves as needed to maintain constant pressure.

6. Adjust the valves in the water system to achieve the calculated appropriate pressure for the next test increment, and repeat steps #4 and #5 above.

7. If the appropriate test interval gauge pressure cannot be achieved due to a highly-permeable tested bedrock interval, the maximum achieved gauge pressure and the pumping rate data for the five minute test increment should be recorded.

8. The packer test for a given bedrock interval is complete after all five test increments have been performed.

9. Record the test data on the packer test data log.

VIII. Packer Test Data Reduction

Packer test data are reduced to develop estimates of hydraulic conductivity for each tested interval based on standard data reduction procedures (United States Bureau of Reclamation, 1974; Houlsby, 1976). Data are entered into an automatic packer-test data reduction spreadsheet program. The spreadsheet calculates the hydraulic conductivity from each of the five test increments for each tested bedrock interval as:

$$K = C_p\, Q/H$$

where:

K = hydraulic conductivity (feet per year);
Q = flow rate (gallons per minute);
H = total head applied during test (feet); and
Cp = packer coefficient.

Based on equations published in the Earth Manual (United States Bureau of Reclamation 1974), the packer coefficient can be calculated from:

$$C_p = [70267 \ln (L/r)] / 2\pi L$$

where:

L = length of the tested bedrock interval (feet); and
r = radius of tested bedrock corehole (feet).

In addition to the hydraulic conductivity value, the packer test reduction spreadsheet calculates a Ludgeon value (Houlsby, 1976) for each of the five test increments. The five Ludgeon values are evaluated to interpret the type of flow and bedrock formation response and most representative calculated hydraulic conductivity value for the tested bedrock interval from the following list:

(1) Laminar Flow

Indication: Ludgeon values are approximately equal.
Conductivity: Average of values from five test increments.

(2) Turbulent Flow

Indication: Ludgeon value from increment #3 is less than those from the lower pressure increments, which are approximately equal in value.
Conductivity: Value from increment #3.

(3) Dilation of Bedrock Fractures

Indication: Ludgeon value from increment #3 is greater than those from the lower pressure increments which are approximately equal in value.
Conductivity: Average value from increments #1 and #5.

(4) Wash-out of Fracture Filling Materials

Indication: Progressive increase in five Ludgeon values without any return to lower values during increments #4 and #5.

Conductivity: Value from increment #1.

(5) Void Filling

Indication: Progressive decrease in five Ludgeon values without any return to values during increments #4 and #5.

Conductivity: Value from increment #5.

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FIGURE 1
TYPICAL CONSTANT-HEAD INJECTION TEST DATA SHEET

SITE: ______ ENV. CONSULTING FIRM: ______
BOREHOLE NO.: ______ FIELD PERSONNEL: ______
LOCATION: ______ DATE: ______
TEST NO: ______

Pilot hole diameter: ______ Pretest water level: ______
Top of test section: ______ Product layer thickness: ______
Bottom of test section: ______ Reference point: ______
ID of water pipe: ______ Elevation of reference point: ______
Packer type: ______ Transducer type: ______
Length of packer: ______ Transducer calibration: ______
Depth to packer bottom: ______ Flowmeter: ______
Pretest water pressure (Po): ______ Start reading: ______
Packer inflation pressure: ______ End reading: ______

S#	Pt	t	Q	delta Q
Step No.	Test Section Pressure (psi)	Time from Start of Test (min)	Flow Rate (gpm)	Change in Flow Rate between Readings (gpm)

APPENDIX B

GENERIC QUALITY ASSURANCE PROJECT PLAN FOR SITE INVESTIGATIONS AT NON-OWNED FORMER MGP SITES

QAPP

GENERIC
QUALITY ASSURANCE PROJECT PLAN

FOR

SITE INVESTIGATIONS

AT NON-OWNED FORMER MGP SITES

Prepared for:
Niagara Mohawk
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NOVEMBER 2002

Reviewed and Approved by: ______________________ ______________
(Project Quality Assurance Manager) (Signature) (Date)

Site Specific
Revisions Attached: Supplement No. _____ Date __________

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1.0 GENERAL

This Generic Quality Assurance Project Plan (QAPP) has been prepared to specify procedures that will provide data of known, documented quality, and which will be legally defensible, should the need exist. This document specifically supplements the Generic Field Sampling Plan (FSP), also attached as an appendix to the Site-Specific Work Plan. To the extent discrepancies exist between this Generic QAPP and the Site-Specific Work Plan, the Site-Specific Work Plan shall control.

2.0 PROJECT DESCRIPTION

The project sites are Former Non-owned Manufactured Gas Plant (MGP) sites. The purpose of the investigations is to gather sufficient data to enable the New York State Department of Environmental Conservation (NYSDEC) and Niagara Mohawk, a National Grid Company (NM) to characterize chemical substances which are or may be present at the Sites and to enable the NYSDEC and NM to determine whether such substances pose a significant threat to public health or the environment.

The data collected as a result of these investigations will be used to support the Site Characterizations and Remedial Investigation/Feasibility Studies (RI/FS) as described in the Site-Specific Work Plans. The types, numbers, and locations of environmental samples to be collected are also described in the Site-Specific Work Plans. Field procedures for all environmental sampling activities are detailed in the FSP.

3.0 PROJECT ORGANIZATION

The project organization is described in detail in the Site-Specific Work Plan. The project organization describes the relationship between the NM Project Manager, NYSDEC Project Manager, NM's Engineering Consultant, and subcontractors (e.g. laboratories, data validators, drillers, etc.).

For the purpose of quality control, the Engineering Consultant's Project Quality Assurance Manager (PQAM) will be responsible for review of data upon receipt from the analytical laboratory. The PQAM will assure that data validation screening is performed by trained and experienced data validators using the applicable criteria specified in the NYSDEC 2001 Analytical Services Protocol (ASP). For the purposes of this document, all references to ASP indicate the 2001 NYSDEC Analytical Services Protocol. The specific requirements for data validation screening are given in Section 9.3. The PQAM will be responsible for ensuring that all analytical data are in conformance with requirements of this QAPP.

4.0 QA/QC OBJECTIVES FOR MEASUREMENT OF DATA

The overall quality assurance (QA) objective for the project is to develop and implement procedures which will provide data of known, documented quality. Field and laboratory quality assurance/quality control (QA/QC) requirements defined in the NYSDEC ASP and other applicable guidelines ensure acceptable levels of data quality will be maintained throughout the sampling and analysis program.

The QA/QC objectives for all measurement data include precision, accuracy, representativeness, completeness, and comparability. The data reduction, validation, and reporting scheme is presented in Figure 1. The quality assurance samples to be collected (type and frequency of collection) are specified in the Site-SpecificWork Plans.

4.1 Precision

Precision is an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Specifically, it is a quantitative measurement of the variability of a group of measurements compared to their average value (USEPA, 1987). Precision is usually stated in terms of standard deviation, but other estimates such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum value), and relative range are common. For this project, precision will be evaluated by recording duplicate measurements of the same parameter on similar sample aliquots under the same conditions and calculating the relative percent difference (RPD) between the values. The formula for calculating RPD is presented in Section 13.2.

RPDs can only be calculated when the duplicate samples both contain detectable concentrations of the analyte. If an analyte is considered not detected at the detection limit, then RPD cannot be calculated. Instead, the results of the analysis of the two-spiked laboratory samples will be used to determine precision.

Measurement data for this project will include field data as well as laboratory analytical data. Laboratory precision will be performed according to the requirements described in the associated analytical methods. The field measurement data may include immunoassay polycyclic aromatic hydrocarbon (PAH) and/or polychlorinated biphenyl (PCB) screening, pH, conductivity, temperature, turbidity, organic vapor readings, and water level measurements. The objective for precision of field data collection methods is to take replicate (minimum of two for every 20 samples) measurements for field parameters to determine the reproducibility of the measurements.

Precision of the immunoassay screening will be evaluated by the field analysis of replicate samples as equivalent levels of PAHs/PCBs. As the screening is not quantitative (i.e., the screening determines if the constituents are present above or below standard values and does not provide a numeric result), RPDs cannot be calculated on the field-analyzed samples. Therefore, measurement of equivalent levels of constituent (i.e., detected below the same standard or within the same range of two standards) will be considered as denoted precision of the screening test.

For the pH meter, precision will be tested by multiple readings in the medium of concern. Consecutive readings should agree within 0.1 pH units after the instrument has been field calibrated with standard buffers before each use. The thermometer will be visually inspected prior to each use to ensure its condition is satisfactory. Consecutive measurements of a given sample should agree to within 1°Celsius. After calibration, the conductivity meter will be tested for precision at ± 1% of full-scale, depending on the meter/scale. The organic vapors will be measured using a Photovac Microtip (or equivalent) photoionization detector (PID). Daily background and upwind readings of drilling and sampling activities will be measured prior to commencing work and at periodic intervals throughout each day's activities. The natural variation/fluctuation in measurements at background or upwind locations will be used for baseline background values, and the variability will be noted. Water level indicator readings will be precise within 0.01 feet for duplicate measurements or additional water level measurements will be collected to determine whether the difference is due to operator or instrument error. Turbidity measurements will be calibrated to a precision of ± 2% nephelometric turbidity units (NTUs).

4.2 Accuracy

Accuracy is a measure of the difference between a measured value and the "true" or accepted reference value. The accuracy of an analytical procedure is best determined by the analysis of a sample containing a known quantity of material and is expressed as the percent of the known quantity, which is recovered, or measured. The recovery of a given analyte is dependent upon the sample matrix, method of analysis, and the specific compound or element being determined. The concentration of the analyte relative to the detection limit of the analytical method is also a major factor in determining the accuracy of the measurement. Concentrations of analytes that are close to the detection limits are less accurate because they are affected by such factors as instrument "noise". Higher concentrations will not be as affected by instrument or other variables and thus will be more accurate.

The accuracy of laboratory-measured data will be evaluated by determining the percent recovery of both matrix and blank spike samples as described in Section 13.1. For the measurement of organics by gas chromatography (GC) or GC/mass spectroscopy (MS), the recovery of a surrogate spiked into each sample, blank, and standard will also be used to assess accuracy.

Accuracy between the immunoassay screening and the laboratory analytical results will be evaluated by the confirmatory testing of 10 percent (i.e., one in ten) of the environmental samples at the off-site laboratory. The rate of potential false positives and negatives should be less than 15 percent. Screening samples will not be spiked in the field by the addition of known parameter concentrations. However, the confirmatory samples sent to the off-site laboratory will undergo surrogate spiking and recovery evaluation and, to the extent possible, may be chosen as the site-specific matrix spike sample(s) for additional accuracy determination.

The objective for accuracy of the other field measurements is to achieve and maintain factory equipment specifications for the field equipment. Field measurements cannot be assessed for accuracy by spiking the medium with the analytical parameter and measuring the increase in response;

therefore, these instruments can only be assessed for accuracy by the response to a known sample (such as a calibration standard) used to standardize them. The pH meter, conductivity meter, and turbidity meter are calibrated with solutions traceable to the National Institute of Standards and Technology (NIST, formerly the National Bureau of Standards).

All volatile organic detectors (such as the PID) will be calibrated to an appropriate standard daily prior to use.

4.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. Samples must be representative of the environmental media being sampled. Selection of sample locations and sampling procedures will incorporate consideration of obtaining the most representative sample possible.

Field and laboratory procedures will be performed in such a manner as to ensure, to the degree that is technically possible, that the data derived represents the in-place quality of the material sampled. Every effort will be made to ensure chemical compounds will not be introduced into the sample via sample containers, handling, or analysis. Decontamination of sampling devices and digging equipment will be performed between samples as outlined in the FSP. Laboratory sample containers will be thoroughly cleaned in accordance with procedures outlined in Section 5.2. Analysis of field blanks, trip blanks, and method blanks will also be performed to monitor for potential sample contamination from field and laboratory procedures.

The assessment of representativeness also must consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated through the analysis of field duplicate samples, coded to ensure the samples are treated and analyzed as separate samples. The analytical laboratory will make every reasonable effort to assure the samples are adequately homogenized prior to taking aliquots for analysis, so the reported results are representative of the sample received. Many means of homogenization expose the sample to significant risk of contamination or loss through volatilization, and these should be avoided if possible.

Chain-of-custody procedures will be followed to document that contamination of samples has not occurred during container preparation, shipment, and sampling. Details of blank/duplicate and chain-of-custody procedures are presented in Sections 5.3 and 6.1.

4.4 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid. The QC objective for completeness is generation of valid data for 100 percent of the analysis requested. Any data deficiencies and their impact on project goals will be evaluated during data validation and discussed in the Data Usability Summary Report (DUSR) (see Section 9.3.2).

4.5 Comparability

Comparability expresses the degree of confidence with which one data set can be compared to another. The comparability of all data collected for this project will be ensured by:

- Using identified standard methods for both sampling and analysis phases of this project;
- Ensuring traceability of all analytical standards and/or source materials to USEPA or NIST;
- Verifying all calibrations with an independently prepared standard from a source other than that used for calibration;
- Using standard reporting units and reporting formats including the reporting of QC data;
- The validation of all analytical results, including the use of data qualifiers in all cases where appropriate; and
- The requirement that all validated flags be used any time an analytical result is used for any purpose whatsoever.

These steps will ensure all future users of either the data or the conclusions drawn from them will be able to judge the comparability of these data and conclusions.

5.0 SAMPLING PROCEDURES

5.1 Sampling Program

The objective of the sampling program is to provide current data concerning the presence and nature and extent of contamination of groundwater, surface water, soils (surface and subsurface), and/or sediment. Sampling and analysis may include as identified in the Site-SpecificWork Plan:

- groundwater samples
- surface water samples
- sediment samples
- surface and/or subsurface soil samples
- air samples

5.2 Sampling Procedures and Handling

Sample Container Preparation

Sample containers will be properly washed and decontaminated by the factory or laboratory prior to use. All preservatives will be added to containers prior to shipment by the laboratory. The types of containers and preservation techniques are shown in Table 1. Records of the sources of bottles and preservatives will be kept by the analytical laboratory.

Methods of Sampling

As a minimum, sampling procedures will be in accordance with the most recent NYSDEC or USEPA guidelines and/or regulations, as appropriate. Alternate techniques will be utilized when such guidelines and/or regulations are inappropriate or non-existent. Alternate techniques will be implemented only after consultation with NYSDEC, whenever possible.

Referenced sampling procedures are listed below. All procedures will be the latest in effect as of the date of this Generic QAPP.

- USEPA - 600-4-79-020, "Methods for Chemical Analysis of Water and Wastes"
- National Water Well Association - "Manual of Ground-water Sampling Procedures"
- USEPA - 600-4-83-040, "Characterization of Hazardous Waste Sites - a Methods Manual: Volume II. Available Sampling Methods"
- USEPA - OSWER - 9950.1 "RCRA Ground-water Monitoring Technical Enforcement Guidance Document"
- USEPA - 540/S-95/504, "Low-Flow (Minimal Drawdown) Ground Water Sampling Procedures"

- NYSDEC – "Technical and Administrative Guidance Memoranda" (TAGMs)

All sampling methods are explained in detail in the FSP.

5.3 Quality Assurance Samples

Field Quality Control Samples

To assess field sampling and decontamination performance, two types of "blanks" will be collected and submitted to the laboratory for analyses. The blanks will include:

Trip Blank - A trip blank will be prepared by the laboratory, and will consist of 40-ml volatile organic analysis (VOA) vials containing distilled, deionized water which accompanies the other sample bottles into the field and back to the laboratory. A trip blank will be included with each shipment of water samples for which analysis for Target Compound List (TCL) volatiles or benzene, toluene, ethylbenzene and total xylenes (BTEX) is planned. The trip blank will be analyzed for TCL volatile organic compounds or BTEX to assess any contamination introduced as a result of sampling and transport, , handling and storage.

Equipment Blank - Equipment blanks will be taken at a minimum frequency of one per 20 field samples per sample matrix as specified in the Site-SpecificWork Plan. Equipment blanks are used to determine the effectiveness of the decontamination procedures for sampling equipment. It is a sample of deionized, distilled water provided by the laboratory, which has passed through or over the sampling apparatus. It is usually collected as a last step in the decontamination procedure, prior to collecting a sample. The equipment blanks will be analyzed for the same parameters as the matrix being sampled.

In addition, the precision of field sampling procedures will be assessed by collecting coded field duplicates and matrix spike (MS)/matrix spike duplicates (MSD)/matrix duplicates (MD).

The duplicates will consist of:

Field Duplicate - To determine the reproducibility and homogeneity of samples, coded field duplicates will be collected. The samples are termed "coded" because they will be labeled in such a manner that the laboratory will not be able to determine that they are a duplicate sample. This will eliminate any possible bias that could arise. The frequency of collection of these samples is one per 20 field samples as specified in the Site-SpecificWork Plans. The criteria for assessing coded field duplicates are given in Section 6.0.

Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate (MS/MSD/MD) - MS/MSD/MD samples (MSD for organics; MD for inorganics) will be collected at a frequency of one pair per 20 field samples per seven day sample delivery group (SDG). The reproducibility and homogeneity of the samples can be assessed by determining the

RPD for both spike and non-spike compounds as described in Section 13.0. The MS, MSD, and MD samples should be Site-Specific, unless otherwise authorized by the Engineering Consultant's Project Manager and/or PQAM after consultation with NM and NYSDEC personnel whenever possible.

6.0 SAMPLE TRACKING AND CUSTODY

Sample chain-of-custody (COC) will be initiated by the laboratory with selection and preparation of the sample containers. To reduce the chance for error, the number of personnel handling the samples will be minimized.

In-situ or on-site monitoring data will be controlled and entered in permanent logbooks. Personnel involved in the COC and transfer of samples will be trained on the purpose and procedures prior to implementation.

Evidence of sample traceability and integrity will be provided by COC procedures. These procedures document the sample traceability from the selection and preparation of the sample containers by the laboratory, to sample collection, to sample shipment, to laboratory receipt and analysis. The sample custody flowchart is shown in Figure 2. A sample will be considered to be in a person's custody if the sample is:

- In a person's possession;
- Maintained in view after possession is accepted and documented;
- Locked and tagged with custody seals so that no one can tamper with it after having been in physical custody; or
- In a secured area which is restricted to authorized personnel.

6.1 Field Sample Custody

A COC record will accompany the sample from time of collection to receipt by the analytical laboratory. If samples are split and sent to different laboratories, COC records will be sent with each sample. Figure 3 is a typical example of a chain-of-custody record. The "remarks" column will be used to record specific considerations associated with sample acquisition such as: sample type, container type, sample preservation methods, and analyses to be performed. Two copies of this record will accompany the samples to the laboratory. The laboratory will maintain one file copy, and the completed original will be returned to the Engineering Consultant's Project Manager.

Individual sample containers, provided by the laboratory, will be used for shipping/couriering samples. The shipping containers are insulated, and ice will be used to maintain samples at approximately four degrees Celsius until samples are returned and in the custody of the laboratory. All sample bottles within each shipping container will be individually labeled and controlled.

Each sample shipping container will be assigned a unique identification number by the laboratory, and will be marked with indelible ink on the outside of the shipping container. This number will be recorded on the COC record. The field sampler will indicate each individual sample designation/location number in the space provided on the appropriate COC form for each sample collected. The shipping container will then be closed, and a seal provided by the laboratory affixed to the latch. This seal must be broken to open the container. Tampering may be indicated if the seal is broken before receipt at the laboratory. The laboratory will contact the FOL or Engineering Consultant's Project Manager, and the associated samples will not be analyzed if tampering is apparent.

6.2 Laboratory Sample Custody

The FOL will notify the laboratory of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped as well as the anticipated date of arrival.

The laboratory sample program will meet the following criteria:

- The laboratory will designate a sample custodian who is responsible for maintaining custody of the samples and for maintaining all associated records documenting that custody.
- Upon receipt of the samples, the custodian will check the original chain-of-custody documents and compare them with the labeled contents of each sample container for correctness and traceability. The sample custodian will sign the COC record and record the date and time received.
- Care will be exercised to annotate any labeling or descriptive errors. In the event of any discrepancy in documentation, the laboratory will immediately contact the Engineering Consultant's Project Manager and/or PQAM as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies, such as broken or leaking bottles. That assessment will be recorded as part of the incoming COC procedure.
- The samples will be stored in a secured area at a temperature of approximately four degrees Celsius until analyses are to commence.
- A laboratory tracking record will accompany the sample or sample fraction through final analysis for control.
- A copy of the tracking form will accompany the laboratory report and will become a permanent part of the project records.

6.3 Sample Tracking System

A sample tracking system will be implemented to monitor the status of sampling events and laboratory analysis of samples. Sample numbers, types, analytical parameters, sampling dates, and sample delivery group (SDG) designations for samples, and required due dates for receipt of analytical results will be entered into the system. The Engineering Consultant's Project Manager will use the tracking system to monitor the project sampling schedules and the status of analytical reports, and to implement any penalty clauses for late delivery per standard laboratory subcontracts when necessary.

A description of the sample tracking system follows:

1. For each day that samples are collected, the Field Operations Lead (FOL) or designee will complete a COC form (Figure 3) and a Daily Status and Monitoring Report (Figure 4) listing all appropriate samples.
2. The FOL or designee will retain the client copy of the COC, and forward the laboratory copy of the COC with the sample shipment.
3. The FOL or designee will fax copies of the completed COC form and Daily Status and Monitoring Report to the Engineering Consultant's PM. The Engineering Consultant's PM or a designated employee will confirm sample shipment with the laboratory and resolve any sample transfer issues.
4. The status of analytical results will be tracked by the Engineering Consultant's PM or designee using the information provided on the completed COC form and Daily Status and Monitoring Report. The information shall be summarized in a computerized database, as warranted.

Upon receipt of the analytical results from the laboratory, the Engineering Consultant's PM or designee will review the data package for completeness and contract compliance. The Engineering Consultant's PM will then forward the result package to the data validator for validation. The data validator shall be required to submit a complete set of validated data to the Engineering Consultant's PM within 60 days of receipt of the data package report.

The Engineering Consultant's Project Manager or a designated representative will maintain day-to-day contact with the laboratory concerning specific samples and analyses directly or by assignment.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

7.1 Field Instrumentation Calibration

The FOL will be responsible for ensuring that instrumentation are of the proper range, type and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to their specific calibration protocols/procedures.

All field measurement instruments must be calibrated according to the manufacturer's instructions prior to the commencement of the day's activities. Exceptions to this requirement shall be permitted only for instruments that have fixed calibrations pre-set by the equipment manufacturer. Calibration information shall be documented on instrument calibration and maintenance log sheets or in a designated field logbook. The calibration information (log sheet or logbook) shall be maintained at the site during the on-site investigation and, once the field work is completed, shall be placed in the Engineering Consultant's project files. Information to be recorded includes the date, the operator, and the calibration standards (concentration, manufacturer, lot number, expiration date, etc.). All project personnel using measuring equipment or instruments in the field shall be trained in the calibration and usage of the equipment, and are personally responsible for ensuring that the equipment has been properly calibrated prior to its use.

In addition, all field instruments must undergo response verification checks at the end of the day's activities and at any other time that the user suspects or detects anomalies in the data being generated. Verification checks may also be performed at the request of NM or NYSDEC representatives. The checks consist of exposing the instrument to a known source of analyte (e.g., the calibration solution), and verifying a response. If an unacceptable instrument response is obtained during the check (i.e., not within specifications), the data shall be labeled suspect, the problem documented in the site logbook, and appropriate corrective action taken.

Any equipment found to be out of calibration shall be re-calibrated. When instrumentation is found to be out of calibration or damaged, an evaluation shall be made to ascertain the validity of previous test results since the last calibration check. If it is necessary to ensure the acceptability of suspect items, the originally required tests shall be repeated (if possible), using properly calibrated equipment, to acquire replacement data for the measurement in question.

Any instrument consistently found to be out of calibration shall be repaired or replaced within 24 hours or field work will be terminated until the malfunctioning equipment is repaired/replaced.

7.2 Laboratory Instrumentation Calibration

Personnel at the laboratory will be responsible for ensuring that analytical instrumentation are of the proper range, type and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to specific protocols/procedures.

Off-site laboratory equipment shall be calibrated using certified/nationally recognized standards and according to the applicable methodologies and the laboratory Standard Operating Procedures (SOPs).

In addition, these methods/procedures specify the appropriate operations to follow during calibration or when any instrument is found to be out of calibration.

8.0 ANALYTICAL PROCEDURES

All off-site laboratory samples will be analyzed according to the methods provided in Exhibit D of the NYSDEC ASP. QA/QC procedures given in Exhibit E and I of the ASP will be followed. Regardless of the method used, all analytical and extraction holding times must meet the NYSDEC ASP requirements for that analytical group (i.e., volatile analyses, including BTEX, have a holding time of seven days, if unpreserved). Holding times will be calculated from verified time of sample receipt at the laboratory. For NYSDEC ASP, samples must be received at the laboratory within 48 hours of sample collection. The analytical laboratory chosen for the project will be certified, and must maintain certification, under the New York State Department of Health's Environmental Laboratory Approval Program for analyses of solid and hazardous waste. The breakdown of investigative samples is detailed in the Site-Specific Work Plan. Laboratory analytical methods and quantitation limits are presented in Tables 2 and 3 of this Generic QAPP. The method detection limits (MDLs) for the analytes will be specified by the laboratory selected for the project based on its most recent MDL studies, and subject to approval by the NYSDEC.

Field screening samples will be analyzed according to the NYSDEC ASP and the manufacturer's instructions. Unless site-specific requirements dictate a change in concentration limits (which would be explained within the Site-Specific Work Plan), the standard levels for the PAH and PCB screening will be 1 ppm and 10 ppm. The test system user shall be technically qualified individual who has received training in the immunoassay analysis requirements, procedures and potential risks prior to field screening of samples. Use of the field screening test kits will only occur in a controlled environment, following the storage and handling procedures outlined in the NYSDEC ASP and the manufacturer's instructions. Additional technical information on the field screening testing are presented in Attachments 1 and 2.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

The criteria used to identify and quantify the analytes will be those specified for the applicable methods in the ASP.

The data package provided by the laboratory will contain all items specified in the ASP, as appropriate to the analyses performed. Category B reporting will be used.

9.1 Chain-of-Custody Records

Completed copies of the COC records accompanying each sample from time of initial bottle preparation to completion of analysis shall be attached to the report of analytical testing.

9.2 Data Handling

One complete copy and one additional copy of the analytical data summary report will be provided by the laboratory. One set of the analytical data will be forwarded directly to the data validator by the laboratory. The Engineering Consultant's Project Manager will immediately arrange for filing of the complete package, after the QA/QC reviewer checks the package to ensure all deliverables have been provided. The second data summary report will be used to generate summary tables. These tables will form the foundation of a working database for assessment of the site contamination condition.

The Engineering Consultant's Project Manager will maintain close contact with the QA/QC reviewer to ensure all non-conformance issues are acted upon prior to data manipulation and assessment routines. Once the QA/QC review has been completed, the Engineering Consultant's Project Manager may direct the team leaders or others to initiate and finalize the analytical data assessment.

9.3 Data Validation

9.3.1 Full Data Validation

Data validation is a basic step in the control and processing of the project data generated by the laboratory. The data validation process will consist of a systematic review of the analytical results and QC documentation, and will be performed in accordance with the guidelines identified in Section 9.3.1. All off-site laboratory data will undergo full validation, unless otherwise stated in the Site-Specific Work Plan. On the basis of this review, the data validator will make judgments and express concerns and comments on the quality and limitations of specific data, as well as on the validity of the overall data package. The data validator will prepare documentation of his or her review and conclusions in a Data Usability Summary Report (DUSR; see Section 9.3.2).

The data validator will inform the Engineering Consultant's Project Manager of data quality and limitations, and assist the Project Manager in interacting with the laboratory to correct data omissions and deficiencies. The laboratory may be required to rerun or resubmit data depending on the extent of the deficiencies, and their importance in meeting the data quality objectives within the overall context of the project. The validated laboratory data will be reduced into a computerized tabulation which will be suitable for inclusion in the Site Characterization and RI Reports and will be designed to facilitate comparison and evaluation of the data. The data tabulations will be sorted by classes of constituents and by sample matrix. Each individual table will present the following information:

- Sample matrix, designations, and locations;
- Sample dates;
- Constituents for which positive results were obtained;
- Reported constituent concentrations in the field and/or trip blanks associated with the samples;
- Constituent concentration units;
- Name and location of laboratory which performed the analyses;
- Data qualifiers provided by the laboratory; and
- Data qualifiers and comments provided by the data validator, if any.

9.3.1 Data Usability Summary Report (DUSR)

A Data Usability Summary Report (DUSR) will be prepared after reviewing and evaluating the analytical data. The parameters to be evaluated in reference to compliance with the analytical method protocols includes all sample chain-of-custody forms, holding times, raw data (instrument print out data and chromatograms), calibrations, blanks, spikes, controls, surrogate recoveries, duplicates and sample data. If available, the field sampling notes should also be reviewed and any quality control problems should be evaluated as to their effect on the usability of the sample data.

The DUSR will describe the samples and analysis parameters reviewed. Data deficiencies, analytical method protocol deviations and quality control problems will be described and their effect on the data will be discussed in the DUSR.

Resampling/reanalysis recommendations, if applicable, will be made. Data qualifications are documented for each sample analyte following the NYSDEC ASP guidelines.

This work will be performed by trained and experienced data validators who meet the NYSDEC approval criteria. The Environmental Scientist preparing the DUSR must submit a resume to the NYSDEC Quality Assurance Unit documenting relevant experience in environmental sampling and analysis methods and data review and documentation of a Bachelors Degree in Natural Science or Engineering. The results of the data validation screening (i.e. missed holding times or data rejected due to blank contamination) will be incorporated into the data summary tables used in the final investigative report. The DUSR identifies data gaps caused by non-compliant or rejected data, and will indicate what steps have been or will be taken to fill these gaps.

10.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

10.1 Quality Assurance Batching

Each set of samples will be analyzed concurrently with calibration standards, method blanks, MS, MSD or MD, and QC check samples (if required by the protocol). The MS/MSD/MD samples will be designated by the field personnel. If no MS/MSD/MD samples have been designated, then the laboratory must contact the Project Quality Assurance Officer (PQAO) or Engineering Consultant's Project Manager for corrective action.

10.2 Organic Standards and Surrogates

All standard and surrogate compounds are checked by the method of mass spectrometry for correct identification and gas chromatography for degree of purity and concentration. When the compounds pass the identity and purity tests, they are certified for use in standard and surrogate solutions. Concentrations of the solutions are checked for accuracy before release for laboratory use. Standard solutions are replaced monthly or earlier based upon data indicating deterioration.

10.3 Laboratory Quality Control Samples

The quality control samples included are detailed below.

Method Blanks/Preparation Blanks: Analyses for organic compounds (method blank) and inorganics (preparation blank) include a blank analysis of the laboratory reagent water. The blank is analyzed with each set of samples or more often as required to verify that contamination has not occurred during the analytical process. The concentration of target compounds in the blanks must be less than or equal to the method detection limits specified in the ASP for the selected method of analysis.

Matrix Spike/Matrix Spike Duplicate Analysis - This analysis is used to determine the effects of matrix interference on analytical results. Spikes of analytes are added to aliquots of sample matrix in the manner specified in the ASP. Selected samples are spiked to determine accuracy as a percentage recovery of the analyte from the sample matrix and precision as RPD between the MS and MSD samples. A matrix duplicate is prepared in the same manner as the matrix spike sample.

Analytical Duplicate Samples - Replicate samples are aliquots of a single sample that are split on arrival at the laboratory, or upon analysis. Significant differences between two replicates, split in a controlled laboratory environment, will result in flagging the affected analytical results.

Surrogate Spike Analyses - Surrogate spike analyses are used to determine the efficiency of recovery of organic analytes in the sample preparations and analyses. Calculated percentage recovery of the spike is used as a measure of the accuracy of the total analytical method.

Laboratory Control Sample/ (Spike Blank) - For each method which requires a laboratory control sample (LCS) or spike blank, a LCS spike blank will be prepared with each quality control batch and analyzed according to criteria specified in the ASP. These samples support an assessment of the ability of the analytical procedure to generate a correct result without matrix effects or interference affecting the analysis.

11.0 QUALITY ASSURANCE PERFORMANCE AUDITS AND SYSTEM AUDITS

Quality assurance audits may be performed by the Project Quality Assurance Manager (PQAM) or personnel designated by the PQAM. The PQAM and his or her designees function as an independent body and report directly to Engineering Consultant's quality assurance management. The PQAM may plan, schedule, and approve system and performance audits based upon the Engineering Consultant's procedure customized to the project requirements. These audits may be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). At times, the PQAM may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits.

Formal audits encompass documented activities performed by qualified lead auditors to a written procedure or checklists to objectively verify that quality assurance requirements have been developed, documented, and instituted in accordance with contractual and project criteria. Formal audits may be performed on project and subcontractor work at various locations.

Audit reports will be written by lead auditors after gathering and evaluating all resultant data. Items, activities, and documents determined by lead auditors to be in noncompliance will be identified at exit interviews conducted with the involved management. Noncompliances will be logged, documented, and controlled through audit findings which are attached to and are a part of the integral audit report. These audit finding forms will then be directed to management to satisfactorily resolve the noncompliance in a specified and timely manner. All audit checklists, audit reports, audit findings, and acceptable resolutions must be approved by the PQAM prior to issue. QA verification of acceptable resolutions will be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the PQAM will close out the audit report and findings.

It is the Engineering Consultant's Project Manager's overall responsibility to verify that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to the Engineering Consultant's Project Manager within 15 days of completion of the audit. Serious deficiencies must be reported to the Engineering Consultant's Project Manager within 24 hours.

Serious deficiencies identified during an audit will be reported to NM and NYSDEC as part of the DUSR or Site investigation and/or RI Reports.

11.1 System Audits

System audits, performed by the PQAM or designated auditors, may encompass evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or if the Engineering Consultant's Project Manager requests the PQAM to perform unscheduled audits, these activities will be instituted.

11.2 Performance Audits

In accordance with the requirements for NYSDOH ELAP CLP certification, the laboratory will participate in all performance evaluation testing.

Also, one field audit may be performed by the PQAM or designated auditor during collection of the field samples to verify that field samplers are following established sampling procedures. Performance of a field audit will be based on the type of investigation activities being performed, the length of the field project, and any available information concerning prior inspections of the project or sampling team. The Site-Specific Work Plan will provide details on the performance of a field audit.

12.0 PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

12.1 Preventive Maintenance Procedures

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure developed by the operators. Analytical instruments will be serviced at intervals recommended by the manufacturer. An instrument repair/maintenance log book will be kept for each instrument, and this log will be available on-site during field activities and, at the completion of the investigation, be placed in the project files. Entries include the date of service, type of problem encountered, corrective action taken, and initials and affiliation of the person providing the service.

The instrument use log book will be monitored by the analysts to detect any degradation of instrument performance. Changes in response factors or sensitivity are used as indications of potential problems. These are brought to the attention of the laboratory supervisor and preventive maintenance or service is scheduled to minimize down time. Back-up instrumentation and an inventory of critical spare parts are maintained to minimize delays in completion of analyses.

Use of equipment in need of repair will not be allowed, and field work will be terminated until the malfunction is repaired or the instrument replaced.

12.2 Schedules

Written procedures, where applicable, will identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule and to arrange any necessary and prompt service as required. Service to the equipment, instruments, tools, gauges, etc. shall be performed by qualified personnel.

12.3 Records

Logs shall be established to record and control maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges. Records produced shall be reviewed, maintained, and filed by the operators at the laboratories and by the data and sample control personnel when and if equipment, instruments, tools, and gauges are used at the sites. The Engineering Consultant's Project Manager or the PQAM may audit these records to verify complete adherence to these procedures.

12.4 Spare Parts

Where appropriate, a list of critical spare parts will be identified by the operator in consultation with the equipment manufacturer. These spare parts will be stored for availability and use in order to reduce the downtime. In lieu of maintaining an inventory of spare parts, a service contract for rapid instrument repair or backup instruments will be available.

13.0 ASSESSMENT PROCEDURES FOR DATA ACCEPTABILITY

Procedures used to assess data precision and accuracy will be in accordance with the appropriate laboratory method, and as periodically updated.

13.1 Accuracy

The percent recovery is calculated as below:

$$\% = \frac{Ss - So}{S} \times 100$$

So = The background value, i.e.; the value obtained by analyzing the sample

S = Concentration of the spike added to the sample

Ss = Value obtained by analyzing the sample with the spike added

% = Percent Recovery

13.2 Precision

The relative percent difference (RPD) is calculated as below:

$$RPD = \frac{|V1 - V2|}{0.5\,(V1 + V2)} \times 100$$

V1, V2 = The two values obtained by analyzing the duplicate samples

13.3 Completeness

Completeness is the measure of the amount of valid data obtained from a measurement system compared to the total amount expected to be obtained under ideal conditions. A target of 100 percent completeness, calculated for each analysis method, has been established as the overall project objective.

$$PC = \frac{NA}{NI} \times 100$$

where:

PC = Percent completeness
NA = Actual number of valid analytical results obtained
NI = Theoretical number of results obtainable under ideal conditions

14.0 CORRECTIVE ACTION

The following procedures have been established to assure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected.

When a significant condition adverse to quality is noted on-site, at the laboratory, or at a subcontractor location, the cause of the condition will be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the FOL, Engineering Consultant's Project Manager, and involved subcontractor management, at a minimum. Implementation of corrective action is verified by documented follow-up action. All project personnel have the responsibility, as part of the normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality.

At a minimum, corrective actions may be initiated:

- When predetermined acceptance standards are not attained
- When procedure or data compiled are determined deficient
- When equipment or instrumentation is found faulty
- When samples and test results are questionably traceable
- When quality assurance requirements have been violated
- When designated approvals have been circumvented
- As a result of system and performance audits
- As a result of a management assessment
- As a result of laboratory/inter-field comparison studies
- As required by NM
- As required by NYSDEC ASP, 2001

Procedure Description

Project management and staff, such as field investigation teams, remedial response planning personnel, and laboratory groups, monitor on-going work performance in the normal course of daily responsibilities.

Work may be audited at Engineering Consultant's office, Site, laboratory, and subcontractor locations by the PQAM and/or designated auditor. Items, activities, or documents ascertained to be in noncompliance with quality assurance requirements will be documented and corrective actions mandated through audit finding sheets attached to the audit report. Audit findings are logged, maintained, and controlled by the PQAM (Section 11.0).

Technicians assigned quality assurance functions will also control noncompliance corrective actions by having the responsibility of issuing and controlling the appropriate Corrective Action Request Form (Figure 5). All project personnel may identify a noncompliance; however, the technician is responsible for documenting, numbering, logging, and verifying the closeout action. It is the Engineering Consultant's Project Manager's responsibility to verify that all recommended corrective actions are produced, accepted, and received in a timely manner.

The Corrective Action Request (CAR) identifies the adverse condition, reference document(s), and recommended corrective action(s) to be administered. The issued CAR is directed to the responsible manager in charge of the item or activity for action. The individual to whom the CAR is addressed returns the requested response promptly to the technician in charge, affixing his signature and date to the corrective action block, after stating the cause of the conditions and corrective action to be taken. The technician maintains the log for status control of CARs and responses, confirms the adequacy of the intended corrective action, and verifies its implementation. The technician will issue and distribute CARs to specified personnel, including the originator, responsible project management involved with the condition, the Engineering Consultant's Project Manager, involved subcontractor, and the FOL, at a minimum. CARs are transmitted to the project file for the records.

15.0 QUALITY ASSURANCE REPORTS

Quality assurance reports to management may consist of the reports on audits, reports on correction of deficiencies found in audits, a final QA report on field sampling activities, and the data validation report.

At the end of the project, the PQAM may submit a lessons leaned report to the Engineering Consultant's Project Manager which will discuss the QA activities. That report may include discussions of any conditions adverse or potentially adverse to quality, such as responses to the findings of any field or laboratory audits; any field, laboratory, or sample conditions which necessitated a departure from the methods or procedures specified in this QAPP; field sampling errors; and any missed holding times or problems with laboratory QC acceptance criteria; and the associated corrective actions undertaken. This report shall not preclude immediate notification to project management of such problems when timely notice can reduce the loss or potential loss of quality, time, effort, or expense.

These reports, if prepared, shall be reviewed by the Engineering Consultant's Project Manager for completeness and the appropriateness of any corrective actions, and they shall be retained in the project files.

In the final investigative report, laboratory and field QC data will be presented, including a summary of QA activities and any problems and/or comments associated with the analytical and sampling effort. Any corrective actions taken in the field, results of any audits, and any modifications to laboratory protocols will be discussed.

Attachment 1

NYSDEC ASP Methods 4035 (PAHs) and 4020 (PCBs)

Attachment 2

Field PAH and PCB Soil Test Technical Guides and Test Kit Instructions

TABLE 3

TARGET ANALYTES AND CONTRACT REQUIRED QUANTITATION (CRQ) LIMITS[1]

	Contract Required Quantitation Limit Water Samples (ug/L)	Contract Required Quantitation Limit Soil Samples (ug/kg)
NYSDEC ASP TCL Volatile Organic Compounds (by 2001-1)		
Acetone	10	10
Benzene	10	10
Bromodichloromethane	10	10
Bromoform	10	10
Bromomethane	10	10
2-Butanone	10	10
Carbon disulfide	10	10
Carbon tetrachloride	10	10
Chlorobenzene	10	10
Chloroethane	10	10
Chloroform	10	10
Chloromethane	10	10
Dibromochloromethane	10	10
1,1-Dichloroethane	10	10
1,2-Dichloroethane	10	10
1,1-Dichloroethene	10	10
1,2-Dichloroethene (cis and trans)	10	10
1,2-Dichloropropane	10	10
cis-1,3-Dichloropropene	10	10
trans-1,3-Dichloropropene	10	10
Ethylbenzene	10	10
2-Hexanone	10	10
4-Methyl-2-pentanone	10	10
Methylene chloride	10	10
Styrene	10	10
1,1,2,2-Tetrachloroethane	10	10
Tetrachloroethene	10	10
Toluene	10	10
1,1,1-Trichloroethane	10	10
1,1,2-Trichloroethane	10	10
Trichloroethene	10	10
Vinyl chloride	10	10
Total Xylenes	10	10

NOTES

1. Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable. Quantitation limits listed for soil are based on wet weight.
2. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the Site-Specific Work Plan (which will include this information) will take precedence.

TABLE 3 (Cont'd)
TARGET ANALYTES AND CRQ LIMITS[1]

	Contract Required Quantitation Limit Water Samples(ug/L)	Contract Required Quantitation Limit Soil Samples(ug/kg)
NYSDEC ASP TCL - Semivolatile Organic Compounds (by 2001-2) **Base/Neutral Extractables**		
Acenaphthene	10	330
Acenaphthylene	10	330
Anthracene	10	330
Benzo(a)anthracene	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(g,h,i)perylene	10	330
Benzo(a)pyrene	10	330
bis(2-Chloroethoxy)methane	10	330
bis(2-Chloroethyl)ether	10	330
bis(2-ethylhexyl)phthalate	10	330
4-Bromophenyl phenyl ether	10	330
Butyl benzyl phthalate	10	330
Carbazole	10	330
4-Chloroaniline	10	330
2-Chloronaphthalene	10	330
4-Chlorophenyl phenyl ether	10	330
Chrysene	10	330
Dibenz(a,h)anthracene	10	330
Dibenzofuran	10	330
Di-n-butylphthalate	10	330
1,2-Dichlorobenzene	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
3,3'-Dichlorobenzidine	10	330
Diethyl phthalate	10	330
Dimethyl phthalate	10	330
2,4-Dinitrotoluene	10	330

NOTES

1. Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable. Quantitation limits listed for soil are based on wet weight.
2. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the Site-Specific Work Plan (which will include this information) will take precedence.

TABLE 3 (Cont'd)
TARGET ANALYTES AND CRQ LIMITS[1]

	Contract Required Quantitation Limit Water Samples(ug/L)	**Contract Required Quantitation Limit Soil Samples(ug/kg)**
NYSDEC ASP TCL - Semivolatile Organic Compounds (by 2001-2, Cont.)		
2,6-Dinitrotoluene	10	330
Di-n-octylphthalate	10	330
Fluoranthene	10	330
Fluorene	10	330
Hexachlorobenzene	10	330
Hexachlorobutadiene	10	330
Hexachlorocyclopentadiene	10	330
Hexachloroethane	10	330
Indeno(1,2,3-cd)pyrene	10	330
Isophorone	10	330
2-methyl Naphthalene	10	330
Naphthalene	10	330
2-Nitroaniline	25	800
3-Nitroaniline	25	800
4-Nitroaniline	25	800
Nitrobenzene	10	330
N-Nitroso-diphenylamine	10	330
N-Nitroso-dipropylamine	10	330
2,2' Oxybis(1-chloropropane)	10	330
Phenanthrene	10	330
Pyrene	10	330
1,2,4-Trichlorobenzene	10	330

NOTES

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2. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the Site-Specific Work Plan (which will include this information) will take precedence.

TABLE 3 (Cont'd)
TARGET ANALYTES AND CRQ LIMITS[1]

	Contract Required Quantitation Limit Water Samples(ug/L)	Contract Required Quantitation Limit Soil Samples(ug/kg)
NYSDEC ASP TCL - Semivolatile Organic Compounds (by 2001-2, Cont.) **Acid Extractables (cont.)**		
4-Chloro-3-methylphenol	10	330
2-Chlorophenol	10	330
2,4-Dichlorophenol	10	330
2,4-Dimethylphenol	10	330
4,6-Dinitro-2-methylphenol	25	800
2,4-Dinitrophenol	25	800
2-Methylphenol	10	330
4-Methylphenol	10	330
2-Nitrophenol	10	330
4-Nitrophenol	25	800
Pentachlorophenol	25	800
Phenol	10	330
2,4,5-Trichlorophenol	25	800
2,4,6-Trichlorophenol	10	330
NYSDEC ASP TCL Pesticides and PCBs (by 2001-3)		
Aldrin	0.05	1.7
alpha-BHC	0.05	1.7
beta-BHC	0.05	1.7
delta-BHC	0.05	1.7
gamma-BHC (Lindane)	0.05	1.7
Chlordane (alpha &/or gamma)	0.05	1.7
4,4'-DDD	0.10	3.3
4,4'-DDE	0.10	3.3
4,4'-DDT	0.10	3.3
Dieldrin	0.10	3.3
Endosulfan I	0.05	1.7
Endosulfan II	0.10	3.3
Endosulfan sulfate	0.10	3.3

NOTES

1. Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable. Quantitation limits listed for soil are based on wet weight.
2. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the Site-Specific Work Plan (which will include this information) will take precedence.

TABLE 3 (Cont'd)
TARGET ANALYTES AND CRQ LIMITS[1]

	Contract Required Quantitation Limit Water Samples(ug/L)	**Contract Required Quantitation Limit Soil Samples(ug/kg)**
NYSDEC ASP TCL - Pesticides and PCBs (by 2001-3, Cont.)		
Endrin	0.10	3.3
Endrin Aldehyde	0.10	3.3
Endrin Ketone	0.10	3.3
Heptachlor	0.05	1.7
Heptachlor Epoxide	0.05	1.7
Methoxychlor	0.50	17.0
Toxaphene	5.0	170.0
Aroclor-1016	1.0	33.0
Aroclor-1221	2.0	67.0
Aroclor-1232	1.0	33.0
Aroclor-1242	1.0	33.0
Aroclor-1248	1.0	33.0
Aroclor-1254	1.0	33.0
Aroclor-1260	1.0	33.0
NYSDEC ASP TAL Metals and Cyanide (by CLP-M)		
Aluminum	200	
Antimony	60	
Arsenic	10	
Barium	200	
Beryllium	5	
Cadmium	5	
Calcium	5000	
Chromium	10	
Cobalt	50	
Copper	25	
Iron	100	
Lead	3	
Magnesium	5000	

NOTES

1. Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable. Quantitation limits listed for soil are based on wet weight.
2. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the Site-Specific Work Plan (which will include this information) will take precedence.

TABLE 3 (Cont'd.)
TARGET ANALYTES AND CRQ LIMITS[1]

	Contract Required Quantitation Limit Water Samples(ug/L)	**Contract Required Quantitation Limit Soil Samples(ug/kg)**
NYSDEC ASP TAL Metals and Cyanide (by CLP-M) (Cont.)		
Manganese	15	
Mercury	0.2	
Nickel	40	
Potassium	5000	
Selenium	5	
Silver	10	
Sodium	5000	
Thallium	10	
Vanadium	50	
Zinc	20	
Cyanide	10	

NOTES

1. Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable. Quantitation limits listed for soil are based on wet weight.
2. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the Site-Specific Work Plan (which will include this information) will take precedence.

These CRQLs are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E. The quantitation limits for samples may be considerably higher depending on the sample matrix.

TABLE 1
SAMPLE CONTAINERIZATION

Analysis	Bottle Type	Preservation[1]	Holding Time[2]
Aqueous Samples			
Volatile Organics (BTEX)	40 ml glass vial with Teflon-lined septa	Cool to 4°C	7 days
PCBs/Pesticides	1000 ml amber glass	Cool to 4°C	5 days*
Semivolatile Organics (PAHs)	1000 ml amber glass	Cool to 4°C	5 days*
Metals	1000 ml polyethene	HNO_3 to pH <2	6 months (Mercury 26 days)
Cyanide	1000 ml polyethene	NaOH to pH >12	12 days
Soil & Sediment Samples			
Volatile Organics (BTEX)	Wide-mouth glass w/ teflon-lined septa [3]	Cool to 4°C	7 days
Semivolatile Organics (PAHs)	Wide-mouth glass w/ teflon cap [3]	Cool to 4°C	5 days*
Pesticide/PCBs	Wide-mouth glass w/ teflon cap [3]	Cool to 4°C	5 days*
Metals, Cyanide	Wide mouth glass w/ teflon cap [3]	Cool to 4°C	Metals - 6 months Mercury - 26 days Cyanide - 12 days

NOTES

1. All samples to be preserved in ice at 4°C during collection and transport.
2. Days from verified time of sample receipt (VTSR) by the laboratory.
3. Sized appropriately for the analytical method.
4. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in containerization requirements, the Site-Specific Work Plan (which will include this information) will take precedence.

* Extraction of water samples for pesticides/PCB analysis by separating funnel must be completed within five days of VTSR. Continuous liquid-liquid extraction is the required extraction for water samples for semivolatiles. Continuous liquid-liquid extraction of water samples, or sonication or soxhlet procedures for semivolatile and pesticides/PCB analyses, shall be started within five days. If a re-extraction and reanalysis must be performed, the extraction must start within 10 days and completed within 12 days of VTSR. Extracts of either water or soil/sediment samples must be analyzed within 40 days of VTSR.

TABLE 2
LABORATORY ANALYSIS PROGRAM

Matrix	Parameter [1]	Analytical Method [2]
Water	BTEX	Method 8260B*
	VOC	2001-1
	SVOC	2001-2
	PAHs	Method 8270C*
	PCBs and Pesticides	2001-3
	Metals	CLP-M (various for individual metals)
	Cyanide	CLP-M
Soil & Sediments	BTEX	Method 8260B*
	VOC	2001-1
	SVOC	2001-2
	PAHs	Method 8270C*
	Pesticides and PCBs	2001-3
	Metals	CLP-M (various for individual metals)
	Cyanide	CLP-M
	TCLP	Method 1311; Method Series 7000, 8000
Waste Characteristics		Methods 1010/1020A; 9040B/9041A; Section 7.3

NOTES

1. Abbreviations: BTEX = Benzene, Toluene, Ethylbenzene, Xylene; VOCs = Volatile organic compounds; SVOCs = Semivolatile organic compounds; PAHs = Polycyclic aromatic Hydrocarbons; TCLP = Toxicity Characteristic Leaching Procedure; PCBs = Polychlorinated Biphenyls; CLP = Contract Laboratory Program.
2. NYSDEC Analytical Services Protocol, 2001, Category B deliverables.
   Analyses must meet NYSDEC ASP holding time specified for Methods in Exhibit I Part II.
3. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in analytical requirements, the Site-Specific Work Plan (which will include this information) will take precedence

* BTEX and PAH analyses must meet NYSDEC ASP holding time specified for Methods 2001-1 and 2001-2, respectively.

FIGURE 1

DATA REDUCTION, VALIDATION AND REPORTING

Figure 1

DATA REDUCTION, VALIDATION & REPORTING SCHEME

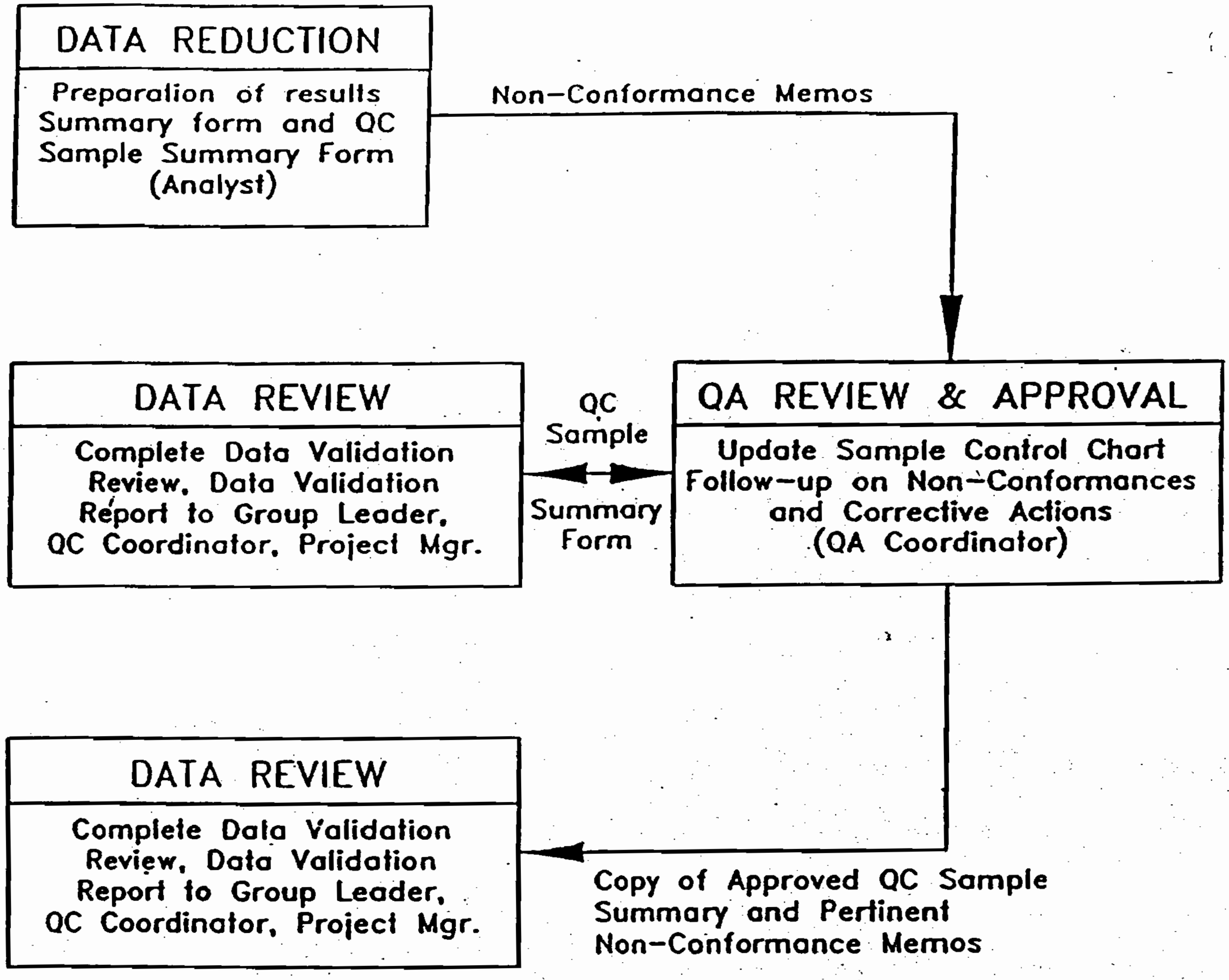
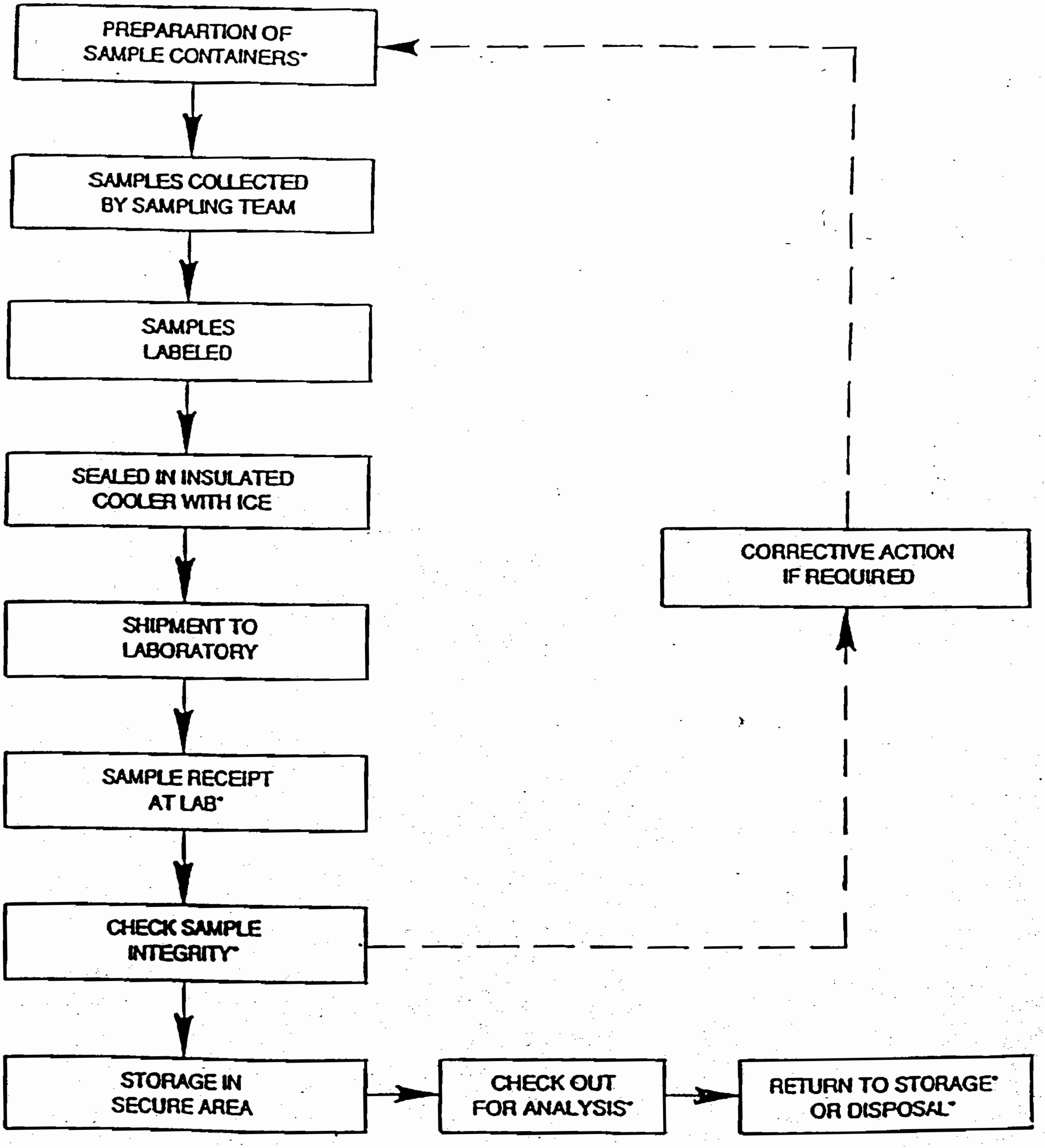


FIGURE 2

SAMPLE CUSTODY

Figure 2

SAMPLE CUSTODY



* Requires sign-off on Chain of Custody Form.

FIGURE 3

CHAIN-OF-CUSTODY RECORD

STL
Committed To *Your* Success

Severn Trent Laboratories
200 Monroe Turnpike
Monroe CT 06468
Tel: (203) 261-4458
Fax: (203) 268-5346

CHAIN OF CUSTODY RECORD

PAGE OF
NO.

STL JOB #:
CLIENT:
PROJECT ID:
STL PROJECT MGR:
RUSH ☐ YES ☐ NO
DUE DATE

[illegible]								[illegible] REMARKS
BOTTLE TYPE AND PRESERVATION								

BOTTLE SET #	CLIENT SAMPLE ID	DATE / TIME SAMPLED	MATRIX	LAB [illegible]	QC [illegible]	FIELD FILTERED / CIRCLE Y or N								SAMPLE REMARKS
						Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	

MATRIX CODES

A	AIR	S	SOIL
AQ	AQUEOUS	SL	SLUDGE
C	COMPLEX	W	WIPE
D	DRUM WASTE	0	OTHER
OI	OIL	FB	FIELD BLANK
		TB	TRIP BLANK

BOTTLES PREPARED BY DATE / TIME
SIGNATURE
SAMPLES COLLECTED BY DATE / TIME
SIGNATURE

BOTTLES REC'D BY DATE / TIME
SIGNATURE
RECEIVED IN LAB BY DATE / TIME
SIGNATURE

REMARKS ON SAMPLE RECEIPT

☐ BOTTLES INTACT ☐ CUSTODY SEALS
☐ PRESERVED ☐ SEALS INTACT
☐ CHILLED ☐ SEE REMARKS

LABORATORY COPY

TO RE-ORDER CALL THE GRAPHIC DESIGN GROUP, INC. 516-243-1082

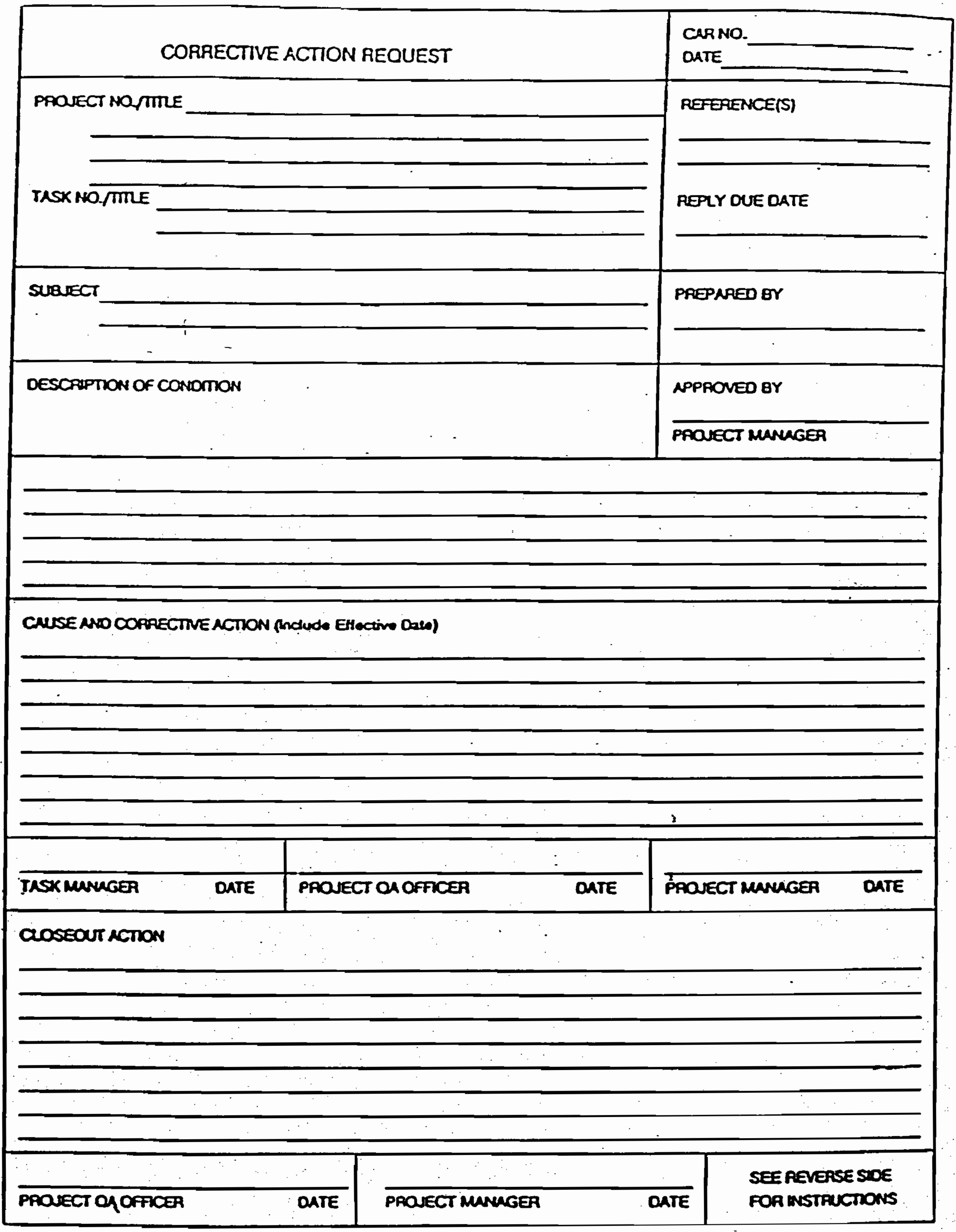
FIGURE 4

DAILY STATUS AND MONITORING REPORT

FIGURE 5

CORRECTIVE ACTION REQUEST FORM

Figure 5



CORRECTIVE ACTION REQUEST

CAR NO. ____

DATE ____

PROJECT NO./TITLE ____

TASK NO./TITLE ____

REFERENCE(S) ____

REPLY DUE DATE ____

SUBJECT ____

PREPARED BY ____

DESCRIPTION OF CONDITION

APPROVED BY ____

PROJECT MANAGER

CAUSE AND CORRECTIVE ACTION (Include Effective Date)

TASK MANAGER DATE

PROJECT QA OFFICER DATE

PROJECT MANAGER DATE

CLOSEOUT ACTION

PROJECT QA OFFICER DATE

PROJECT MANAGER DATE

SEE REVERSE SIDE FOR INSTRUCTIONS

ATTACHMENT 1

ENSYS FIELD PAH AND PCB SOIL TEST TECHNICAL GUIDES AND TEST KIT INSTRUCTIONS

STRATEGIC DIAGNOSTICS INC.

PAHEnSys® 12T SOIL TEST SYSTEM

70613

RAPID IMMUNOASSAY SCREEN

User's Guide

This method correctly identifies 95% of samples that are PAH-free and those containing 1ppm or greater of PAHs. A sample that develops less color than the standard is interpreted as positive. It contains PAHs. A sample that develops more color than the standard is interpreted as negative. It contains less than 1 ppm PAHs.

IMPORTANT NOTICE

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of PAHs. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

TROUBLE SHOOTING GUIDE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

Wash Step - Lack of vigorous washing may result in false positives or negatives depending on whether the wash error was committed on standard or sample tubes. *Solution*: Make sure that the operator washes four times vigorously.

Pipette Calibration - An out-of-calibration pipette may result in false positives or negatives depending on whether the amount is greater or less than the specified transfer volume. *Solution*: Check the calibration at least daily and after any extreme mechanical shock (such as dropping). An indication that the pipette is out of calibration is if the gold barrel is loose and will turn. (When set on 30 µl there should be about 1/4 of an inch between the white plunger and the end of the clear pipette tip.)

Air bubbles in the pipette - the presence of air bubbles in the pipette tip when transferring extracts may result in false positives or negatives depending on whether the error was committed on standard or sample tubes. *Solution*: quickly examine the pipette tip each time an aliquot is withdrawn and go back to the source and take another aliquot to displace the bubble if necessary.

Mixing - Lack of thorough mixing, when instructed, can cause inconsistent results. *Solution*: observe the mixing times in the instructions and to mix with sufficient force to ensure that the liquid is homogeneous.

Timing - it is important to follow the timing steps in the instructions carefully. The incubation step in the antibody tubes can vary a bit without harm to the test. The color development step timing is critical and should be no less than 2 minutes and no greater than 3 minutes.

Addition of Drops - it is important to carefully count the drops added to color development steps. The addition of ±1 drop to the instructed 5 drops can cause variability in the results RIGHT AROUND THE DETECTION LEVELS OF INTEREST. One drop less could result in a darker color (a less dilute solution) and result in a false negative. One drop more could result in a lighter color (a more dilute solution) and result in a false positive

Wiping the Tubes - wiping of the tubes should be done before they are read in the spectrophotometer because smudges and fingerprints on the tubes can give potentially false negative readings.

Mixing Lot #'s - never mix lots! Each kit's components are QC'd together for optimal performance and may give inaccurate results with components from other kits, that are not of the same lot #. Also, the user must NEVER mix components from different types of kits (ex: Petro kit buffer tubes can't be used with a PAH kit).

Storage and Operating Temperatures - temperature requirements are very important and should be strictly adhered to. This information can be found in the kit User's Guide.

Shelf-life - each kit label contains the kit expiration date. To achieve accurate results, kits must be used prior to expiration.

WORKSTATION SET-UP

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WORKSTATION SET-UP

- **Mechanical pipette tips**
- **Stop solution**
- **Standard vial**
- **4 antibody coated tubes**
- **Substrate A**
- **Filtration barrel & plunger**
- **1 and 10 ppm**
- **dilution ampules**
- **Substrate B**
- **Bulb pipette**
- **4 blue buffer tubes**
- **4 conjugate tubes**

READ BEFORE PROCEEDING

- Follow diagram above to setup workstation.
- Items that you will need that are not provided in the test kit include:
  a permanent marking pen, laboratory tissue (or paper towels), a liquid waste container, and disposable gloves.
- This User's Guide was written for analyzing soil samples for PAHs at 1 and 10 ppm.

PAH Standard

Ampule Cracker

TEST PREPARATION

- Label amber vial "PAH standard" and the current date; Standard is usable for up to 2 weeks from this date. Open PAH Standard ampule by slipping ampule cracker over top, and then breaking top at scored neck. Transfer to empty amber vial with bulb pipette. Always cap tightly when finished using Standard.

Bulb Pipette

Amber Vial

PHASE 1 SAMPLE EXTRACTION & PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST.

WEIGH SAMPLE

1c

1a Place unused weigh boat on pan balance.

1b Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.

1c Weigh out 10 + / - 0.1 grams of soil.

1d If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.

Pan balance

Weigh Boat

Wooden spatula

EXTRACT PAHS

2b

2a Uncap extraction jar and place on flat surface. Without contacting solvent, puncture foil seal with ampule cracker or sharp object. Peel the remainder of the seal off extraction jar.

2b Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

2c Recap extraction jar tightly and shake vigorously for one minute.

2d Allow to settle for one minute. Repeat steps 1a -2c for each sample to be tested.

Sample extraction jar

FILTER SAMPLE

3c

3a Remove lid from extraction jar.

3b Disassemble filtration plunger from filtration barrel.

3c Insert bulb pipette into top (liquid) layer in extraction jar and draw up sample. Transfer at least 1/2 bulb capacity into filtration barrel. **Do not use more than one full bulb.**

3d Press plunger firmly into barrel until adequate filtered sample is available (place on table and press if necessary).

Filtration plunger

Bulb pipette

Filtration barrel

READ TO AVOID COSTLY MISTAKES

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SAMPLE DILUTION PROGRAM FOR DETECTION LEVELS OTHER THAN 1 & 10PPM

1. The sample dilution procedure on the next page is for standard detection levels. The following diagram represents the sample dilution procedure for all other detection levels.

2. At your request, your kit may include extra dilution ampules to reach high detection levels.

3. **EVERY AMPULE PROVIDED MUST BE USED!**

If there are any questions concerning the dilution procedure please call Technical Services before running the samples to help avoid costly mistakes.
1-800-544-8881.

EXAMPLE:

Lowest ppm **Intermediate ppm** **Highest ppm**

Dilution Ampules

NOTE: Your order may include additional ampules in order to achieve your test levels. Always transfer filtered sample to the dilution ampule labeled with the lowest PPM level and then transfer from this ampule to the next higher level dilution tube.

PHASE 2 SAMPLE & STANDARD PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Label the glass conjugate and plastic antibody coated tubes with a permanent marking pen.
- When using the mechanical pipette always withdraw and dispense below the liquid level. Instructions for operating the Mechanical Pipette are found on page 13.
- "Shake tubes" means to thoroughly mix the contents with special care not to spill or splash.

DILUTE AND BUFFER SAMPLE FOR 1 PPM AND 10 PPM DETECTION LEVELS

4a Uncap enough blue buffer, conjugate, and antibody coated tubes for Samples and Standards.

4b Empty a blue buffer tube into each conjugate tube.

4c Assemble new tip onto mechanical pipette.

4d Open 1 and 10 ppm dilution ampules by slipping ampule cracker over tip, and then breaking top at scored neck.

PHASE 2 SAMPLE & STANDARD PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

DILUTE AND BUFFER SAMPLE

4e Withdraw 75 μL of filtered sample using mechanical pipette and dispense below the liquid level in 1 ppm dilution ampule. Gently shake ampule for 5 seconds.

4f Withdraw 75 μL of diluted sample from the 1 ppm dilution ampule and dispense below the liquid level in the 10 ppm dilution ampule. Gently shake ampule for 5 seconds.

Dilution ampules (1 & 10 ppm)

Plastic Safety Sleeve

4g Withdraw 75 μL of diluted sample from 10 ppm dilution ampule and dispense below the liquid level in corresponding conjugate tube. Always wipe tip after dispensing into conjugate tube. Withdraw 75μL of 1ppm sample and dispense into corresponding conjugate tube.

Mechanical pipette tip

Mechanical pipette

4h Assemble new tip onto mechanical pipette and withdraw 75μl of PAH Standard and dispense below the liquid level in two conjugate tubes. Immediately replace cap on PAH Standard vial.

4i Gently shake conjugate tubes for 5 seconds.

READ BEFORE PROCEEDING

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

TRANSFER FROM CONJUGATE TUBE TO ANTIBODY COATED TUBE

5b.1

5b.2

5c

5a. Set timer for 10 minutes.

5b. Working left to right in the workstation:

1. Fit all antibody coated tubes firmly on top of all corresponding conjugate tubes.
2. **Start timer and immediately invert all** connected tube pairs so that the liquid is poured into the antibody coated tubes. Return the tube pairs to the appropriate workstation row making sure the larger (antibody coated) tube is on the bottom.

5c. Invert all tube pairs several more times making sure the pair is returned to the workstation with the larger (antibody coated) tube on the bottom.

5d. Disconnect and discard the smaller glass conjugate tubes. [It is not important to worry about drops of liquid adhering to lips of tubes].

Antibody coated tubes (contained in resealable "zip-seal" aluminized pouch)

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

DILUTE AND BUFFER SAMPLE

4e Withdraw 75 µL of filtered sample using mechanical pipette and dispense below the liquid level in 1 ppm dilution ampule. Gently shake ampule for 5 seconds.

6a

4f Withdraw 75 µL of diluted sample from the 1 ppm dilution ampule and dispense below the liquid level in the 10 ppm dilution ampule. Gently shake ampule for 5 seconds.

6b

Wash bottle

4g Withdraw 75 µL of diluted sample from 10 ppm dilution ampule and dispense below the liquid level in corresponding conjugate tube. Always wipe tip after dispensing into conjugate tube. Withdraw 75µL of 1ppm sample and dispense into corresponding conjugate tube.

4h Assemble new tip onto mechanical pipette and withdraw 75µl of PAH Standard and dispense below the liquid level in two conjugate tubes. Immediately replace cap on PAH Standard vial.

4i Gently shake conjugate tubes for 5 seconds.

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- This phase of the procedure requires critical timing and care in handling the antibody coated tubes.

ADD ENZYME

6a Dispense first drop from enzyme dropper into liquid waste container.

Note: before dispensing drops, tap capped tip on hard surface to avoid dispensing air bubbles.

6b Dispense 3 drops of enzyme into each blue buffer tube by squeezing the dropper.

6c Shake buffer tubes for 5 seconds.

7d

INCUBATION

7a Set timer for 10 minutes.

7b Start timing and immediately pour solution from each blue buffer tube into appropriate antibody coated tube.

7c When pouring is complete, gently shake all 4 tubes for 5 seconds.

A

Substrate A

B

Substrate B

STOP

Stop

PHASE 4 INTERPRETATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SELECT STANDARD

8a Wipe outside of all antibody coated tubes.

8b Place both Standard tubes in photometer.

8c Switch tubes until the photometer reading is negative or zero. Record reading.

If reading is greater than - 0.3 in magnitude , results are outside QC limits. Retest the sample(s).

8d Remove and discard tube in right well. The tube in the left well is the more conservative standard and should be used.

MEASURE SAMPLE

9a Place 1 ppm tube in right well of photometer and record reading shown on display.

If photometer reading is negative or zero, PAHs are present.

If photometer reading is positive, concentration of PAHs are less than 1 ppm.

9b Place 10 ppm tube in right well of photometer and record reading shown on display.

If photometer reading is negative or zero, PAHs are present.

If photometer reading is positive, concentration of PAHs are less than 10 ppm.

QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

How It Works

Standards, Samples, and color-change reagents are added to test tubes coated with a chemical specific to PAHs. The concentration of PAHs in an unknown **Sample** is determined by comparing its color intensity with that of a **Standard.**

Note: PAHs concentration is inversely proportional to color intensity; the lighter the color development of the sample, the higher the concentration of PAHs.

Quality Control

Standard precautions for maintaining quality control:

- Do not use reagents or test tubes from one Test System with reagents or test tubes from another Test System.
- Do not use the Test System after its expiration date.
- Each analysis must include 2 **Standards**, with no more than a total of 12 antibody coated tubes.
- Do not exceed incubation periods prescribed by the specific steps.
- Results may not be valid if photometer reading for **Standards** exceed 0.3 in magnitude.

Storage and Handling Precautions

- Wear protective gloves and eyewear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- Keep aluminized pouch (containing unused antibody coated tubes) sealed when not in use.
- If liquid from the extraction jar, or PAH Standard comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Operate test at temperatures greater than 40° F/4 °C and less than 90° F/32° C.
- After use, dispose of kit components in accordance with applicable federal and local regulations.

System Description

Each PAH RISc Soil Test System contains enough material to perform four complete tests, each at 1 and 10 ppm.

The PAH RISc Soil Test is divided into four phases. The instructions and notes should be reviewed before proceeding with each phase.

Hotline Assistance

If you need assistance or are missing necessary Test System materials, call toll free:

1-800-544-8881.

Validation and Warranty Information

Product claims are based on validation studies carried out under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

PAH-free soil and soil containing 1 ppm and 10 ppm of PAHs were tested with the EnSys® PAH analytical method. The method correctly identified 95% of these samples. A sample that has developed less color than the standard is interpreted as positive. It contains PAHs. Either a 1 ppm or a 10 ppm sample that has developed more color than the standard is interpreted as negative. It contains less than the indicated level of PAHs (1 ppm or 10 ppm).

The company does not guarantee that the results with the EnSys® PAH Soil Test System will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

Strategic Diagnostics Inc. warrants that this product conforms to the descriptions contained herein. No other warranties, whether expressed or implied, including warranties of merchantability and of fitness for a particular purpose shall apply to this product.

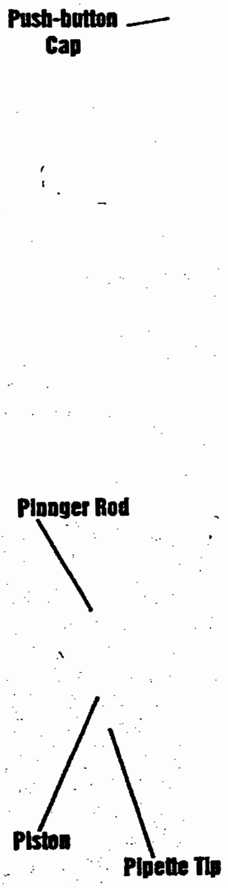
SDI neither assumes nor authorizes any representative or other person to assume for it any obligation or liability other than such as is expressly set forth herein.

Under no circumstances shall SDI be liable for incidental or consequential damages resulting from the use or handling of this product.

MECHANICAL PIPETTE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

HOW TO OPERATE THE MECHANICAL PIPETTE



To Set Or Adjust Volume

Remove push-button cap and use it to loosen volume lock screw. Turn lower part of push-button to adjust volume up or down. Meter should read "075". Tighten volume lock screw and replace push-button cap.

To Assemble Pipette Tip

Slide larger mounting end of pipette tip onto end of pipette. Holding tip in place, press push-button until plunger rod enters pipette tip. Ensure no gap exists between piston and plunger rod (see illustration).

To Withdraw Sample

With tip mounted in position on pipette, press push-button to first stop and hold it. Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no bubbles exist in liquid portion of sample. If bubbles exist, dispense sample and re-withdraw sample.

To Dispense Sample

Place tip into dispensing vessel (immersing end of the tip if vessel contains liquid) and slowly press push-button to first stop. (Do not push to second stop or tip will eject).

Remove tip from vessel and release push-button.

To Eject Tip

Press push-button to second stop. Tip is ejected.

For additional information regarding operation and use of pipette, please refer to your pipette manual.

ON-SITE QUALITY CONTROL/QUALITY ASSURANCE RECOMMENDATIONS
SDI EnSys® TEST SYSTEM

Please read the following before proceeding with field testing.

SAMPLING

The result of your screening test is only as valid as the sample that was analyzed. Samples should be homogenized thoroughly to ensure that the 10 grams you remove for field testing is representative of the sample as a whole. All other applicable sample handling procedures should be followed as well.

PRIOR TO TESTING SAMPLES

Carefully follow the instructions in the User's Guide included with every test kit. This is the key element in obtaining accurate results. In addition, store your unused test kits at room temperature and do not use them past their expiration date (see label on each test kit).

INTERNAL TEST QC

Two standards are analyzed with each sample to provide internal test system quality control. With both standards inserted in the photometer, a valid test is indicated when the magnitude of the displayed number (irrespective of the sign, + or -) is less than the value given in the User's Guide. Test runs resulting in a greater number should be repeated to ensure valid conclusions.

QA/QC

The validity of field test results can be substantially enhanced by employing a modest, but effective QA/QC plan. SDI recommends that you structure your QA/QC plan with the elements detailed below. These have been developed based on the data quality principles established by the U.S. Environmental Protection Agency.

A. **Sample Documentation**
   1. Location, depth
   2. Time and date of collection and field analysis

B. **Field analysis documentation** - provide raw data, calibration, any calculations, and final results of field analysis for all samples screened (including QC samples)

C. **Method calibration** - this is an integral part of EnSys RIS® immunoassay tests; a duplicate calibration is performed for each set of samples tested (see the instructions in the User's Guide)

D. **Method blank** - analyze methanol from the extraction jar.

E. **Site-specific matrix background field analysis** - collect and field analyze uncontaminated sample from site matrix to document matrix effect

F. **Duplicate sample field analysis** - field analyze duplicate sample to document method repeatability; at least one of every 20 samples should be analyzed in duplicate

G. **Confirmation of field analysis** - provide confirmation of the quantitation of the analyte via an EPA-approved method different from the field method on at least 10% of the samples; choose at least two representative samples testing above the action level; provide chain of custody and documentation such as gas chromatograms, mass spectra, etc.

H. **Performance evaluation sample field analysis (optional, but strongly recommended)** - field analyze performance evaluation sample daily to document method/operator performance

I. **Matrix spike field analysis (optional)** - field analyze matrix spike to document matrix effect on analyte measurement

FURTHER QUESTIONS?

SDI's technical support personnel are always prepared to discuss your quality needs to help you meet your data quality objectives. 1-800-544-8881.

Data for PAH EnSys® Soil Test

Operator: ______________ Date: ______________ Location: ______________

Sample ID	ΔOD	OD sample	Interpretation	OD sample	Interpretation	N O T E S
	Standards	_____ ppm		_____ ppm		

STRATEGIC DIAGNOSTICS INC.

PCB EnSys®
12T SOIL
TEST SYSTEM

70203

RAPID IMMUNOASSAY SCREEN

User's Guide

IMPORTANT NOTICE

This method correctly identifies 95% of samples that are PCB-free and those containing 1 ppm or greater of PCBs. A sample that develops less color than the standard is interpreted as positive. It contains PCBs. A sample that develops more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of polychlorinated biphenyls. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

TROUBLESHOOTING GUIDE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WASH STEP

Lack of vigorous washing may result in false positives or negatives depending on whether the wash error was committed on standard or sample tubes. Solution: Make sure to wash four times vigorously, washing the whole set of 12 tubes at once.

PIPET CALIBRATION

An out-of-calibration pipet may result in false positives or negatives depending on whether the amount is greater or less than the specified transfer volume. *Solution*Check the calibration at least daily and after any extreme mechanical shock (such as dropping). An indication that the pipet is out of calibration is if the gold barrel is loose and will turn. (When set on 30 µl there should be about a 1/4 of an inch between the white plunger and the end of the clear pipet tip.)

AIR BUBBLES IN THE PIPET

The presence of air bubbles in the pipet tip when transferring extracts may result in false positives or negatives depending on whether the error was committed on standard or sample tubes. *Solution*Quickly examine the pipet tip each time an aliquot is withdrawn and go back to the source and take another aliquot to displace the bubble if necessary.

MIXING

Lack of thorough mixing, when instructed, can cause inconsistent results. *Solution*Observe the times in the instructions and mix with sufficient force to ensure that the liquid is homogenous.

TIMING

It is important to follow the timing steps in the instructions carefully. The incubation step in the antibody tubes can vary a bit without harm to the tests. The color development step timing is critical and should be no less than 2 minutes and no greater than 3 minutes.

WIPING THE TUBES

Wiping of the tubes should be done before they are read in the spectrophotometer because smudges and fingerprints on the tubes can give potentially false negative readings.

MIXING LOT #'S

Never mix lots! Each kit's components are matched for optimal performance and may give inaccurate results with the components from other kits with different lot #'s. Also, NEVER mix components from different types of kits (ex: Petro kit buffer can not be used with a PAH kit).

STORAGE AND OPERATING TEMPERATURES

Temperature requirements are very important and should be strictly adhered to. This test kit should be stored at less than 80°F/27°C and operated between 40°F/4°C and 90°F/32°C.

SHELF-LIFE

Each kit label contains the kit expiration date. To achieve accurate results, kits must be used prior to expiration.

WORKSTATION SET-UP

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WORKSTATION SET-UP

- **Mechanical pipet tips**
- **Filter barrels & plungers**
- **Ampule cracker**
- **Glass PCB buffer tubes**
- **Substrate A**
- **Eppendorf pipet tips**
- **Bulb pipets**
- **PCB standard**
- **Antibody coated tubes**
- **Substrate B**
- **Extraction jars**
- **1 & 10 ppm dilution ampules**
- **Stop Solution**

Workstation shows components for 3 samples tested at 2 levels

TEST PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Do not attempt to run more than 12 tubes, two of which must be standards.
- Items that you will need that are not provided in the test kit include: a permanent marking pen, laboratory tissue (or paper towels), a liquid waste container, and disposable gloves.
- This User's Guide was written for analyzing soil samples for PCBs at 1 and 10 ppm. See table on page 10 for sensitivity to various Aroclors.

TEST PREPARATION

- Label all Eppendorf repeater tips. Tips can be reused for future analyses. Label the first 5mL tip "A", the second 5mL tip "B" and the third 5mL tip "Stop".
- Label the 12.5 mL tip "Buffer".

Eppendorf Tip

STANDARD PREPARATION

- Open PCB Standard ampule by slipping ampule cracker over top, and then breaking tip at scored neck. Transfer solution to empty vial with Bulb Pipets.
- Label vial with current date. Standard is usable for 2 weeks. Always cap tightly when finished using standard.

PCB Standard

Ampule cracker

Bulb pipet

Amber vial

PHASE 1 EXTRACTION & PREPARATION OF THE SAMPLE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WEIGH SAMPLE

1a. Place unused weigh boat on pan balance.

1b. Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.

1c. Weigh out 10+/0.1 grams of soil.

1d. If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.

Weigh Boat

Pan balance

Wooden spatula

EXTRACT PCBS

2a. Uncap extraction jar and place on a flat surface. Without contacting solvent puncture foil seal with ampule cracker or sharp object. Peel the remainder of the seal off extraction jar.

2b. Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

2c. Recap extraction jar tightly and shake **vigorously** for one minute.

2d. Allow to settle for one minute.

Repeat steps 1a - 2c for each sample to be tested.

Extraction Jar

FILTER SAMPLE

3c

3a. Disassemble filtration plunger from filtration barrel.

3b. Insert bulb pipet into top (liquid) layer in extraction jar and draw up sample. Transfer **at least ½ bulb capacity** into filtration barrel. **Do not use more than one full bulb.**

3c. Press plunger firmly into barrel until adequate filtered sample is available (place on table and press if necessary).

Repeat steps **3a - 3c** for each sample to be tested.

Filtration plunger

Bulb pipet

Filtration barrel

READ TO AVOID COSTLY MISTAKES

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SAMPLE DILUTION PROGRAM

1. The sample dilution procedure on the next page is for standard detection levels. The following diagram represents the sample dilution procedure for all other detection levels.
2. Your kit may include extra dilution ampules to reach high detection levels.
3. **EVERY AMPULE PROVIDED MUST BE USED!**

If there are any questions concerning the dilution procedure please call SDI Technical Services before running the samples to help avoid costly mistakes. (1-800-544-8881)

EXAMPLE:

Lowest ppm **Intermediate ppm** **Highest ppm**

Dilution Ampules

NOTE: **Your Kit may include additional ampules in order to achieve your test levels. Always transfer filtered sample to the dilution ampule labeled with the lowest PPM level and then transfer from this ampule to the next higher level dilution tube.**

PHASE 2 SAMPLE & STANDARD PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Label the plastic antibody coated tubes with a permament marking pen.
- When using the mechanical pipet always withdraw and dispense below the liquid level.
- "Shake tubes" means to thoroughly mix the contents with special care not to spill or splash.

DILUTE SAMPLES AND STANDARDS

4a. Set the Eppendorf Repeater on 4, assemble the "Buffer" tip and fill with Buffer.

4b. Dispense 1 mL of Buffer into each glass buffer tube.

4c. Open 1 and 10 ppm dilution ampules by slipping ampule cracker over top, and then breaking top at scored neck.

4d. Withdraw 60 μL of filtered sample using mechanical pipet and dispense below the liquid level in "1 ppm" dilution ampule. Gently shake ampule from side to side for 5 seconds to mix thoroughly.

4e. Withdraw 60 μL from the "1 ppm" dilution ampule using mechanical pipet and dispense below the liquid level in "10 ppm" dilution ampule. Gently shake ampule from side to side for 5 seconds to mix thoroughly.

4f. Transfer 60 μL from each dilution ampule into glass buffer tubes. Always wipe tip after dispensing into buffer tube.

4g. Change pipet tip and repeat 4d - 4f for each sample.

4h. Assemble new pipet tip on mechanical pipet and transfer 60 μL from Standard vial into two glass buffer tubes. Immediately replace cap on PCB Standard vial.

4i. Shake all glass buffer tubes for 5 seconds.

Dilution ampules

Ampule cracker

Mechanical pipet

Mechanic pipet tip

Glass buffer tubes

PCB Standard vial

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

TRANSFER FROM DILUTION TUBE TO ANTIBODY COATED TUBE

5b.1

5b.2

5c

5a. Set timer for 10 minutes

5b. Working left to right in the workstation:

1. Fit all antibody coated tubes firmly on top of all corresponding glass buffer tubes.
2. Start timer and immediately invert all connected tube pairs so that the liquid is poured into the antibody coated tubes. Return the tube pairs to the appropriate workstation row making sure the larger (antibody coated) tube is on the bottom.

5c. Invert all tube pairs several more times making sure the pair is returned to the workstation with the larger (antibody coated) tube on the bottom.

5d. Disconnect and discard the smaller (dilution) tubes. It is not important to worry about drops of liquid adhering to lips of tubes.

5e. Place conjugate tubes behind antibody tubes in workstation. Remove grey caps and discard.

TRANSFER OF CONJUGATE TO ANTIBODY COATED TUBES

6b

6c

6d

AFTER 10 MINUTES, IMMEDIATELY:

6a. Set timer for 5 minutes.

6b. Working left to right in the workstation:
Start timer and immediately:
Dissolve the conjugate pellets by horizontally connecting the antibody coated tubes and conjugate tubes and **tilt the liquid up to pour it onto the conjugate.**

6c. Return the connected tubes to the appropriate workstation row making sure **the larger (antibody coated) tube is on the bottom. It is important that this step is completed within one minute for all tubes.**

6d. In order to adequately mix solution, **invert** all connected tube pairs **several more times** making sure that the pair is returned to the workstation with the larger (antibody coated) tube on the bottom.

6e. Disconnect and discard the conjugate tubes. It is not important to worry about the loss of liquid adhering to lip of tubes.

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING
WASH PROCEDURE

- An accurate test requires a vigorous wash accomplished by directing a strong stream into the antibody coated tubes.
- The wash solution is a harmless, dilute solution of detergent.

WASH

7a

7b

7a After the 5 minute incubation, empty antibody coated tubes into liquid waste container.

7b Wash antibody coated tubes by vigorously filling and emptying a total of 4 times.

7c Tap antibody coated tubes upside down on paper towels to remove excess liquid. Residual foam in the tubes will not interfere with test results.

Note: When running up to 12 antibody coated tubes, tubes can be washed in two groups - one group immediately following the other group.

Wash bottle

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

COLOR DEVELOPMENT

8a. Set the Eppendorf Repeater on 2, assemble the "A" tip and fill with Substrate A (TMB, yellow label).

8b. Dispense once (200 µL) into each antibody coated tube.

8c. Set timer for exactly 2 1/2 minutes.

8d. Assemble "B" tip, fill with Substrate B, start timer, and dispense once (200 µL H_2O_2, green label) into each antibody coated tube.

8e. Shake all tubes for 5 seconds. Solution will turn blue in some or all antibody coated tubes.

8f. Assemble "Stop" tip, fill with Stop Solution (red label), and stop reaction at end of 2 1/2 minutes by dispensing once (200 µL) into each antibody coated tube.

Substrate A Substrate B Stop

AROCLOR SENSITIVITY

Aroclor	Lowest Detection Level
1248	1.0 ppm
1254	0.5 ppm
1260	0.5 ppm
1242	2.0 ppm
1232	4.0 ppm
1016	4.0 ppm

PHASE 4 ANALYSIS OF RESULTS

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SELECT STANDARD

9b

9a. Wipe outside of all antibody coated tubes.

9b. Place both Standard tubes in photometer.

9c. Switch tubes until the photometer reading is negative or zero. Record reading.

If reading is greater than - 0.3 in magnitude (reading is less than or lower than - 0.3), results are outside QC limits. Retest the sample(s). (See QC Example)

9d. Remove and discard tube in right well. The tube in the left well is the conservative standard.

QC Check Example:

If the photometer reading (with both Standard tubes) is **-0.34 or 0.34**, results are <u>outside</u> the QC limits, and the samples should be retested.

If the photometer reading (with both Standard tubes) is **-0.27 or 0.27**, results are <u>within</u> the QClimits, and testing may proceed.

MEASURE SAMPLE

10a

10a. Place 1 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 1 ppm.

10b. Place 10 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 10 ppm.

QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

System Description

Each SDI PCB Ensys® Soil 12 Test Case contains enough material to perform 12 test samples, each at two detection levels.

The SDI PCB EnSys Soil Test is divided into four phases. The instructions and notes should be reviewed before proceeding with each phase.

Hotline Assistance

If you need assistance or are missing necessary Test System materials, call toll free: 1-800-544-8881.

Validation and Warranty Information

Product claims are based on validation studies carried out under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

PCB-free soil and soil containing 1 ppm or greater of PCBs were tested with the SDI EnSys PCB analytical method. The method correctly identified 95% of these samples. A sample that has developed less color than the standard is interpreted as positive. It contains PCBs. A sample that has developed more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

SDI does not guarantee that the results with the PCB EnSys Soil 12 Test System will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

How It Works

Standards, Samples, and color-change reagents are added to test tubes, coated with a chemical specific to PCBs. The concentration of PCBs in an unknown **Sample** is determined by comparing its color intensity with that of a **Standard**.

Note: PCB concentration is inversely proportional to color intensity; the lighter the color development of the sample, the higher the concentration of PCBs.

Quality Control

Standard precautions for maintaining quality control:

- Do not use reagents or test tubes from one Test System with reagents or test tubes from another Test System.
- Do not use the Test System after any portion has passed its expiration date.
- Do not attempt the test using more than 12 antibody coated tubes (two of which are Standards) at the same time.
- Do not exceed incubation periods prescribed by the specific steps.
- Always follow the procedure in this user's guide.
- Use EPA Method 8080 or Code of Federal Regulations Title 40, Part 136, Appendix A, Method 680 to confirm results.

Storage and Handling Precautions

- Wear protective gloves and eyewear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- Keep aluminized pouch (containing unused antibody coated tubes) sealed when not in use.
- If Stop Solution or liquid from the extraction jar comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Standard Solution contains PCBs. Test samples may contain PCBs. Handle with care.

REPEATER PIPET & MECHANICAL PIPET

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

HOW TO OPERATE THE REPEATER PIPET

To Set Or Adjust Volume

To determine the pipetting volume, the dial setting (1-5) is multiplied by the minimum pipetting volume of the tip.

To Assemble Pipet Tip

Slide filling lever down until it stops. Then raise the locking clamp and insert the tip until it clicks into position. Be sure the tip plunger is fully inserted into the barrel before lowering the locking clamp to affix the tip in place.

To Fill Tip

With tip mounted in position on pipet, immerse end of tip into solution. Slide filling lever upward slowly.

To Dispense Sample

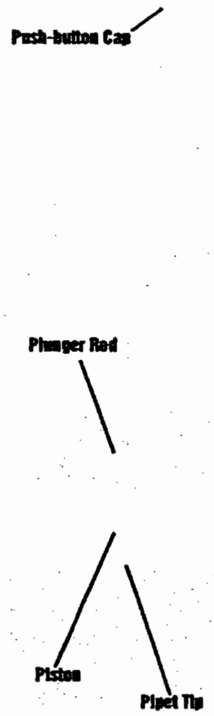
Check the volume selection dial to ensure pipetting volume. Place tip inside test tube so that tip touches the inner wall of tube. Completely depress the pipetting lever.

To Eject Tip

Empty tip of any remaining solution into appropriate container. Raise locking clamp upward, and remove the tip.

For additional information regarding operation and use of repeater, please refer to your Repeater pipet manual.

Mechanical Pipet



Repeater Pipet

HOW TO OPERATE THE MECHANICAL PIPET

To Set Or Adjust Volume

Remove push-button cap and use it to loosen volume lock screw. Turn lower part of push-button to adjust volume up or down. Meter should read "060". Tighten volume lock screw and replace push-button cap.

To Assemble Pipet Tip

Slide larger mounting end of pipet tip onto end of pipet. Holding tip in place, press push-button until plunger rod enters pipet tip. **Ensure no gap exists between piston and plunger rod.**

To Withdraw Sample

With tip mounted in position on pipet, press push-button to first stop and hold it.

Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no bubbles exist in liquid portion of sample. If bubbles exist, dispense sample and re-withdraw sample.

To Dispense Sample

Place tip into dispensing vessel (immersing end of the tip if vessel contains liquid) and slowly press push-button to first stop. (Do not push to second stop or tip will eject).

Remove tip from vessel and release push-button.

To Eject Tip

Press push-button to second stop. Tip is ejected.

For additional information regarding operation and use of pipet, please refer to your pipet manual.

ON-SITE QUALITY CONTROL/QUALITY ASSURANCE RECOMMENDATIONS
SDI EnSys® 12 TEST SYSTEM

Please read the following before proceeding with field testing.

PRIOR TO TESTING SAMPLES

Carefully follow the instructions in the User's Guide included with every test kit. This is the key element in obtaining accurate results. In addition, store your unused test kits at room temperature and do not use them past their expiration date (see label on each test kit).

INTERNAL TEST QC

Two standards are analyzed with each sample to provide internal test system quality control. With both standards inserted in the photometer, a valid test is indicated when the magnitude of the displayed number (irrespective of the sign, + or -) is less than the value given in the User's Guide. Test runs resulting in a greater number should be repeated to ensure valid conclusions.

QA/QC

The validity of field test results can be substantially enhanced by employing a modest, but effective QA/QC plan. SDI recommends that you structure your QA/QC plan with the elements detailed below. These have been developed based on the data quality principles established by the U.S. Environmental Protection Agency.

A. **Sample Documentation**
   1. Location, depth
   2. Time and date of collection and field analysis

B. **Field analysis documentation** - provide raw data, calibration, any calculations, and final results of fieldanalysis for all samples screened (including QC samples)

C. **Method calibration** - this is an integral part of SDI's EnSys immunoassay tests; a duplicate calibration is performed for each set of samples tested (see the instructions in the User's Guide)

D. **Method blank** - analyze methanol from the extraction jar.

E. **Site-specific matrix background field analysis** - collect and field analyze uncontaminated sample from site matrix to document matrix effect

F. **Duplicate sample field analysis** - field analyze duplicate sample to document method repeatability; at least one of every 20 samples should be analyzed in duplicate

G. **Confirmation of field analysis** - provide confirmation of the quantitation of the analyte via an EPA-approved method different from the field method on at least 10% of the samples; choose at least two representative samples testing above the action level; provide chain of custody and documentation such as gas chromatograms, mass spectra, etc.

H. **Performance evaluation sample field analysis (optional, but strongly recommended)** - field analyze performance evaluation sample daily to document method/operator performance

I. **Matrix spike field analysis (optional)** - field analyze matrix spike to document matrix effect on analyte measurement

FURTHER QUESTIONS?

SDI's technical support personnel are always prepared to discuss your quality needs to help you meet your data quality objectives. (1-800-544-8881)

Data for SDI PCB EnSys® 12T Soil Test

Operator:.................................... Date:.............. Location:...

Sample ID	ΔOD	OD sample	Interpretation	OD sample	Interpretation	Comments
	Standards	____ ppm		____ ppm		

APPENDIX C

SITE HEALTH AND SAFETY PLAN

ADDENDUM TO THE GENERIC ENVIRONMENTAL HEALTH AND SAFETY PLAN FOR SITE INVESTIGATIONS

MALONE FORMER MGP SITE, MALONE, NEW YORK

The above-referenced document, prepared for Niagara Mohawk's Investigation Program for Non-Owned Former MGP Sites, has been reviewed by TRC Environmental Corporation's (TRC's) Corporate Health and Safety Director to ensure completeness and conformance with TRC corporate policies. Based upon this review and approval, TRC will implement and adhere to the health and safety program described in the Generic HASP for the upcoming Malone former MGP field investigation program. Site-specific information, including updated emergency and Contact Information and directions to the nearest hospital are attached.

TRC Environmental Corporation

Gary Ritter, CIH, CHMM
TRC Corporate Health and Safety Director

Date 7-15-03

EMERGENCY AND SITE CONTACT INFORMATION (as of 8/23/04)

CONTACT	FIRM OR AGENCY	TELEPHONE NUMBER
Police	--	911
Fire Department	--	911
Hospital	Alice Hyde Medical Center 115 Park Street Malone, NY 12953	(518) 483-3000
Ambulance	--	911
NM Project Manager: Steve Stucker	Niagara Mohawk	(315) 428-5652 (office)
NM MGP Program Director: Chuck Willard	Niagara Mohawk	(315) 428-5015
NM Safety Department Brian Powell	Niagara Mohawk	(315) 428-6194 (office) (518) 923-6005 (pager)
TRC Project Manager/Site Lead: Doug Martin	TRC Environmental Corp.	(860) 298-6204 (office) (860) 966-0825 (cell)
TRC Safety Manager: Gary Ritter	TRC Environmental Corp.	(860) 298-6256
Chemtrec	--	(800) 424-9300
National Response Center	--	(800) 424-8802
NYSDEC Spill Hotline	NYSDEC	(800) 457-7362 (518) 457-7362
NYSDEC Project Manager: Russ Huyck, P.E.	NYSDEC	(518) 897-1242 (office)
Poison Control Center	--	(800) 336-6997
Underground Facility Protective Organization (UFPO)	UFPO	(800) 962-7962
Utility Emergencies (Electric and Gas)	Niagara Mohawk	(800) 932-0301
Village sewer and water Frank Riley	Village of Malone Department of Public Works	(518) 483-3521

PLAN ACCEPTANCE FORM

This form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the Generic EHS Plan. It is maintained on Site by the EL as a project record.

Each field team member shall sign this section after Site-specific training is completed and before being permitted to work on-site.

I have read, or have been informed of, the Generic Environmental Health and Safety Plan and the Site Specific Work Plan and understand the information presented. I will comply with the provisions contained therein.

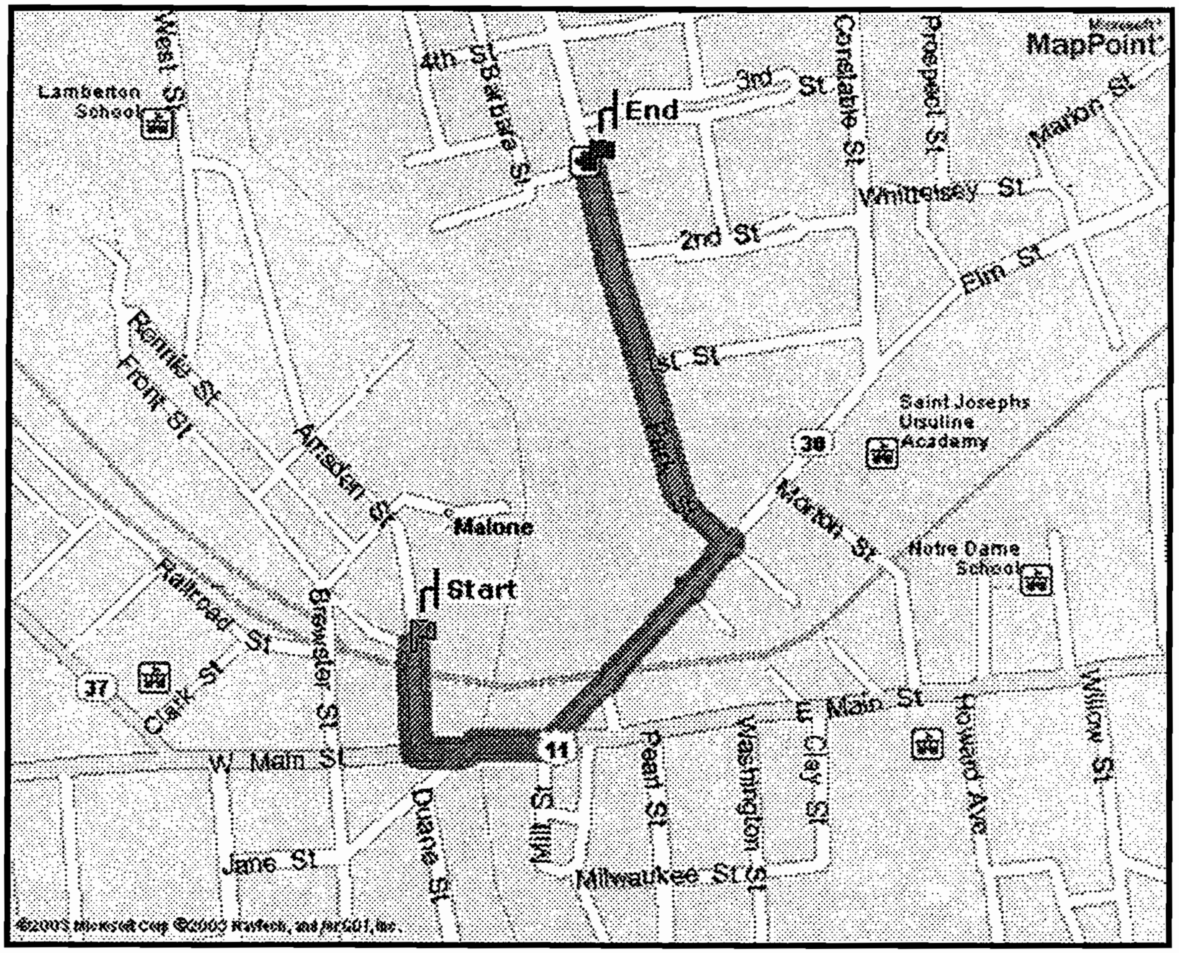
Name (Print and Sign)	Date
DOUGLAS MARTIN Douglas A Martin	2/26/04
HARRY LYON	2-26-04
CRAIG BROWN	
	2-26-04
	8-18-04
Douglas A Martin	8/18/04
HARRY LYON	

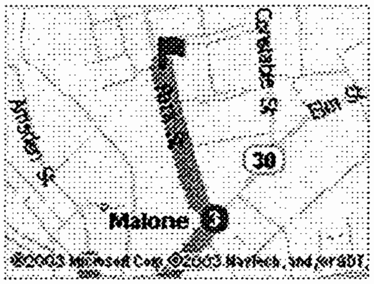
DIRECTIONS TO HOSPITAL

msn Maps & Directions

Featuring Microsoft® MapPoint® Technology

Start: 25 Amsden St, Malone, NY 12953
End: 115 Park St, Malone, NY 12953
Total Distance: 0.7 Miles
Estimated Total Time: 3 minutes



Directions	Miles	Map
Start: Depart 25 Amsden St, Malone, NY 12953 on Amsden St (South)	0.1	
1: Turn LEFT (East) onto US-11 [W Main St]	0.1	
2: Bear LEFT (North-East) onto SR-30 [Elm St]	0.2	
3: Turn LEFT (North-West) onto Park St **End:** Arrive 115 Park St, Malone, NY 12953	0.3	

GENERIC

ENVIRONMENTAL HEALTH AND SAFETY PLAN

FOR

SITE INVESTIGATIONS

AT NON-OWNED FORMER MGP SITES

NOVEMBER 2002

Prepared for:

Niagara Mohawk, A National Grid Company
300 Erie Boulevard West
Syracuse, New York

Reviewed and Approved by: ______________________ ________________
(Signature) (Date)

Site Specific
Revisions Attached: Supplement No. _____ Date ____________

GENERIC ENVIRONMENTAL HEALTH AND SAFETY PLAN
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APPROVALS

By their signatures, the undersigned certify that this Generic Environmental Health and Safety (EHS) Plan is approved and will be utilized at all Niagara Mohawk Non-owned Former MGP Sites.

Date

Engineering Consultant Program Manager

Engineering Consultant Safety Manager

Date

EMERGENCY CONTACTS

The Emergency Contacts should be listed in each of the Site-Specific Work Plans. On arrival at each Site, the list of emergency phone numbers should be verified and posted by the Environmental Leader (EL). In the event of any situation or unplanned occurrence requiring assistance, the appropriate contact(s) should be made from the list. For emergency situations, contact should first be made with the EL who will notify emergency personnel who will then contact the appropriate response teams. The emergency contacts list must be in an easily accessible location at the Site.

ROUTE TO HOSPITAL:

The Route to Hospital will be available in the Site-Specific Work Plan. Upon arrival at the Site before work commences, the directions to the hospital and a route-map from the Site must be posted by the EL. Travel time from the Site to the hospital should be estimated. Only in **non-emergency** situations should an injured person be transported to the hospital by means other than an ambulance.

Emergency Contacts

Niagara Mohawk Project Managers:	
William R. Jones, PE	315-428-5690 (Office)
Douglas Mayer	315-428-5386 (Office)
Peter Moreau	315-428-6808 (Office)
James F. Morgan	315-428-3101 (Office)
Steven P. Stucker, CPG	315-428-5652 (Office)
Charles F. Willard, PG	315-428-5015 (Office)
Niagara Mohawk Safety Department:	
Brian Powell	315-460-1303 (Office)
Engineering Consultant Safety Manager:	
Engineering Consultant Program Manager:	

SECTION 1 - INTRODUCTION

1.1 PURPOSE AND REQUIREMENTS

This Generic Environmental Health and Safety Plan (EHS Plan) addresses the health and safety practices that will be employed by all Site workers participating in activities at any Niagara Mohawk Non-owned Former MGP Site. This EHS Plan takes into account the typical hazards inherent to this type of Site and activities, and presents procedures to be followed by Engineering Consultant personnel (Engineering Consultant), its subcontractors, and all other on-site personnel in order to avoid and, if necessary, protect against health and/or safety hazards. Activities performed under this Generic EHS Plan will comply with applicable parts of OSHA Regulations, primarily 29 CFR Parts 1910 and 1926. Modifications to the Generic EHS Plan may be made with the approval of the Safety Manager using the Change Request Form provided in Appendix A.

This Generic EHS Plan assigns responsibilities, establishes standard operating procedures (SOPs), and provides for contingencies that may arise while operations are being conducted at these Niagara Mohawk Non-owned Former MGP Sites.

The provisions of the plan are mandatory for all on-site personnel. All personnel shall abide by this plan. Subcontractors may prepare their own Generic EHS Plans to be reviewed and approved by the Engineering Consultant Safety Manager, but they must conform to this Plan at a minimum. All personnel who engage in project activities must be familiar with this Generic EHS Plan and comply with its requirements. These personnel must sign-off on the Plan Acceptance Form (Appendix A) prior to beginning work on the Site. The Plan Acceptance Form must be submitted to the Engineering Consultant Safety Manager.

The Engineering Consultant Safety Manager shall review each individual Site to be investigated and the specific activities planned for the Site Investigation and shall address health and safety issues unique to that Site or not fully covered by the Generic EHS Plan in the Site-Specific Work Plan. If necessary, modifications to this Generic EHS Plan shall also be made by the Engineering Consultant Safety Manager to address Site-specific factors.

1.2 SITE DESCRIPTION

This information is provided in the Site-Specific Work Plan.

1.2.1 Summary of Site Conditions

This information will be found in the Site-Specific Work Plan.

1.3 SCOPE OF WORK

The following list is a summary of field activities, which may be implemented as part of the Site Characterization (SC) or Remedial Investigation (RI) at Niagara Mohawk Non-owned Former MGP Sites. Further details are provided in the Site-Specific Work Plan.

- Soil gas sampling
- Drilling and Well Installation
- Excavation of test pits
- Geophysical investigation
- Abandoned underground pipe sampling
- Tank investigation
- On and off site investigation
- Indoor air monitoring and sampling
- Water and sediment sampling

1.4 PROJECT TEAM ORGANIZATION

This section specifies the Project Organization.

1.4.1 Engineering Consultant Project Manager (PM)

The PM responsibilities typically include:

- Ensuring the identification of Site-Specific Work Plans during the planning phase of the project;
- Ensuring that the Generic EHS Plan and the Site-Specific Work Plans have the required approvals before any Site work is conducted; and
- Ensuring that the SM or EL is informed of project changes, which require modifications to the Generic EHS Plan.

1.4.2 *Engineering Consultant* Safety Manager (SM)

The Safety Manager (SM) responsibilities typically include:

- Ensuring that the Generic EHS Plan is reviewed by personnel with the appropriate regulatory knowledge;
- Approving the individual who is assigned as the EL for the project;
- Ensuring that the Generic EHS Plan addresses the EHS risks and regulatory requirements for the project;
- Reviewing the Site-Specific Work Plan;
- Ensuring that the EL understands the requirements of the Generic EHS Plan;
- Provides for the development and approval of the Generic EHS Plan;

- Serves as the primary contact to review health and safety matters that may arise;
- Approves revised or new safety protocols for field operations;
- Coordinates revisions of this Generic EHS Plan with field personnel; and
- Assists in the investigation of all incidents.

1.4.3 **Engineering Consultant Environmental Leader**

The EL is a person knowledgeable in appropriate safety and health regulations with at least one year of experience or specialized training in serving in an H&S staff role on hazardous waste remediation sites. The EL's responsibilities typically include:

- Ensures that the Generic EHS Plan is implemented in conjunction with the SM;
- Ensures all information is added to the plan in a timely manner as it becomes available;
- Ensures that field work is scheduled with adequate personnel and equipment resources to complete the job safely;
- Ensures that emergency phone numbers have been developed in the Site-Specific Work Plans and are posted and maintained and that adequate telephone communication between field crews and emergency response personnel is maintained;
- Ensures that field Site personnel are adequately trained and qualified to work at the Site;
- Enforces Site health and safety rules;
- Conducts daily safety briefings;
- Investigates all incidents;
- Conducts weekly Site inspections;
- Completes and maintains Accident/Incident Report Forms;
- Conducting Generic EHS activities specified in Generic EHS Plan, as assigned;
- Identifying new information and/or operational changes which require modifications to the Generic EHS Plan;
- Ensuring that plan modifications are documented and are approved by the SM;
- Ensures that proper personal protective equipment is utilized by field teams;
- Monitors compliance with this Generic EHS Plan;
- Notifies SM of all accidents/incidents;
- Determines upgrade or downgrade of personal protective equipment (PPE) based on Site conditions and/or real-time monitoring results;
- Ensures that monitoring instruments are calibrated;

- Reports to SM to provide summaries of field operations and progress; and
- Maintains health and safety data in the field logbooks.

1.4.4 Site Personnel

Site personnel shall report any unsafe or potentially hazardous conditions to the EL, also:

- Maintain knowledge of the information, instructions and emergency response actions contained in the Generic EHS Plan and the Site-Specific Work Plan
- Comply with rules, regulations and procedures as set forth in this SHSP and any revisions
- Prevent admittance to work sites by unauthorized personnel
- Inspect all tools and equipment, including PPE, daily prior to use

SECTION 2 - RISK ANALYSIS

2.1 CHEMICAL HAZARDS

Compounds that typically may be encountered while conducting remedial investigation at this Site or any former MGP Site include polycyclic aromatic hydrocarbons (PAHs), benzene, toluene, ethyl benzene and xylene (BTEX); and cyanide salts. Specific compounds and their relevant properties are shown in Table 2-1 (see Appendix B).

In addition to the compounds on-site, some of the solvents used in the processing of samples and for the decontamination of equipment are potentially hazardous to human health if not used properly. In addition to the chemical hazards existing at the Site, additional chemical hazards may be present due to materials being brought to the Site, such as acids/organic compounds, and decontamination fluids. Prior to working with these materials on-site, MSDSs shall be obtained and reviewed by all potentially affected personnel. A copy of all MSDSs shall be available at the Site location.

2.2 PHYSICAL HAZARDS

Most safety hazards are discussed in the Activity Hazard Analysis (AHA) in Appendix E for the different phases of the project. In addition to the AHAs, general work rules and other safety procedures are described in Section 6.1 of this Generic EHS Plan.

2.2.1 Heat Stress

Site activities may take place during time periods where exposure to temperature extremes could occur. In order to minimize exposure to temperature extremes, Site personnel shall be familiar with the health effects of exposure to temperature extremes and the control measures that can minimize exposure. Procedures for monitoring and prevention may be found in Appendix F.

2.2.2 Noise

Noise is a potential hazard associated with the operation of heavy equipment, power tools, pumps and generators. All employees routinely working within 10 feet of these operations will wear hearing protection. All employees are to receive a pre-employment audiogram as part of their physical examination. High noise areas shall be so designated.

2.2.3 Drill Rig Operations

In order to install monitoring wells and soil borings, a hollow-stem auger-drilling rig will be used. Working with or near this equipment poses many potential hazards, including being struck by or against, or pinched/caught by, that can result in serious physical harm. All employees will be briefed on the potential hazards prior to the start of the job.

2.2.4 Hand and Power Tool Usage

In order to complete the various tasks for the project, hand and power tools may be utilized. The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool, fire, and electrocution. A ground fault current interrupter (GFCI) shall be used with all power tools used on-site.

2.2.5 Fire and Explosion

The use of a drill rig, diesel engine, steam cleaners and tools that are gasoline powered presents the possibility of encountering fire and explosion hazards. Prior to the start of any work, all underground utilities and piping that may pose a potential hazard will be identified and located. The One Call center will be called and underground utilities will be located and marked, on private property a private locating service will be used and/or a geophysical survey will be conducted. In the event a pipe or line is struck, work will stop and the emergency response plan will be implemented. Additionally, diesel fuel and gasoline shall be stored in metal cans with self-closing lids and flash arrestors.

2.2.6 Slips, Trips, and Falls

Working in and around the Site may pose slip, trip and fall hazards due to potentially slippery surfaces and uneven terrain. Potential adverse health effects include falling to the ground and becoming injured or twisting an ankle.

2.2.7 Manual Lifting

Manual lifting of heavy objects will be required for several tasks. Workers will be trained on proper lifting and getting help. Not following proper lifting technique can result in back injuries and strains. Back injuries are a serious concern as they are the most common workplace injury, often resulting in lost or restricted work time, and long treatment and recovery periods.

2.2.8 Steam, Heat, and Splashing

Exposure to steam/heat/splashing hazards can occur during steam cleaning operations and sampling activities. Exposure to steam/heat/splashing can include scalding/burns, eye injury, and puncture wounds. PPE will include ANSI approved safety glasses, face shield whenever splashing is involved and Tyvek or Poly/Saran coveralls.

2.2.9 Traffic and Road Hazards

Speed limit for traffic is 15 mph for all areas of the site except the main road where the speed limit is 25 mph.

- Personnel are not allowed to use a cellular phone while driving a vehicle on-site.
- Use flagmen or spotters for traffic control whenever there is work on or along a roadway, heavy or congested traffic, "blind spots", or where there are road hazards or unsafe road conditions. Flagmen must use flags/sign paddles that are 18" x 18" square minimum. For projects requiring work affecting traffic on public roads, including temporary lane closures, a traffic control plan shall be prepared in accordance with the requirements contained in the Manual on Uniform Traffic Control Devices for Streets and Highways (available for purchase at http://mutcd.fhwa.dot.gov/ser-pubs.htm).
- The temporary traffic control zone includes the entire section of roadway between the first advance warning sign through the last traffic control device, where traffic returns to its normal path and conditions. Most temporary traffic control zones can be divided into four areas: the advance warning area, the transition area, the activity area, and the termination area.
- In the advance warning area, drivers are informed of what to expect. The advance warning may vary from a single sign or flashing lights on a vehicle to a series of signs in advance of the temporary traffic control zone transition area. On freeways and expressways, where driver speed is generally in the higher range (45 mph or more), signs may be placed from 500 feet to 1/2 mile or more before the temporary traffic control zone.
- Transition Area - When redirection of the driver's normal path is required, traffic must be channeled from the normal path to a new path. This redirection is intended to occur at the beginning of the transition area. In mobile operations, this transition area moves with the workspace. Transition areas usually involve strategic use of tapers. (Tapers are cones used in a pattern to direct traffic, see Section 6 of MUTCD.)
- Activity Area - The activity area is an area of roadway where the work takes place. It is composed of the workspace and the traffic space, and may contain one or more buffer spaces.
- Termination Area - The termination area is used to return traffic to the normal traffic path. The termination area extends from the downstream end of the work area to the End Road Work signs.
- All personnel directly involved with this phase of work will wear high visibility vests, shirts, or jackets at all times.
- Use proper controls to restrict traffic (if necessary) and/or inform personnel in daily tailgate safety meeting.
- Put cones/barriers up at a safe distance, taper the cones from near the shoulder to the lane line to send traffic in that direction and to keep unnecessary traffic out of work area(s).
- Do not approach heavy equipment unless eye contact with appropriate hand signals has been made with the operator to cease activity. Equipment operators shall confirm that

eye contact had been made by stopping operation and clearly showing their hands are off of the controls.

2.2.10 Confined Space Entry

Follow OSHA 1910.146 confined space procedure including air monitoring and instrument calibration. No confined space entry should be made if there is any other feasible method for doing the job. If a confined space entry must be made, planning and training with the fire department for possible rescue of confined space entrants must be accomplished prior to the confined space entry. Determine if the confined space is a permit required confined space. If the confined space is a permit required confined space, the permit must be filled out and all conditions addressed prior to entry. Purging and ventilation must be conducted to remove hazardous atmospheres if they are detected by air monitoring.

"Confined space," means a space that:

(1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and
(2) Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and
(3) Is not designed for continuous employee occupancy.

A Permit Required Confined Space is a confined space which has one or more of the following characteristics:

(1) Contains or has the potential to contain a hazardous atmosphere

(2) Contains a material that has the potential to engulf the entrant

(3) Has an internal configuration that could trap or asphyxiate an entrant

2.2.11 Boating and Water Safety

Follow Coast Guard safety regulations. Boat should be equipped with at least 1 pair of oars, throwing ring with at least 50' of line, Personal Floatation Devices (PFDs) for each person onboard, 1 Ball-end Boat hook, tie-up line, tool kit, a 10 pound minimum ABC type fire extinguisher, flashlight, air horn, anchor. File a float plan before you leave the shore. Nobody will stand in the boat while underway or docking.

2.3 BIOLOGICAL HAZARDS

During the course of the project, there is a potential for workers to come into contact with biological hazards such as animals, insects and plants. The Activity Hazard Analysis found in Appendix E will include specific hazards and control measures for each task.

2.3.1 **Animals**

During Site operations, animals such as dogs, cats, mice and snakes may be encountered. Workers shall use discretion and avoid all contact with animals. If these animals present a problem, efforts will be made to remove these animals from the Site by contacting a licensed pest control technician.

2.3.2 **Insects**

Insects, such as mosquitoes, ticks, bees and wasps may be present during certain times of the year. Workers will be encouraged to wear repellents when working in areas where insects are expected to be present. If insects are prevalent, efforts will be made to remove them from the Site by contacting a licensed pest control technician.

2.3.2.1 Lyme Disease

Since the site is located in the northeast, the potential for coming into contact with deer ticks exists. Lyme disease is caused by an infection from a deer tick that is about the size of the head of a pin. After a blood feeding, the tick becomes engorged and may vomit its stomach contents into the host, a microorganism (spirochete) may be transmitted into the bloodstream that may lead to Lyme disease. The feeding time is 24 to 48 hours. The effects of the disease vary from person to person, which often makes it difficult to diagnose. Typically, the incubation period ranges from two days to two weeks. In most cases, the infected area will resemble a red bull's eye with concentric rings. Within the same period, flu-like symptoms may develop. If left untreated, the red ringed area will eventually fade and Lyme disease may further develop into an arthritis-like condition.

The best method for stopping insect borne disease is to avoid the bite. Control measures to prevent Lyme Disease include the following:

- Avoid dense or high brush, when possible
- Wear light colored clothing
- Spray DEET on your skin and Permethrin on clothing and work boots
- Tuck pant legs into socks and shirts into gloves, if possible
- Self/Buddy check of neck, hairline, groin and body after working in areas that may contain deer ticks
- Wear light colored tyvek or clothing
- Wear booties over work boots
- Look for ticks upon returning from field work
- Shower As Soon As Possible
- If a tick is found, suffocate it with baby oil applied to the tick, then remove it by pulling gently at the head with tweezers or better, the Pro-Tick removal system. (See below.)
- Report any of the above symptoms and all tick bites to the SHSO for evaluation. Employees bitten by deer ticks during the course of employment, or one who finds an engorged tick on their body, will be given a medical examination.

Analysis of the tick for Spirochete may be warranted. Administration of antibiotic therapy may be warranted.

4.2.2 Plants

Plants such as poison ivy and poison oak may be prevalent at the site during certain times of the year. Workers will be trained to recognize these plants and to minimize contact with them. Employees may wear PPE in order to reduce the potential for exposure. Pre-exposure topical lotions, such as Tecuu, may be applied prophylactically. "Ivy Block" is an easy to use non-prescription, pre-exposure lotion. You apply it like sunscreen to all exposed skin. It dries quickly and the active ingredient, bentoquatam, guards you against the harmful oil in poison ivy, oak and sumac. Remove lotion with running water and soap after risk of exposure has ended. Toll FREE ORDER LINE (800) 421-1223.

The use of Clorox wipes to decontaminate reusable clothing to preclude exposure to poison ivy may prove valuable. Gloves should be worn during decontamination and removal of PPE.

SECTION 3 – MEDICAL MONITORING AND PERSONNEL PROTECTION

3.1 MEDICAL MONITORING

All contractor and subcontractor personnel performing field work where potential exposure to contaminants exists at the Site are required to have passed a medical surveillance examination in accordance with 29 CFR 1910.120(f).

A medical examination shall be administered and shall include a medical and work history and a standard occupational physical, examination of all major organ systems, complete blood count with differential (CBC), and a SMAC/23 blood chemistry screen which includes calcium, phosphorous, glucose, uric acid, BUN, creatinine, albumin, SGPT, SGOT, LDH, globulin, A/G ratio, alkaline phosphatase, total protein, total bilirubin, triglyceride, cholesterol, and a creatinine/BUN ratio. Additionally a pulmonary function test will be performed by trained personnel to record Forced Vital Capacity (FVC) and Forced Expiratory Volume in one second (FEV1.0). An audiogram and visual acuity measurement, including color perception, is provided.

A physician's medical release for work will be confirmed by the EL before an employee can work in the exclusion zone. The examination will be taken annually at a minimum and upon termination of hazardous waste site work if the last examination was not taken within the previous six months. Additional medical testing may be required by the SM in consultation with the EL if an over-exposure or accident occurs, if an employee exhibits symptoms of exposure, or if other Site conditions warrant further medical surveillance.

3.1.1 Medical Data Sheet

A medical data sheet is provided in Appendix A. This medical data sheet is voluntary and should be completed by all on-site personnel and will be maintained at the Site. Where possible, this medical data sheet will accompany the personnel needing medical assistance. The medical data sheet will be maintained in a secure location, treated as confidential, and used only on a need-to-know basis.

TABLE 3-1
PERSONAL PROTECTIVE EQUIPMENT SELECTION

TASK	HEAD	EYE/ FACE	FEET	HANDS	BODY	HEARING	RESPIRATOR
Mobilization/demobilization	HH	SG	STB	LWG	Work	EP as needed	Level D
Soil Gas sampling	HH	SG	STB	LWG	Work	EP as needed	Level D
Well Drilling	HH	SG	STB	LWG	Work	EP as needed	Level D
Geophysical investigation	HH	SG	STB	LWG	Work	EP as needed	Level D
Excavation of test pits	HH	SG	STB, OB	LWG	Tyvek	EP as needed	Level D*
Abandoned underground pipe sampling	HH	SG	STB, OB	Nit, Sur	Tyvek or Poly	EP as needed	Level D *
Tank investigation	HH	SG	STB, OB	Nit, Sur	Tyvek or Poly	EP as needed	Level D*
Indoor air monitoring	HH	SG	STB, OB	LWG	Tyvek	EP as needed	Level D*
Water and Sediment sampling	HH	Goggles	STB, OB	Nit, Sur	Tyvek or Poly	None	Level D*
On and off site investigation	HH	SG	STB	LWG	Work	EP as needed	Level D
Heavy equipment decontamination	HH	PFS with SG or sp. gog.	STB, OB	Nit, Sur	Poly	EP as needed	Level D

HEAD PROTECTION
HH = Hard Hat
HEARING PROTECTION
EP = ear plugs
RESPIRATORY PROTECTION
Level D = No respiratory protection required
Level C = Full face air purifying respirator with OV/R-100 cartridges

EYE/FACE PROTECTION
PFS = Plastic Face Shield
SG = ANSI approved safety glasses with side shields
sp. gog. = Splash Goggles
BODY PROTECTION
Poly = Polyethylene coated tyvek coveralls
Tyvek = Uncoated paper tyvek coveralls
Work = Work clothes

FOOT PROTECTION
OB = Overboot
STB = Leather work boots with steel toe.
HAND PROTECTION
LWG = Leather Work Gloves
Nit = Nitrile
Sur = Surgical

* Level C if air monitoring indicates action level exceeded.

3.2 PERSONAL PROTECTIVE EQUIPMENT

The personal protective equipment (PPE) specified in Table 3-1 represents a hazard analysis for PPE selection. Specific information on the selection rationale for each activity can be found under Section 2.0 and Appendix E-Activity Hazard Analysis. For the purposes of PPE selection, the SM and EL are considered competent persons. The signature on the front of the Generic EHS Plan constitutes certification of the hazard assessment.

As established in this SHSP, the initial level of personal protective equipment (PPE) will be modified Level D for all activities. Sampling data and past experience indicate a relatively low hazard for exposure. Level C PPE may be required if action levels indicate the need to upgrade. For activities not covered by AHAs, the EL will conduct the hazard assessment and select the PPE using the form provided in Appendix A and will certify the assessment by signing the form. PPE selection will be made in consultation with the SM. Modifications for initial PPE selection may also be made by the EL in consultation with the SM using the same form. A written justification for major downgrades will be provided to the SM for approval on a Change Request form. Both the respirator and cartridges specified for use in Level C protection must be fit-tested prior to use in accordance with OSHA regulation (29 CFR 1910.134). Cartridges should be changed out on the following schedule:

- Every shift or 8 hours under normal conditions; and
- Every four hours under conditions of high humidity (>85%).

Air purifying respirators cannot be worn under the following conditions:

- Oxygen deficiency;
- IDLH concentrations; and
- If contaminant levels exceed designated use concentrations.

3.3 AIR MONITORING REQUIREMENTS

3.3.1 On-site Air Monitoring

The following monitoring instruments will be used during all field operations:

- Photoionization Detector (PID), Photovac Microtip with 10.6 eV probe or equivalent
- Colorimetric detector tubes and pump for Benzene and Hydrogen Cyanide, the tubes for Benzene will only be used if a non-transient reading on the PID indicates the presence of VOCs.
- Dust Meter, MIE Miniram model PDM-3 or MIE PDR or equivalent
- Combustible Gas Indicator (CGI)/Oxygen (O_2) meter, MSA model Five Star or equivalent

All air monitoring equipment will be calibrated and maintained in accordance with Appendix D. Organic vapor concentrations shall be measured continuously using the PID during the sampling and drilling activities. A wind-monitoring device shall be used to enable easy detection of wind direction during all intrusive activities. Organic vapor concentrations shall be measured upwind of the work site(s) to determine background concentrations at least twice a day, (once in the morning and once in the afternoon). The EL will interpret monitoring results using professional judgment.

Colorimetric detector tubes shall be used to determine the presence of benzene when action levels suggested in Table 3-2 have been exceeded. Use the following Benzene tube (requires double tube):
Benzene - Range - 0.5 - 10 ppm, SKC Cat. No. = 810-121SP

A dust meter shall be used to measure airborne particulate matter during intrusive activities. Monitoring will be continuous and readings will be observed over a 15-minute period and recorded every 15 minutes for comparison with the action levels.

A CGI/O_2 meter shall be used to monitor for combustible gases and oxygen content in the boreholes and surrounding areas and elsewhere as necessary. During drilling operations, combustible gas readings shall be collected each time the auger bit is removed from the borehole.

The National Institute for Occupational Safety and Health (NIOSH) has established guidelines concerning the action levels for work in a potentially explosive environment. These guidelines are as follows:

- 10% LEL- Limit all activities to those which do not generate sparks.
- 20% LEL- Cease all activities in order to allow time for the combustible gases to vent.

Confined space entry requires stop work and exit at 10% LEL.

TABLE 3-2
ACTION LEVELS

Instrument	Reading	Level of Respiratory Protection/Action
HCN Monotox unit or tube	< 3 ppm	D
	Alarm at 3 ppm or greater	B
PID	Bkg - < 1 ppm, NT[*] above background (Bkg) in breathing zone (Bz)	D
PID	> 1 ppm, NT above bkg in Bz	Use detector tube for Benzene.
	1 - 10 ppm confirmed benzene with detector tube	C, notify SM
	1 - 25 ppm, NT above bkg (absence of benzene)	D
PID	> 25 and < 250 ppm, NT above bkg in Bz	C
PID	> 250 ppm, NT above bkg in Bz	B Institute vapor suppression measures

NT = Non Transient

TABLE 3-2
(Continued)

ACTION LEVELS

Instrument	Reading	Level of Respiratory Protection/Action
CGI/O_2 meter	> 10% LEL, borehole	Proceed with caution
CGI/O_2 meter	> 20% LEL, borehole	Stop work, allow to vent
CGI/O_2 meter	> 5% LEL, in Bz	Limit activities to those which do not generate sparks
CGI/O_2 meter	> 20% LEL, in Bz	Stop work, allow to vent, if levels do not drop below 20% LEL the borehole will be sealed.
CGI/O_2 meter	< 19.5% O_2, in Bz	B
CGI/O_2 meter	> 23.5% O_2, surrounding area or borehole	Stop work and evacuate the work area. Eliminate all ignition sources. Purge borehole if necessary. Identify source of oxygen.
Dust Meter	< 2.5 mg/m^3	D
Dust Meter	>2.5 – 10 mg/m^3, 15-minute avg. **or** 1½ x above background	C with R-100 cartridges Institute dust suppression measures
Dust Meter	> 10 mg/m^3,	Stop work

If the combustible gases in the well/borehole are not diminished after allowing adequate time to vent, then the following steps should be taken:

- Obtain an air compressor (minimum 1.5 horsepower).
- Place the compressor a safe distance from the well (at least 20 ft.). This precaution is necessary since the compressor is an ignition source.
- Place hose into the well/hole until it reaches bottom.
- Run compressor for 15 minutes.
- Measure the percent LEL in the well/borehole. If the reading continues above 20% LEL, continue to run the compressor. If levels are below 20% LEL, continue to monitor the well/borehole for 5 minutes; if readings remain below 20% LEL, resume drilling, and continue to monitor. If levels do not drop below 20% LEL the borehole will be sealed and work on that well will cease.

3.3.2 <u>Community Air Monitoring Plan</u>

Real-time air monitoring for volatile compounds at the perimeter of the exclusion zone will be conducted. If particulates become a concern at the Site, possibly as a result of drilling activities or wind erosion of soils, this community plan will be modified accordingly. The following procedures will be implemented during field activities as appropriate:

- Volatile organic compounds will be monitored at the downwind perimeter of the exclusion zone on a continuous basis. If total organic vapor levels exceed 5 ppm above background, drilling activities will be halted and monitoring continued under the provisions of the Vapor Emission Response Plan. All readings must be recorded in the field logbook and be available for State (NYSDEC & NYSDOH) personnel to review.
- Particulates will become a concern if visible dust emissions occur from Investigation activities or wind erosion. When particulates become a concern, the following protocol will be followed. Particulates will be continuously monitored downwind of the exclusion zone with a portable real-time particulate monitor that will have an alarm set at 2.5 mg/m^3. If downwind particulate levels integrated over a period of 15 minutes exceed 2.5 mg/m^3, then particulate levels upwind of the exclusion zone will be measured. If the downwind particulate level is more than two and one half times greater than the upwind particulate level, then drilling activities will be stopped and corrective action taken. All readings will be recorded in the field logbook and be available for State (NYSDEC & NYSDOH) personnel to review. These action levels can be modified with the agreement of NYSDEC & NYSDOH if particulates are better characterized and identified.

Vapor Emission Response Plan

If the ambient air concentration of organic vapors exceeds 25 ppm above background levels at the perimeter of the exclusion zone with no Benzene present, drilling activities will cease and monitoring continued. If the organic vapor level decreases below 25 ppm (above background), drilling activities may resume. If the organic vapor levels are greater than 25 ppm but less than 50 ppm over background at the perimeter of the work area, activities may resume provided:

- Level C protection is provided to workers in the EZ with Organic Vapor cartridges.
- The organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest residence or commercial structure, whichever is less, is below 25 ppm over background; and
- More frequent intervals of monitoring, as directed by the EL, are conducted.

If the organic vapor level is above 50 ppm over background at the perimeter of the exclusion zone, work activities will halt and odor control contingencies will be implemented. A biodegradable, surfactant-based foam concentrate, such as MSA's VEEfoam, will then be sprayed onto the drill cuttings or excavated soils to control the fugitive vapors. When work shutdown occurs, downwind air monitoring as directed by the EL will be implemented to ensure that vapor emissions do not impact the nearest residential or commercial structure.

If organic vapor levels greater than 25 ppm over background are identified 200 feet downwind from the investigation Site, or half the distance to the nearest residential or commercial property line, whichever is less, all work must cease. If, following cessation of work activities and implementation of odor control contingencies, organic vapor levels persist above 25 ppm above background 200 feet downwind or half the distance to the nearest residential or commercial property from the exclusion zone, then air quality must be monitored within 20 feet of the perimeter of the nearest residential/commercial structure (the "20 foot zone").

If organic vapor levels approach 25 ppm above background within the "20 foot zone" for a period of more than 30 minutes, or organic vapor levels greater than 50 ppm above background for any time period occur within the "20 foot zone", then the following steps will be taken:

- The local police authorities will immediately be contacted by the EL and advised of the situation.
- Frequent air monitoring will be conducted at 30-minute intervals within the 20 foot zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the EL.
- All emergency contacts will go into effect as appropriate.
- If readings fail to drop below 25 ppm after 30 minutes the borehole will be sealed.

3.4 WASTE DISPOSAL PROCEDURES

All discarded materials, waste materials or other objects shall be handled in such a way as to preclude the potential for spreading contamination, creating a sanitary hazard or causing litter to be left on-site. All potentially contaminated materials, e.g., clothing, gloves, etc., will be bagged or drummed as necessary, labeled and segregated for off-site disposal. All non-contaminated materials shall be collected and bagged for appropriate disposal as non-hazardous solid waste. Additional waste disposal procedures may be developed in conjunction with the Engineering Consultant as applicable.

Non-hazardous wastes will be managed in accordance with NYSDEC regulations for solid waste. IDW will be containerized, characterized and disposed within ninety days in accordance with applicable regulations. If RCRA hazardous wastes are generated which require off-site disposal, they will be managed in accordance with RCRA and NYSDEC regulations and this Generic EHS Plan will be amended to include all applicable requirements for hazardous waste management.

All disposal facilities and transporters used for off-site disposal will be approved by Niagara Mohawk prior to use. The Engineering Consultant will prepare all waste documentation (profiles, Bills of Lading, manifests) for review and signature but personnel will not sign any waste documentation unless written authorization is provided by Niagara Mohawk.

SECTION 4 - WORK ZONES AND DECONTAMINATION

4.1 SITE WORK ZONES

To reduce the spread of hazardous materials by workers from the contaminated areas to the clean areas, zones will be delineated at the Site. The flow of personnel between the zones should be controlled. The establishment of the work zones will help ensure that personnel are properly protected against the hazards present where they are working, work activities and contamination are confined to the appropriate areas, and personnel can be located and evacuated in an emergency.

4.1.1 Exclusion Zone

Exclusion zones will be established at the Site for all drilling activities; unprotected onlookers should be located 50 feet upwind of drilling or soil sampling activities. In the event that volatile organics are detected in the breathing zone as discussed in Section 3.3, all personnel within the exclusion zone must don Level C protection. Exclusion zones will also be established during any activity when Level C protection is established as a result of conditions discussed in Section 3.0.

All personnel within the exclusion zone will be required to use the specified level of protection. No eating, drinking, or smoking will be allowed in the exclusion or decontamination zones.

4.1.2 Decontamination Zone

If appropriate, a decontamination zone will be established between the exclusion zone and the support zone, and will include the personnel and equipment necessary for decontamination of equipment and personnel (discussed below). Personnel and equipment in the exclusion zone must pass through this zone before entering the support zone. This zone should always be located upwind of the exclusion zone.

4.1.3 Support Zone

The support zone will include the remaining areas of the job site. Break areas, operational direction and support facilities (to include supplies, equipment storage and maintenance areas) will be located in this area. No equipment or personnel will be permitted to enter the support zone from the exclusion zone without passing through the personnel or equipment decontamination station. Eating, smoking, and drinking will be allowed only in this area.

4.2 DECONTAMINATION

Any water used in decontamination procedures will be containerized on-site and sampled before off-site transportation and disposal.

4.2.1 Decontamination of Personnel

The need for decontamination will be determined by the EL. Minimum decontamination may be necessary if only Level D protection is used. However, at a minimum, disposable gloves used during sampling activities should be removed and bagged; personnel will be encouraged to remove clothing and shower as soon as is practicable at the end of the day. All clothing should be machine-washed. All personnel will wash hands and face prior to eating and before and after using the restroom.

Decontamination will be necessary if Level C protection is used. The following OSHA-specified procedures include steps necessary for complete decontamination prior to entry into the support zone, and steps necessary if a worker only needs to change a respirator or respirator canister.

Modification can be made to the twelve-station decontamination process by the ESS depending upon the extent of contamination.

Station 1: Segregated Equipment Drop

Deposit equipment used on the Site (tools, sampling devices and containers, monitoring instruments, clipboards, etc.) on plastic drop cloths or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross-contamination.

Station 2: Suit/Safety Boot and Outer-Glove Wash

Thoroughly wash chemically resistant suit, safety boots and outer gloves. Scrub with long-handle, soft-bristle scrub brush and copious amounts of Alconox/water solution. Necessary equipment includes:

1. Wash tub (30 gallon or large enough for person to stand in)
2. Alconox/water solution
3. Long-handle soft-bristle scrub brushes

Station 3: Suit/Safety Boot and Outer-Glove Rinse

Rinse off Alconox/water solution using copious amounts of water. Repeat as many times as necessary. Necessary equipment includes:

1. Wash tub (30 gallon or large enough for person to stand in)
2. Spray unit
3. Water

4. Long-handle, soft-bristle scrub brushes

Station 4: Outer Gloves Removal

Remove the outer gloves and deposit in individually marked plastic bags. Necessary equipment includes:

1. Plastic bag

Station 5: Canister or Mask Change

If a worker leaves the exclusion zone to change a canister (or mask), this is the last step in the decontamination procedures. The worker's canister is exchanged, new outer glove donned, and joints taped. Worker returns to duty. Otherwise the worker proceeds to Station 6. Necessary equipment includes:

1. Canister (or mask)
2. Tape
3. Gloves

Station 6: Removal of Chemically Resistant Suit

With assistance of helper, remove suit. Deposit in container with plastic liner. Necessary equipment includes:

1. Container with plastic liner

Station 7: Inner-Glove Wash

Wash inner gloves with Alconox/water solution that will not harm skin. Repeat as many times as necessary. Necessary equipment includes:

1. Alconox/water solution
2. Wash tub
3. Long-handle, soft-bristle brushes

Station 8: Inner-Glove Rinse

Rinse inner gloves with water. Repeat as many times as necessary. Necessary equipment includes:

1. Water
2. Wash tub

Station 9: Respirator Removal

Remove face-piece. Avoid touching face. Wash respirator in clean, sanitized solution, allow to dry, and deposit face-piece in plastic bag. Store in clean area. Necessary equipment includes:

1. Plastic bags
2. Sanitizing solution
3. Cotton

Station 10: Inner-Glove Removal

Remove inner gloves and deposit in container with plastic liner. Necessary equipment includes:

1. Container with plastic liner

Station 11: Field Wash

Wash hands and face. Necessary equipment includes:

1. Water
2. Soap
3. Tables
4. Wash basins or buckets
5. Clean towels

Station 12: Redress

If re-entering exclusion zone put on clean field clothes (e.g., Tyvek, gloves, etc.). Necessary equipment includes:

1. Table
2. Clothing

4.2.2 Decontamination of Equipment

Drill rigs and backhoes will have gross contamination removed by manual scraping or brushing, then be steam cleaned and drilling equipment will be decontaminated prior to moving to a Site. Drilling equipment used for multiple boreholes and the back of backhoes used for test pit excavation will be decontaminated prior to drilling each boring/digging each test pit at the Site. The equipment will be decontaminated in the following manner:

- The drill rig/backhoe will have gross contamination manually removed by scraping then be steam cleaned.
- Down-hole equipment (auger bits, drill rods, split-spoons, etc.) will be steam cleaned and air dried to remove gross contamination.
- Surface equipment, such as field meters and surveying instruments, will be wiped with a clean, damp cloth.
- All decontamination will take place only on the Decon Pad.

A drilling sequence hierarchy (from less impacted to more impacted boring locations) will be followed to minimize the potential for cross contamination.

SECTION 5 - SAMPLE SHIPMENT

Samples collected in the Investigation, with the exception of any drum samples, tank samples, or other concentrated wastes, will be classified as environmental samples. In general, environmental samples are collected from streams, ponds, or wells and are not expected to be grossly contaminated with high levels of hazardous materials. The sample tag or label will be legibly written and completed with an indelible pencil or waterproof ink. The information will also be recorded in a field logbook. As a minimum, it will include:

- Exact location of sample
- Time and date sample was collected
- Name of sampler witnesses (if necessary)
- Project codes, sample station number, and identifying code (if applicable).
- Type of sample (if known)
- Laboratory number (if applicable)
- Any other pertinent information

5.1 ENVIRONMENTAL SAMPLES

Environmental samples will be packaged and shipped via courier and/or overnight carrier according to the following procedure:

Packaging

1. Place sample container, properly identified and with a sealed lid, in a polyethylene bag, and seal bag.
2. Place sample in a fiberboard container or plastic cooler that has been lined with a large polyethylene bag.
3. Pack with enough noncombustible, absorbent, cushioning material to minimize the possibility of the container breaking.
4. Seal large bag.
5. Seal or close outside container.

Marking/Labeling

Sample containers must have a completed sample identification label and the outside container must be marked "Environmental Sample." The appropriate side of the container must be marked

"This End Up" and arrows should be drawn accordingly. No DOT marking labeling is required.

Shipping Papers

No DOT shipping papers are required.

Transportation

There are no DOT restrictions on mode of transportation.

5.2 Hazardous Samples

Drum samples, tank samples, sludge samples, and grossly contaminated soil samples will be shipped as DOT Hazardous Materials. The designation "Flammable Liquid" or "Flammable Solid" will be used. The samples will be transported as follows:

1. Collect sample in a 16-ounce or smaller glass or polyethylene container with nonmetallic teflon-lined screw cap. Allow sufficient air space (approximately 10% by volume) so container is not liquid full at 54°C (130°F). If collecting a solid material, the container plus contents should not exceed one pound net weight. If sampling for volatile organic analysis, fill VOA container to septum but place the VOA container inside a 16-ounce or smaller container so the required air space may be provided. Large quantities, up to 3.786 liters (1 gallon), may be collected if the sample's flash point is 23°C (75°F) or higher. In this case, the flash point must be marked on the outside container (e.g., carton, cooler), and shipping papers should state that "Flash point is 73°F or higher."
2. Seal sample and place in a 4-mil-thick polyethylene bag, one sample per bag.
3. Place sealed bag inside a metal can with noncombustible, absorbent cushioning material (e.g., vermiculite or earth) to prevent breakage, one bag per can. Pressure-close the can and use clips, tape or other positive means to hold the lid securely.
4. Mark the can with:

    - Name and address of originator
    - "Flammable Liquid N.O.S. UN 1993" (or "Flammable Solid N.O.S. UN 1325)
      NOTE: UN numbers are now required in proper shipping names.

5. Place one or more metal cans in a strong outside container such as a picnic cooler or fiberboard box. Preservatives are not used for hazardous waste Site samples.
6. Prepare for shipping:

"Flammable Liquid, N.O.S. UN 1993" or "Flammable Solid, N.O.S. UN 1325"; "Cargo Aircraft Only (if more than 1 quart net per outside package); "Limited Quantity" or "Ltd. Qty."; "Laboratory Samples"; "Net Weight xxxx" or "Net Volume yyyy" (of hazardous contents) should be indicated on shipping papers and on outside of shipping container. "This Side Up" or "This End Up" should also be on container. Sign shipper certification.

7. Stand by for possible carrier requests to open outside containers for inspection or modify packaging. It is wise to contact the overnight carrier before packing to ascertain local packaging requirements and not to leave area before the carrier vehicle (aircraft, truck) is on its way.

SECTION 6 - ACCIDENT PREVENTION AND CONTINGENCY PLAN

6.1 ACCIDENT PREVENTION

All field personnel will receive health and safety training prior to the initiation of any Site activities. On a day-to-day basis, individual personnel should be constantly alert for indicators of potentially hazardous situations and for signs and symptoms in themselves and others that warn of hazardous conditions and exposures. Rapid recognition of dangerous situations can avert an emergency. Before daily work assignments, regular meetings should be held. Discussion should include:

- Tasks to be performed.
- Time constraints (e.g., rest breaks, cartridge changes).
- Hazards that may be encountered, including their effects, how to recognize symptoms or monitor them, concentration limits, or other danger signals.
- Emergency procedures.

6.1.1 Drilling

Prior to any drilling activity, efforts will be made to contact the Underground Facilities Protective Organization (UFPO) to determine whether underground installations will be encountered and, if so, where these installations are located. Hard hats, safety glasses, and safety boots must as a minimum be worn within 50 feet of the drill rig. The drill rig cannot be operated within 10 feet of power lines. The EL will provide constant on-site supervision of the drilling subcontractor to ensure that they are meeting the health and safety requirements. If deficiencies are noted, work will be stopped and corrective action will be taken (e.g., retrain, purchase additional safety equipment). Reports of health and safety deficiencies and the corrective action taken will be forwarded to the Safety Manager.

6.1.2 Vehicles and Heavy Equipment

Working with large motor vehicles and heavy equipment could be a major hazard at this Site. Injuries can result from equipment hitting or running over personnel, impacts from flying objects, or overturning of vehicles. Vehicle and heavy equipment design and operation will be in accordance with 29 CFR, Subpart O, 1926.600 through 1926.602. In particular, the following precautions will be utilized to help prevent injuries/accidents.

- All items affecting safety such as brakes, hydraulic lines, light signals, fire extinguishers, fluid levels, steering, tires, horn, back up alarm, tires and other safety items will be checked at the beginning of each shift.

6.2.7 Accident/Incident Reporting

As soon as first aid and/or emergency response needs have been met, the following parties are to be contacted by telephone:

1. Program Manager
2. Safety Manager

Written confirmation of verbal reports are to be submitted to the SM within 24 hours by the EL. The report form is to be used for this purpose. All representatives contacted by telephone are to receive a copy of this report. If the employee involved is not a Engineering Consultant employee, his employer shall receive a copy of this report.

For reporting purposes, the term accident refers to fatalities, all injuries (even first aid cases only), spill or exposure to hazardous materials (radioactive materials, toxic materials, explosive or flammable materials), fire, explosion, property damage, or potential occurrence of the above.

6.2.8 Procedures In the Event That Ionizing Radiation is Detected

If radiation is expected to be a problem then work must cease until radiation detection instruments can be obtained for monitoring. Contact SM for assistance and file Change Request to this safety plan. If radiation levels exceed background levels, the EL must consult immediately with the Safety Manager (SM). All OSHA requirements concerning work in an environment containing ionizing radiation (29 CFR 1910.96) must be met. At no time are personnel to work at a Site where whole body dose exceeds 2 mr in any one hour.

SECTION 7 - TRAINING

7.1 GENERAL HEALTH AND SAFETY TRAINING

In accordance with and pursuant to 29 CFR 1910.120, hazardous waste Site workers shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations unless otherwise noted in the above reference. At a minimum, the training shall have consisted of instruction in the topics outlined in the standard. Personnel who have not met the requirements for initial training shall not be allowed to work in any Site activities in which they may be exposed to hazards (chemical or physical).

7.1.1 Three Day Supervised On the Job Training

In addition to the required initial hazardous waste operations training, each employee shall have received three days of directly supervised on-the-job training. This training will address the duties the employees are expected to perform.

7.2 ANNUAL EIGHT-HOUR REFRESHER TRAINING

Annual eight-hour refresher training will be required of all hazardous waste Site field personnel in order to maintain their qualifications for field work. The training will cover a review of 1910.120 requirements and related company programs and procedures

7.3 SUPERVISORY TRAINING

Supervisors and health and safety personnel shall have completed an additional eight hours of specialized training in accordance with 29 CFR 1910.120.

7.4 SITE-SPECIFIC TRAINING

The EL will be responsible for developing a Site-specific occupational hazard training program and providing training to all personnel that are to work at the Site. Prior to commencement of field activities, all field personnel assigned to the project will have completed training that will specifically address the activities, procedures, monitoring, and equipment used in the Site operations. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity. At a minimum, this training shall consist of the following topics:

- Names of personnel responsible for Site safety and health;
- Safety, health, and other hazards at the Site;
- Proper use of personal protective equipment;
- Work practices by which the employee can minimize risk from hazards;
- Safe use of engineering controls and equipment on the Site;
- Acute effects of compounds at the Site; and
- Decontamination procedures.

The training shall also incorporate those practices detailed in Appendix C.

7.5 ON-SITE SAFETY BRIEFINGS

Project personnel and visitors will be given on-site health and safety briefings on a daily basis by the EL to assist Site personnel in safely conducting their work activities. The briefings will include information on new operations to be conducted, changes in work practices or changes in the Site's environmental conditions; as well as periodic reinforcement of previously discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety inspections. The meetings will also be an opportunity to periodically update the crews on monitoring results. Prior to starting any new activity, a training session using the Activity Hazard Analysis will be held for crewmembers involved in the activity.

7.6 FIRST AID AND CPR

The SM will identify those individuals requiring first aid and CPR training in order to ensure that emergency medical treatment is available during field activities. It is expected that a minimum of two field personnel on-site at any one time will have first aid, and CPR training. The training will be consistent with the requirements of the American Red Cross Association.

7.7 BLOODBORNE PATHOGENS TRAINING

Individuals on-site who have First Aid and CPR certification and who may provide emergency medical treatment, shall have completed training in Bloodborne Pathogens.

7.8 HAZARD COMMUNICATION

Hazard communication training will be provided in accordance with the requirements contained in OSHA 29 CFR 1910.1200.

7.9 HAZARDOUS WASTE TRAINING

Federal RCRA and State hazardous waste generator regulations require that all employees performing job functions related to hazardous waste be trained. As such, all persons performing job functions related to hazardous waste must be trained. The following training related documentation must be maintained at the Site:

- The job title of each position related to hazardous waste management and the name of the employee filling each position;
- A written job description for each position related to hazardous waste management;

- A written description of the type and amount of training that is given to each person filling a hazardous waste management job description; and
- Records must be kept until closure of the Site.

7.10 USDOT TRAINING

All personnel performing job functions related to the transportation of hazardous materials, including subcontractors, must undergo USDOT HM126-F HAZMAT training prior to performing any job function related to the transportation of any waste from the project Site. This includes, but is not limited to the following:

- Placing hazardous waste in containers;
- Moving or handling hazardous waste;
- Marking and labeling containers;
- Selecting packaging; and
- Determining a USDOT proper shipping name and description for hazardous waste and materials.

APPENDIX A

FORMS FOR HEALTH AND SAFETY-RELATED ACTIVITIES

FORMS FOR HEALTH AND SAFETY-RELATED ACTIVITIES

OSHA Job Safety and Health Protection Poster

Note: The OSHA Job Safety and Health Protection Poster must be posted prominently during field activities. The actual poster must be at least 8 1/2 by 14 inches with 10 point type.

ONLINE ORDER: If you would prefer to obtain a pre-printed copy of this poster, you may do so by submitting your order through the OSHA Online Publications Order Form. Simply select Publication Number 3165 from the list.

Medical Data Sheet

To be completed by all Site personnel. Used in the event of an emergency for information.

Field Team Review /Site-Specific Health and Safety Training Form

Signed by all Site personnel to indicate that they will comply with and understand the provisions of the Generic EHS Plan.

Weekly Health and Safety Report

To be completed by the EL on a weekly basis to summarize Site activities related to health and safety.

Air Monitoring Form

Used to document air-monitoring performed.

Change Request Form

For documenting changes to the Generic EHS Plan. See attached forms.

PPE Selection Form

To be completed for PPE hazard assessment and selection for additional tasks not covered by the Generic EHS Plan.

MEDICAL DATA SHEET

The brief medical data sheet shall be completed by all on-site personnel and will be kept in the Support Zone by the EL as a project record during the conduct of Site operations. It accompanies any personnel when medical assistance is needed or if transport to a hospital is required.

Project: ____________________
Name: ____________________ Home Telephone: ____________
Address: ____________________
Age: ________ Height ________ Weight ________ Blood Type ________

Name and Telephone Number of Emergency Contact: ____________________
____

Drug or Other Allergies: ____________________

Particular Sensitivities: ____________________

Do You Wear Contacts? ____________________

Provide A Check List Of Previous Illnesses: ____________________
____

What Medications Are You Presently Using? ____________________
____

Do You Have Any Medical Restrictions? ____________________

Name, Address, And Phone Number Of Personal Physician: ____________________
____
____

PLAN ACCEPTANCE FORM

This form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the Generic EHS Plan. It is maintained on Site by the EL as a project record.

Each field team member shall sign this section after Site-specific training is completed and before being permitted to work on-site.

I have read, or have been informed of, the Generic Environmental Health and Safety Plan and the Site Specific Work Plan and understand the information presented. I will comply with the provisions contained therein.

Name (Print and Sign)	**Date**

WEEKLY HEALTH AND SAFETY REPORT

PROJECT NAME: ______________________________

LOCATION: ______________________________

SITE INFORMATION

Week Ending ____________

Hours Worked: Labor: ______ Subs: ______

Check Level of Protection

For the week: B ___ C ___ D ___

INJURIES AND ILLNESSES

Yes______ No______

Describe:______________________________

MAJOR ACTIVITIES CONDUCTED THIS WEEK:

(drum handling, sampling, excavation, abatement/T&D, etc.)

SIGNIFICANT EVENTS THIS WEEK:

(regulatory visits, equipment malfunctions, process start-up or shutdown):

FUTURE ISSUES:

(schedule, manpower allocation, monitoring equipment, other resources needed)

SITE AUDIT/INSPECTIONS CONDUCTED

Yes ______ No ______

(describe outstanding findings and attach results)

HAZARDOUS ACTIVITIES

Hot Work.....................................Yes ______ No ______ Dates: ______________
Lockout/Tagout ....Yes ______ No ______ Dates: ______________
Confined Space Entry ....Yes ______ No ______ Dates: ______________
Soils Analysis Classification ....Yes ______ No ______ Dates: ______________
Excavation Daily Check List........Yes ______ No ______ Dates: ______________
Crane On-Site ....Yes ______ No ______ Dates: ______________
Critical Lift Plan Performed ....Yes ______ No ______ Dates: ______________

AIR MONITORING:
Real Time

Major Activity	Location(s)	Worker Occupation	FID/PID Range	CGI/O2 Range	PDM Range	Other

PERSONAL AIR MONITORING

Analyte	Activity Monitored	Occupation	Location	Result	Type of Sample*

SUBCONTRACTORS ON SITE

Company Name	Task or Function	Return to Site Next Week (Y/N)

Environmental Leader - Signature _______________

Date _______________

CHANGE REQUEST FORM

PROJECT: ______________________________

CHANGE NUMBER: ______________________________

PROJECT LOCATION: ______________________________

DESCRIPTION OF CHANGE: ______________________________

____

____

REASON FOR CHANGE: ______________________________

____

____

RECOMMENDED DISPOSITION: ______________________________

____

____

EL: ____________________ ____________

Signature Date

SAFETY MANAGER:

Signature Date

DISTRIBUTION: Safety Manager
Project Manager
Quality Assurance Representative
Environmental Leader

GENERIC EHS PLAN CHANGE

Change Number: ____________ Date Effective: ________________

Pen and Ink changes to be made in the Generic EHS Plan to alert the reader of this change:

Reason for the change to be incorporated into the Generic EHS Plan:

TEXT OF CHANGE TO BE INCORPORATED:

CHANGE RECORDS

Record of Changes:

Initial for attaching any Changes to this Generic EHS Plan. Enter the Change Number and Date Issued. File the completed field changes to this Generic EHS Plan at the end as attachments. Make PEN and INK changes in the text to alert the reader to the changes that are required in the Change.

CHANGE NUMBER	DATE ENTERED	SYNOPSIS OF CHANGE	INITIAL

E 6.1 - PERSONAL PROTECTIVE EQUIPMENT (PPE) SELECTION

ACTIVITY: ______________________________

TASK	HEAD	EYE/FACE	FEET	HANDS	BODY	HEARING	RESPIRATOR

EL______________________________________

APPENDIX B

TABLE 2-1, CHEMICAL DATA

TABLE 2-1
Chemical Data

COMPOUND	CAS#	ACGIH TLV	OSHA PEL	ROUTE OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Benzene	71-43-2	0.5 ppm, (Skin)(Ca.) 2.5 ppm STEL	1.0 ppm, (Skin) 5 ppm STEL	Inhalation Ingestion Absorption Skin Contact	Irritates eyes, skin, nose, resp. syst.; giddiness; headache, nausea, staggered gait; fatigue, lassitude; dermatitis	Eyes, skin, blood, CNS, bone marrow, respiratory system	Liquid with an aromatic odor VP= 75 mm IP= 9.24eV
PAHs as Coal tar pitch volatiles (CTPV)	65996-93-2	0.2 mg/m3 (Ca.)	0.2 mg/m^3	Inhalation Skin contact	Irritant to eyes, swelling, acne contact dermatitis,	Resp. System, CNS, liver, kidneys, skin, bladder	Colorless/ pale green, solid, faint aromatic odor
Cyanide	74-90-8 592-01-8 151-50-8 143-33-9	5 mg/m^3 4.7 ppm (skin) (C)	10 ppm (skin)	Ingestion, Inhalation, Skin contact	Irritated eyes, skin, noise, throat, dizziness, nausea	Eyes, skin, resp. sys, CNS, skeleton, kidneys	Variable
Ethyl benzene	100-41-4	100 ppm	100 ppm	Inhalation Skin Contact Ingestion	Irritates eyes, skin, mucous membranes; headache; dermatitis; narcosis, coma.	Eyes, skin, resp. system, CNS	VP= 7 mm, aromatic odor, IP= 8.76 eV
Toluene	108-88-3	50 ppm (skin)	200 ppm 300 ppm (C) 500 ppm (10 min max peak)	Inhalation Absorption Ingestion Skin Contact	Irritates eyes and nose, fatigue, weakness, confusion, euphoria, dizziness; headache, dilated pupils, lacrimation, nervousness, muscular fatigue, insomniadermatitis,	Liver, eyes kidneys, resp syst. skin, CNS	Colorless liquid with a sweet, pungent, benzene like odor. VP= 21 mm IP= 8.82eV
Xylene	1330-20-7	100 ppm, 150 ppm (STEL)	100 ppm	Inhalation Absorption Ingestion Skin Contact	Irritates eyes, nose, throat, and skin; dizziness, drowsiness, staggered gait, vomiting, abdominal pain, dermatitis	Eyes, skin, resp. system, GI tract, CNS, blood, liver, kidneys	Colorless liquid with an aromatic odor VP = 79 mm IP= 8.56 eV

Abbreviations

C = ceiling limit, not to be exceeded
Ca. = Carcinogen (Cancer Causing)
CNS = Central Nervous System
CVS= Cardiovascular System
eV = electron volt
FP = Flash point
IP = Ionization Potential
mm = millimeter
NE = not established
ppm = parts per million
Skin = significant route of exposure
STEL = Short-term exposure limit (15 minutes)
TWA = Time-weighted average (8 hours)
VP = vapor pressure approximately 68° F in mm Hg (mercury)

APPENDIX C

MATERIAL SAFETY DATA SHEETS

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Benzene, 99%
Catalog Numbers:
AC296880000, AC296880010, AC296880025, AC296880250, AC610231000
Synonyms:
Benzol; Benzole; Benzolene; Carbon oil; Coal naphtha; Cyclohexatriene; Mineral naphtha; Phenyl hydride; Pyrobenzol; Pyrobenzole
Company Identification (Europe): Acros Organics BVBA
Janssen Pharmaceuticalaan 3a
2440 Geel, Belgium
Company Identification (USA): Acros Organics
One Reagent Lane
Fairlawn, NJ 07410
For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS#
71-43-2	Benzene	99.0	200-753-7

Hazard Symbols: T F
Risk Phrases: 11 45 48/23/24/25

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW
Appearance: colorless liquid. Flash Point: -11 deg C.
Danger! Extremely flammable liquid. Aspiration hazard if swallowed. Can enter lungs and cause damage. May cause central nervous system effects. Causes eye and skin irritation. Causes digestive and respiratory tract irritation. May cause reproductive and fetal effects. Cancer hazard. May cause blood abnormalities. Harmful or fatal if swallowed.
Target Organs: Blood, central nervous system, eyes, bone marrow, immune system.

Potential Health Effects
Eye: Causes severe eye irritation. May cause slight transient injury.
Skin:Causes moderate skin irritation. May be absorbed through the skin in harmful amounts. Direct contact with the liquid may cause erythema (redness) and vesiculation (blistering). Prolonged or repeated contact has been associated with the development of a dry scaly dermatitis or with secondary infections.
Ingestion: Aspiration hazard. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure. May cause effects similar to those for inhalation exposure. Aspiration of material into the lungs may cause chemical pneumonitis, which may be fatal.

Inhalation: Causes respiratory tract irritation. May cause adverse central nervous system effects including headache, convulsions, and possible death. May cause drowsiness, unconsciousness, and central nervous system depression. Central nervous system effects may include confusion, ataxia, vertigo, tinnitus, weakness, disorientation, lethargy, drowsiness, and finally coma. Exposure may lead to irreversible bone marrow injury. Exposure may lead to aplastic anemia. May be absorbed through the lungs.

Chronic: Possible cancer hazard based on tests with laboratory animals. Prolonged or repeated exposure may cause adverse reproductive effects. May cause bone marrow abnormalities with damage to blood forming tissues. May cause anemia and other blood cell abnormalities. Chronic exposure has been associated with an increased incidence of leukemia and multiple myelomas. Immunodepressive effects have been reported. Animal studies have reported fetotoxicity (growth retardation) and teratogenicity (exencephaly, angulated ribs, dilated brain ventricles).

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:

Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.

Skin:

Get medical aid immediately. Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.

Ingestion:

Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Possible aspiration hazard. Get medical aid immediately.

Inhalation:

Get medical aid immediately. Remove from exposure to fresh air immediately. If breathing is difficult, give oxygen. Do NOT use mouth-to-mouth resuscitation. If breathing has ceased apply artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:

Containers can build up pressure if exposed to heat and/or fire. As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Water runoff can cause environmental damage. Dike and collect water used to fight fire. Vapors can travel to a source of ignition and flash back. Extremely flammable. Material will readily ignite at room temperature. Use water spray to keep fire-exposed containers cool. Containers may explode in the heat of a fire. Vapors may be heavier than air. They can spread along the ground and collect in low or confined areas. Vapors may form an explosive mixture with air.

Extinguishing Media:

Use water spray to cool fire-exposed containers. Water may be ineffective. Do NOT use straight streams of water. For large fires, use water spray, fog or regular foam. For small fires, use dry chemical, carbon dioxide, water spray or regular foam. Cool containers with flooding quantities of water until well after fire is out.
Autoignition Temperature:561 deg C (1,041.80 deg F)
Flash Point: -11 deg C (12.20 deg F)
Explosion Limits, lower:1.3 vol %
Explosion Limits, upper:7.1 vol %
NFPA Rating: (estimated) Health: 2; Flammability: 3; Reactivity: 0

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks:
Use water spray to dilute spill to a non-flammable mixture. Avoid runoff into storm sewers and ditches which lead to waterways. Use water spray to disperse the gas/vapor. Remove all sources of ignition. Absorb spill using an absorbent, non-combustible material such as earth, sand, or vermiculite. Do not use combustible materials such as saw dust.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Ground and bond containers when transferring material. Do not breathe dust, vapor, mist, or gas. Do not get in eyes, on skin, or on clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep container tightly closed. Avoid contact with heat, sparks and flame. Do not ingest or inhale. Use only in a chemical fume hood. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames.
Storage:
Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a tightly closed container. Keep from contact with oxidizing materials. Store in a cool, dry, well-ventilated area away from incompatible substances.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Use explosion-proof ventilation equipment. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use only under a chemical fume hood.

Exposure Limits

```
+--------------------+-------------------+-------------------+-----------------+
| Chemical Name |          | NIOSH | |
|--------------------|-------------------|-------------------|-----------------|
| Benzene                    |0.5 ppm;         |0.1 ppm TWA; |10 ppm TWA |
ACGIH 0.5 ppm; 2.5 ppm STEL; skin - potential for cutaneous absorption
NIOSH 0.1 ppm NIOSH Potential Occupational Carcinogen - see Appendix A segments
OSHA - Final PELs (apply only to exempt industry )10 ppm; C 25 ppm; 1 ppm TWA; |
+--------------------+-------------------+-------------------+-----------------+
```

OSHA Vacated PELs:
Benzene:
10 ppm TWA (unless specified in 1910.1028); 50 ppm STEL (10 min) (unless specified in 1910.1028); C 25 ppm (unless specified in 1910.1028)

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin:
Wear appropriate protective gloves to prevent skin exposure.
Clothing:
Wear appropriate protective clothing to prevent skin exposure.
Respirators:
A respiratory protection program that meets OSHA's 29 CFR :1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State: Liquid
Appearance: colorless liquid
Odor: sweetish odor - aromatic odor
pH: Not available.
Vapor Pressure: 74.3 mm Hg @ 20 deg C
Vapor Density: 2.7 (Air=1)
Evaporation Rate: 2.8 (Ether=1)
Viscosity: 0.647mPa @ 20 deg C
Boiling Point: 80 deg C
Freezing/Melting Point: 6 deg C
Decomposition Temperature: Not available.
Solubility in water: Slightly soluble.
Specific Gravity/Density: 0.874
Molecular Formula: C6H6
Molecular Weight: 78.042

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
Incompatible materials, ignition sources, excess heat.
Incompatibilities with Other Materials:
Chlorine, oxygen, ozone, permanganates, sulfuric acid, peroxides, parachlorates, nitrating agents, nitric acid, chromic acid anhydride, chromium trioxide, iodine pentafluoride, iodine heptafluoride, dioxygenyl tetrafluoroborate, dioxygen difluoride + hydrogen fluoride, sodium peroxide, uranium hexafluoride, bromine pentafluoride, chlorine trifluoride, nitryl perchlorate, aresenic pentafluoride, potassium methoxide, permanganic acid, peroxodisulfuric acid, liquid oxygen, peroxomonosulfuric acid, metal perchlorates, strong oxidizing agents.
Hazardous Decomposition Products:
Carbon monoxide, irritating and toxic fumes and gases, carbon dioxide.
Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

CAS# 71-43-2: CY1400000
LD50/LC50:
CAS# 71-43-2: Dermal, guinea pig: LD50 = >9400 uL/kg; Draize test, rabbit, eye: 88 mg Moderate; Draize test, rabbit, eye: 2 mg/24H Severe; Draize test, rabbit, skin: 20 mg/24H Moderate; Inhalation, mouse: LC50 = 9980 ppm; Inhalation, rat: LC50 = 10000 ppm/7H; Oral, mouse: LD50 = 4700 mg/kg; Oral, rat: LD50 = 930 mg/kg; Skin, rabbit: LD50 = >9400 uL/kg.
Carcinogenicity:
Benzene -
ACGIH: A1 - Confirmed Human Carcinogen
California: carcinogen; initial date 2/27/87
NIOSH: occupational carcinogen
NTP: Known carcinogen
OSHA: Select carcinogen
IARC: Group 1 carcinogen
Epidemiology:
IARC has concluded that epidemiological studies have established the relationship between benzene exposure and the development of acute myelogenous leukemia, and that there is sufficient evidence that benzene is carcinogenic to humans. Animal studies have demonstrated fetoxicity (growth retardation) and teratogenicity (exencephaly, angulated ribs, dilated brain ventricles).
Teratogenicity:
Inhalation, rat: TCLO = 50 ppm/24H (female 7-14 day(s) after conception) Effects on Embryo or Fetus - extra-embryonic structures (e.g., placenta, umbilical cord) and Effects on Embryo or Fetus - fetotoxicity (except death, e.g., stunted fetus).;
Inhalation, mouse: TCLo = 5 ppm (female 6-15 day(s) after conception) Effects on Embryo or Fetus - cytological changes (including somatic cell genetic material) and Specific Developmental Abnormalities - blood and lymphatic systems (including spleen and marrow).
Reproductive Effects:
Inhalation, rat: TCLO = 670 mg/m3/24H (female 15 day(s) pre-mating

and female 1-22 day(s) after conception) female fertility index (e.g. # females pregnant per # sperm positive females; # females pregnant per # females mated).; Oral, mouse: TDLo = 12 gm/kg (female 6-15 day(s) after conception) Fertility - post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants).

Neurotoxicity:

No information available.

Mutagenicity:

DNA Inhibition: Human, Leukocyte = 2200 umol/L.; DNA Inhibition: Human, HeLa cell = 2200 umol/L.; Mutation Test Systems - not otherwise specified: Human, Lymphocyte = 5 umol/L.; Cytogenetic Analysis: Inhalation, Human = 125 ppm/1Y.; Cytogenetic Analysis: Human, Leukocyte = 1 mmol/L/72H.; Cytogenetic Analysis: Human, Lymphocyte = 1 mg/L.

Other Studies:

Standard Draize Test(Skin, rabbit) = 20 mg/24H (Moderate) Standard Draize Test: Administration into the eye (rabbit) = 2 mg/24H (Severe).

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:

If benzene is released to soil, it will be subject to rapid volatilization near the surface and that which does not evaporate will be highly to very highly mobile in the soil and may leach to groundwater. If benzene is released to water, it will be subject to rapid volatilization. It will not be expected to significantly adsorb to sediment, bioconcentrate in aquatic organisms or hydrolyze. It may be subject to biodegradation.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste.

US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.

RCRA P-Series: None listed.

RCRA U-Series: CAS# 71-43-2: waste number U019; (Ignitable waste, Toxic waste).

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: RQ, BENZENE
Hazard Class: 3
UN Number: UN1114
Packing Group: II
Canadian TDG

Shipping Name: BENZENE
Hazard Class: 3(9.2)
UN Number: UN1114

**** SECTION 15 - REGULATORY INFORMATION ****

US FEDERAL
TSCA
CAS# 71-43-2 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA
Section 302 (RQ)
CAS# 71-43-2: final RQ = 10 pounds (4.54 kg); receives an adjustable R
Section 302 (TPQ)
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 71-43-2: acute, chronic, flammable.
Section 313
This material contains Benzene (CAS# 71-43-2, 99 0%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 372.
Clean Air Act:
CAS# 71-43-2 is listed as a hazardous air pollutant (HAP).
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
CAS# 71-43-2 is listed as a Hazardous Substance under the CWA.
CAS# 71-43-2 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 71-43-2 is listed as a Toxic Pollutant under the Clean Water Act.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
Benzene can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

The following statement(s) is(are) made in order to comply with
the California Safe Drinking Water Act:
WARNING: This product contains Benzene, a chemical known to the state
of California to cause cancer.
WARNING: This product contains Benzene, a chemical known to the
state of California to cause birth defects or other reproductive
harm.
California No Significant Risk Level:
CAS# 71-43-2: no significant risk level = 7 ug/day
European/International Regulations
European Labeling in Accordance with EC Directives
Hazard Symbols: T F
Risk Phrases:
R 11 Highly flammable.
R 45 May cause cancer.
R 48/23/24/25 Toxic : danger of serious damage to
health by prolonged exposure through inhalation,
contact with skin and if swallowed.
Safety Phrases:
S 53 Avoid exposure - obtain special instructions
before use.
S 45 In case of accident or if you feel unwell, seek
medical advice immediately (show the label where
possible).
WGK (Water Danger/Protection)
CAS# 71-43-2: 3
United Kingdom Occupational Exposure Limits

**** SECTION 16 - ADDITIONAL INFORMATION ****

MSDS Creation Date: 6/11/1999 Revision #2 Date: 8/02/2000

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way will the company be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if the company has been advised of the possibility of such damages.

TECHNOLOGY CHEMICAL INC -- COAL TAR CREOSOTE

MSDS Safety Information

FSC: 6840
NIIN: 00-286-0446
MSDS Date: 02/04/1993
MSDS Num: BPWXF
Product ID: COAL TAR CREOSOTE
MFN: 01
Responsible Party
Cage: 2U663
Name: TECHNOLOGY CHEMICAL INC
Address: 3718 GRAND AVE
Box: 13268
City: OAKLAND CA 94661
Info Phone Number: 510-339-3066
Emergency Phone Number: 510-339-3066
Preparer's Name: DGSC-SSH 804-279-4371
Review Ind: Y
Published: Y

Preparer Co. when other than Responsible Party Co.

Cage: 2U663
Name: TECHNOLOGY CHEMICAL INC
Address: 3718 GRAND AVE
Box: 13268
City: OAKLAND CA 94661

Contractor Summary

Cage: 2U663
Name: TECHNOLOGY CHEMICAL INC
Address: 3718 GRAND AVE
Box: 13268
City: OAKLAND CA 94661
Phone: 510-339-3066

Item Description Information

Item Manager: S9G
Unit of Issue: DR
Quantitative Expression: 00000000055GL
UI Container Qty: 1
Type of Container: DRUM

Ingredients

Cas: 8001-58-9
RTECS #: GF8615000
Name: CREOSOTE (SARA III)
% Wt: UNKNOWN
Other REC Limits: 0.2 MG/M3 COAL TAR
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
EPA Rpt Qty: 1 LB
DOT Rpt Qty: 1 LB

Cas: 95-13-6

```
RTECS #: NK8225000
Name: INDENE
% Wt: <10
Other REC Limits: NONE SPECIFIED
OSHA PEL: 10 PPM
ACGIH TLV: 10 PPM; 9192
------------------------------
Cas: 91-20-3
RTECS #: QJ0525000
Name: NAPHTHALENE (SARA III)
% Wt: <15
Other REC Limits: NONE SPECIFIED
OSHA PEL: 10 PPM/15 STEL
ACGIH TLV: 10 PPM/15 STEL; 9192
EPA Rpt Qty: 100 LBS
DOT Rpt Qty: 100 LBS
------------------------------
Cas: 92-52-4
RTECS #: DU8050000
Name: DIPHENYL (BIPHENYL) (SARA III)
% Wt: <5
Other REC Limits: NONE SPECIFIED
OSHA PEL: 0.2 PPM
ACGIH TLV: 0.2 PPM; 9192
EPA Rpt Qty: 1 LB
DOT Rpt Qty: 1 LB
------------------------------
Cas: 71-43-2
RTECS #: CY1400000
Name: BENZENE (SARA III)
% Wt: <1
Other REC Limits: NONE SPECIFIED
OSHA PEL: 1PPM/5STEL;1910.1028
ACGIH TLV: 10 PPM; A2; 9192
EPA Rpt Qty: 10 LBS
DOT Rpt Qty: 10 LBS
------------------------------
Name: ALKYL NAPHTHALENE
% Wt: <10
Other REC Limits: NONE SPECIFIED
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
=======================================================
Health Hazards Data
=======================================================
LD50 LC50 Mixture: LD50 (ORAL RAT) IS 1,700 MG/KG
Route Of Entry Inds - Inhalation: YES
Skin: YES
Ingestion: NO
Carcinogenicity Inds - NTP: YES
IARC: YES
OSHA: YES
Effects of Exposure: ACUTE-EYE:MAY CAUSE MODERATE IRRITATION. SKIN: CAN RESULT
  IN SEVERE IRRITATION WHICH WHEN ACCENTUATED BY SUNLIGHT MAY RESULT IN
  PHOTOTOXIC SKIN REACTION.INHALATION:IRRITATION,CNS EFFECTS,SUCH AS HEADAC
  HE,DIZZINESS,COMA AND POSSIBLE DEATH.INGESTION:IRRITATION,NAUSEA, VOMITING
  & ABDOMINAL PAIN.CHRONIC-MAY CAUSE CANCER.
Explanation Of Carcinogenicity: BENZENE. IARC LISTS CREOSOTE AS A POSSIBLE
  CARCINOGENIC AGENT TO HUMAN.
Signs And Symptions Of Overexposure: MAY BE FATAL IF SWALLOWED., NAUSEA,
```

VOMITING. IRRITATION OF RESPIRATORY TRACT, COUGHING AND CHOKING. EYE AND SKIN IRRITATION.

Medical Cond Aggravated By Exposure: PERSONS WITH PRE-EXISTING DISEASE INVOLVING THE SKIN OR BLOOD-FORMING ORGANS MAY BE AT A GREATER RISK OF DEVELOPING ADVERSE HEALTH EFFECTS WHEN EXPOSED TO THIS MATERIAL.

First Aid: SEEK MEDICAL AID.EYE:FLUSH WITH WATER FOR 15 MINUTES.SKIN:WIPE MATERIAL OFF.WASH THOROUGHLY WITH SOAP & WATER/WATERLESS HAND CLEANER.INHALATION:REMOVE TO FRESH AIR.GIVE CPR/OXYGEN IF NEEDED. INGESTION :GIVE 1-2 GLASSES OF WATER/MILK IF CONSCIOUS.INDUCE VOMITING USING IPECAC SYRUP.THEN,GIVE A SLURRY OF 100 G OF ACTIVATED CHARCOAL IN 8 OZ OF WATER.

Handling and Disposal

Spill Release Procedures: STOP LEAK IF NO RISK INVOLVED. STAY UPWIND. SOLIDIFIED SPILL:SHOVEL INTO DRY CONTAINERS AND COVER. FLUSH AREA WITH WATER.SMALL WET SPILL:TAKE UP WITH SAND. FLUSH AREA WITH WATER. DIKE LARGE SPILLS FOR LATER DISPOSAL.CONTAIN RUNOFF FROM FIRE CONTROL.

Waste Disposal Methods: CONSULT LOCAL AUTHORITIES;DISPOSAL MUST BE IN ACCORDANCE WITH LOCAL,STATE AND FEDERAL REGULATIONS. THIS PRODUCT RELEASED INTO THE ENVIRONMENT MUST BE REPORTED TO THE NATIONAL RESPONSE CENTER (800-424 -8802). WHEN SPILLED,REPORTABLE QUANTITY IS 1 LB.

Handling And Storage Precautions: STORE IN COOL, DRY AND WELL VENTILATED AREA. KEEP CONTAINER CLOSED WHEN NOT IN USE.

Other Precautions: AVOID PROLONGED/REPEATED BREATHING OF VAPORS,MISTS/ FUMES.AVOID PROLONGED/REPEATED CONTACT WITH SKIN/EYES.APPLICATION OF CERTAIN PROTECTIVE CREAMS (SUN SCREENS FOR COAL TAR PRODUCTS) BEFORE WORKING/SEVERAL TIMES DURING WORK MAY BE BENEFICIA

Fire and Explosion Hazard Information

Flash Point Method: CC

Flash Point Text: >200F,>93C

Extinguishing Media: USE WATER FOG, CARBON DIOXIDE, FOAM, OR DRY CHEMICAL. WATER OR FOAM MAY CAUSE FROTHING, IF MOLTEN.

Fire Fighting Procedures: WEAR COMPLETE FIRE SERVICE PROTECTIVE EQUIPMENT,INCLUDING FULL-FACE MSHA/NIOSH APPROVED SELF-CONTAINED BREATHING APPARATUS.USE WATER TO COOL CONTAINERS BY FIRE.

Unusual Fire/Explosion Hazard: TOXIC VAPORS/DECOMPOSITION PRODUCTS MAY BE RELEASED FORMING FLAMMABLE/EXPLOSIVE MIXTURES IN AIR. CLOSED CONTAINERS MAY EXPLODE WHEN EXPOSED TO EXTREME HEAT.

Control Measures

Respiratory Protection: NONE NORMALLY REQUIRED.IF EXPOSURES ARE ABOVE TLV(PEL),USE NIOSH APPROVED UNITS AS PER CURRENT 29 CFR 1910.134 AND MANUFACTURERS' "INSTRUCTIONS" AND "WARNINGS". COMBINATION FILTER/ORGANIC VAPOR CARTRI DGES OR CANISTER MAY BE USED.

Ventilation: PROVIDE SUFFICIENT GENERAL/LOCAL EXHAUST VENTILATION TO CONTROL INHALATION EXPOSURE < EXPOSURE LIMITS.

Protective Gloves: IMPERVIOUS

Eye Protection: SAFETY GLASSES/GOGGLES

Other Protective Equipment: IMPERVIOUS PROTECTIVE GARMENTS SUCH AS HEAD/ NECK COVER,APRONS,JACKETS,PANTS,BOOTS,ETC.EYE-WASH FACILITIES,SAFETY SHOWER

Work Hygienic Practices: AVOID CONTACT WITH EYES AND SKIN;DO NOT BREATHE VAPORS/MIST.WASH THOROUGHLY AFTER EACH USE.

Supplemental Safety and Health: MSDS IS NOT AVAILABLE FROM MFR. INFORMATION PRESENTED HEREIN IS ACCURATE AND RELIABLE TO THE BEST OF OUR KNOWLEDGE AND BELIEF BUT IS NOT GUARANTEED TO BE SO. IT IS THE USER'S RESPONSIBILITY TO TAKE AL L SAFETY PRECAUTIONS AS MAY BE NECESSARY. WE HEREBY DISCLAIM ALL

LIABILITY WITH RESPECT TO IT'S USE.

Physical/Chemical Properties

HCC: T6
B.P. Text: >355F,>179C
M.P/F.P Text: UNKNOWN
Decomp Text: UNKNOWN
Vapor Pres: 1 @ 30C
Vapor Density: >1
Spec Gravity: 1.050
Evaporation Rate & Reference: SLOW (N-BUTYL ACETATE=1)
Solubility in Water: SLIGHT
Appearance and Odor: BROWN TO BLACK LIQUID WITH CREOSOTE OR TARRY ODOR
Corrosion Rate: UNKNOWN

Reactivity Data

Stability Indicator: YES
Stability Condition To Avoid: HIGH TEMPERATURES AND OPEN FLAMES
Materials To Avoid: OXIDIZING AGENTS
Hazardous Decomposition Products: OXIDES OF CARBON, SUFUR.
Hazardous Polymerization Indicator: NO
Conditions To Avoid Polymerization: NONE

Toxicological Information

Ecological Information

MSDS Transport Information

Regulatory Information

Other Information

Transportation Information

Responsible Party Cage: 2U663
Trans ID NO: 66557
Product ID: COAL TAR CREOSOTE
MSDS Prepared Date: 02/04/1993
Review Date: 11/17/1999
MFN: 1
Tech Entry NOS Shipping Nm: CONTAINS CREOSOTE AND INDENE AND NAPHTHALENE
Net Unit Weight: 481 LBS
Multiple KIT Number: 0
Review IND: Y
Unit Of Issue: DR
Container QTY: 1
Type Of Container: DRUM
Additional Data: NOTE: THE MAXIMUM ALLOWED BY PASSENGER/CARGO AIR: 5L / 60L.

Detail DOT Information

DOT PSN Code: QKN
Symbols: G

```
DOT Proper Shipping Name: TOXIC LIQUIDS, ORGANIC, N.O.S.
Hazard Class: 6.1
UN ID Num: UN2810
DOT Packaging Group: II
Label: POISON
Special Provision: B110,T14
Packaging Exception: NONE
Non Bulk Pack: 202
Bulk Pack: 243
Max Qty Pass: 5 L
Max Qty Cargo: 60 L
Vessel Stow Req: B
Water/Ship/Other Req: 40
=======================================================
Detail IMO Information
=======================================================
IMO PSN Code: OTX
IMO Proper Shipping Name: TOXIC LIQUID, ORGANIC, N.O.S. o
IMDG Page Number: 6270-1
UN Number: 2810
UN Hazard Class: 6.1
IMO Packaging Group: I/II/III
Subsidiary Risk Label: -
EMS Number: 6.1-02
MED First Aid Guide NUM: T
=======================================================
Detail IATA Information
=======================================================
IATA PSN Code: YIE
IATA UN ID Num: 2810
IATA Proper Shipping Name: TOXIC LIQUID, ORGANIC, N.O.S. *
IATA UN Class: 6.1
IATA Label: TOXIC
UN Packing Group: II
Packing Note Passenger: 609
Max Quant Pass: 5L
Max Quant Cargo: 60L
Packaging Note Cargo: 611
Exceptions: A4
=======================================================
Detail AFI Information
=======================================================
AFI PSN Code: YGF
AFI Symbols: *
AFI Proper Shipping Name: TOXIC LIQUID, ORGANIC, N.O.S.
AFI Hazard Class: 6.1
AFI UN ID NUM: UN2810
AFI Packing Group: II
Special Provisions: P4
Back Pack Reference: A10.5
=======================================================
HAZCOM Label
=======================================================
Product ID: LABEL COVERED UNDER EPA REGS - HAZCOM LABEL NOT AUTHORIZED
=======================================================
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  information is formulated for use by elements of the Department of Defense.
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  warrants, states, or intends said information to have any application, use
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SODIUM CYANIDE

1. Product Identification

Synonyms: Hydrocyanic acid, sodium salt; Cyanogran
CAS No.: 143-33-9
Molecular Weight: 49.01
Chemical Formula: NaCN
Product Codes:
J.T. Baker: 3662, 3663
Mallinckrodt: 7616

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Cyanide	143-33-9	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! MAY BE FATAL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CONTACT WITH ACIDS LIBERATES POISONOUS GAS. CAUSES BURNS TO SKIN, EYES, AND RESPIRATORY TRACT. AFFECTS BLOOD, CARDIOVASCULAR SYSTEM, CENTRAL NERVOUS SYSTEM AND THYROID.

J.T. Baker SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 3 - Severe (Life)
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

In most cases, cyanide poisoning causes a deceptively healthy pink to red skin color. However, if a physical injury or lack of oxygen is involved, the skin color may be bluish. Reddening of the eyes and pupil dilation are symptoms of cyanide poisoning. Cyanosis (blue discoloration of the skin) tends to be associated with severe cyanide poisonings.

Inhalation:
Corrosive to the respiratory tract. The substance inhibits cellular respiration and may cause blood, central nervous system, and thyroid changes. May cause headache, weakness, dizziness, labored breathing nausea and vomiting, which can be followed by weak and irregular heart beat, unconsciousness, convulsions, coma and death.

Ingestion:
Highly Toxic! Corrosive to the gastro-intestinal tract with burning in the mouth and esophagus, and abdominal pain. Larger doses may produce sudden loss of consciousness and prompt death from respiratory arrest. Smaller but still lethal doses may prolong the illness for one or more hours. Bitter almonds odor may be noted on the breath or vomitus. Other symptoms may be similar to those noted for inhalation exposure.

Skin Contact:
Corrosive. May cause severe pain and skin burns. Solutions are corrosive to the skin and eyes, and may cause deep ulcers which heal slowly. May be absorbed through the skin, with symptoms similar to those noted for inhalation.

Eye Contact:
Corrosive. Symptoms may include redness, pain, blurred vision, and eye damage.

Chronic Exposure:
Prolonged or repeated skin exposure may cause a "cyanide" rash and nasal sores.

Aggravation of Pre-existing Conditions:
Workers using cyanides should have a preplacement and periodic medical exam. Those with history of central nervous system, thyroid, skin, heart or lung diseases may be more susceptible to the effects of this substance.

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4. First Aid Measures

IN CASE OF CYANIDE POISONING, start first aid treatment immediately, then get medical attention. A cyanide antidote kit (amyl nitrite, sodium nitrite and sodium thiosulfate) should be available in any cyanide work area. Actions to be taken in case of cyanide poisoning should be planned and practiced before beginning work with cyanides. Oxygen and amyl nitrite can be given by a first responder before medical help arrives. Allow victim to inhale amyl nitrite for 15-30 seconds per minute until sodium nitrite and sodium thiosulfate can be administered intravenously (see Note to Physician). A new amyl nitrite ampule should be used every 3 minutes. If conscious but symptoms (nausea, difficult breathing, dizziness, etc.) are evident, give oxygen. If consciousness is impaired (non-responsiveness, slurred speech, confusion, drowsiness) or the patient is unconscious but breathing, give oxygen and amyl nitrite by means of a respirator. If not breathing, give oxygen and amyl nitrite immediately by means of a positive pressure respirator (artificial respiration).

Inhalation:
If inhaled, remove to fresh air. Administer antidote kit and oxygen per pre-planned instructions if symptoms occur. Keep patient warm and at rest. Do not give mouth to mouth resuscitation.

Ingestion:
If ingested, antidote kit and oxygen should be administered per above. If the patient is conscious, immediately give the patient activated charcoal slurry. Never give anything by mouth to an unconscious person. Do not induce vomiting as it could interfere with resuscitator use.

Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse. Administer antidote kit and oxygen per preplanned instructions if symptoms occur.

Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
If patient does not respond to amyl nitrite, inject intravenously with 10mL of a 3% solution of sodium nitrite at a rate of not more than 2.5 to 5 mL per minute.Once nitrite administration is complete, follow directly with 50 mL of a 25% solution of sodium thiosulfate at the same rate by the same route. Give victim oxygen and keep under observation. If exposure was severe, watch victim for 24-48 hours. If signs of cyanide poisoning persist or reappear, repeat nitrite and thiosulfate injections 1 hour later in 1/2 the original doses. Cyanocabalamin (B12), 1 mg intramuscularly, may speed recovery. Moderate cyanide exposures need be treated only by supportive measures such as bed rest and oxygen.

5. Fire Fighting Measures

Fire:
Not combustible, but upon decomposition or contact with acids, this material releases highly flammable and toxic hydrogen cyanide gas.

Explosion:
Not considered an explosion hazard, but upon heating with chlorates or nitrites to 450C (842F) may cause an explosion. Violent explosion occurs if melted with nitrite salt. Sealed containers may rupture when heated.

Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Do Not use carbon dioxide.

Carbon dioxide can react with this material in the presence of moisture to produce hydrogen cyanide. Water spray may be used to keep fire exposed containers cool. Reacts slowly with water to form hydrogen cyanide.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

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6. Accidental Release Measures

Spills: Ventilate area of leak or spill. Allow only qualified personnel to handle spill. Clean-up personnel require protective clothing and respiratory protection from vapors. Collect material and place in a closed container for recovery or disposal. Do not flush to sewer! Decontaminate liquid or solid residues in spill area with sodium or calcium hypochlorite solution.

US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

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7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Separate from incompatibles. Workers must carefully follow good hygienic practices, including no eating, drinking, or smoking in workplace. Proper use and maintenance of protective equipment is essential. Workers using cyanide need preplacement and annual medical exams. Special training should be given to workers using cyanide. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product. Do not store near combustibles or flammables because subsequent fire fighting with water could lead to cyanide solution runoff. Do not store under sprinkler systems. All persons with the potential for cyanide poisoning should be trained to provide immediate First Aid using oxygen and amyl nitrite. A cyanide anitdote kit (amyl nitrite, sodium nitrite, and sodium thiosulfate) should be readily available in cyanide workplaces. The antidotes should be checked annually to ensure they are still within their shelf-lives. Identification of community hospital resources and emergency medical squads in order to equip and train them on handling cyanide emergencies is essential.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
5 mg/m3 skin (TWA) (as CN)
-ACGIH Threshold Limit Value (TLV):
5 mg/m3 (STEL) Ceiling, skin, as CN
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134).
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
White deliquescent granular solid.
Odor:
Almond odor. Bitter almonds.
Solubility:
48 g/100 cc @ 10C (50F)
Specific Gravity:
1.60 @ 25C/4C
pH:
Aqueous solutions are strongly alkaline.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
1496C (2725F)
Melting Point:
564C (1047F)
Vapor Density (Air=1):

No information found.
Vapor Pressure (mm Hg):
1 @ 817C (1503F)
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Very stable when dry. Moisture will cause slow decomposition, releasing poisonous hydrogen cyanide gas.
Hazardous Decomposition Products:
Emits toxic fumes of cyanide and oxides of nitrogen when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Acid. nitrates, nitrites, chlorates, fluorine, magnesium, and strong oxidizers. Reacts with acids to liberate toxic and flammable hydrogen cyanide gas. Water or weak alkaline solutions can produce dangerous amounts of hydrogen cyanide in confined areas. Reacts with carbon dioxide in air to form hydrogen cyanide gas.
Conditions to Avoid:
Heat, moisture, incompatibles.

11. Toxicological Information

Oral rat LD50: 6440 ug/kg. Investigated as a tumorigen, mutagen, reproductive effector.

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--------\Cancer Lists\------------------------------------------------------
                                        ---NTP Carcinogen---
Ingredient                              Known    Anticipated    IARC Category
------------------------------------    -----    -----------    -------------
Sodium Cyanide (143-33-9)                No          No             None
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12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
This material is expected to be very toxic to aquatic life. This material is expected to be very toxic to terrestrial life.

13. Disposal Considerations

Cyanides must be oxidized to harmless waste before disposal. An alkaline solution (pH about 10) is treated with chlorine or commercial bleach in excess to decompose cyanide. When cyanide-free, it can be neutralized. Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: RQ, SODIUM CYANIDE, SOLID
Hazard Class: 6.1
UN/NA: UN1689
Packing Group: I
Information reported for product/size: 12KG

International (Water, I.M.O.)

Proper Shipping Name: SODIUM CYANIDE, SOLID
Hazard Class: 6.1
UN/NA: UN1689
Packing Group: I
Information reported for product/size: 12KG

15. Regulatory Information

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 --------\Chemical Inventory Status - Part 1\---------------------------------
 Ingredient                                      TSCA  EC   Japan  Australia
 ----------------------------------------------- ----  ---  -----  ---------
 Sodium Cyanide (143-33-9)                        Yes  Yes   Yes      Yes

 --------\Chemical Inventory Status - Part 2\---------------------------------
                                                        --Canada--
 Ingredient                                      Korea  DSL  NDSL  Phil.
 ----------------------------------------------- -----  ---  ----  -----
 Sodium Cyanide (143-33-9)                        Yes   Yes   No    Yes

 --------\Federal, State & International Regulations - Part 1\---------------
                                             -SARA 302-    ------SARA 313-----
 Ingredient                                  RQ    TPQ     List  Chemical
Catg.
 ------------------------------------------  ---   -----   ----  ------------
```

```
Sodium Cyanide (143-33-9)                     10     100     No     Cyanide comp

--------\Federal, State & International Regulations - Part 2\---------------
                                                        -RCRA-     -TSCA-
Ingredient                                    CERCLA    261.33      8(d)
-------------------------------------------   ------    ------     ------
Sodium Cyanide (143-33-9)                     10        P106        No

Chemical Weapons Convention:  Yes    TSCA 12(b):  Yes    CDTA:  Yes
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: No  Pressure: No
Reactivity: No          (Pure / Solid)
```

Australian Hazchem Code: 4X
Poison Schedule: S7
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **1**
Label Hazard Warning:
DANGER! MAY BE FATAL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CONTACT WITH ACIDS LIBERATES POISONOUS GAS. CAUSES BURNS TO SKIN, EYES, AND RESPIRATORY TRACT. AFFECTS BLOOD, CARDIOVASCULAR SYSTEM, CENTRAL NERVOUS SYSTEM AND THYROID.
Label Precautions:
Do not breathe dust.
Do not get in eyes, on skin, or on clothing.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
IN ALL CASES, GET MEDICAL ATTENTION IMMEDIATELY. KEEP A CYANIDE ANTIDOTE KIT (amyl nitrite, sodium nitrite and sodium thiosulfate) in area of product use or storage. First-aiders must take precautions to avoid contact with cyanide substance. If ingested, administer antidote kit and oxygen per pre-planned instructions. If the patient is conscious, immediately give the patient activated charcoal slurry. Never give anything by mouth to an unconscious person. Do not induce vomiting as it could interfere with resuscitator use. If inhaled, remove to fresh air. Administer antidote kit and oxygen per pre-planned instructions if symptoms occur. Keep patient warm and at rest. Do not give mouth to mouth resuscitation. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Administer antidote kit and oxygen per preplanned instructions if symptoms occur.
Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 8.

Disclaimer:

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Prepared by: Environmental Health & Safety

Phone Number: (314) 654-1600 (U.S.A.)

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Ethyl Benzene
Catalog Numbers:
02751 1, 02751-1, 027511
Synonyms:
Ethylbenzol, phenylethane
Company Identification: Fisher Scientific
1 Reagent Lane
Fairlawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS#
100-41-4	Ethylbenzene	100	202-849-4

Hazard Symbols: XN F
Risk Phrases: 11 20

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW
Appearance: clear, colorless. Flash Point: 21 deg C.
Warning! Flammable liquid and vapor. Causes skin irritation. Causes eye irritation. May cause central nervous system depression. Aspiration hazard if swallowed. Can enter lungs and cause damage. May be absorbed through intact skin. Causes digestive and respiratory tract irritation.
Target Organs: Central nervous system.

Potential Health Effects
Eye:
Causes moderate eye irritation. Vapors may cause eye irritation.
Skin:
Causes skin irritation. Prolonged and/or repeated contact may cause irritation and/or dermatitis. May be absorbed through the skin. Contact with the liquid may cause erythema (redness), exfoliation and vesiculation (blistering).
Ingestion:
May cause irritation of the digestive tract. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure. Aspiration of material into the lungs may cause chemical pneumonitis, which may be fatal.
Inhalation:
Inhalation of high concentrations may cause central nervous system effects characterized by nausea, headache, dizziness, unconsciousness and coma. Causes respiratory tract irritation. Vapors may cause dizziness or suffocation.
Chronic:

Chronic inhalation may cause effects similar to those of acute inhalation.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.
Skin:
Get medical aid. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes.
Ingestion:
Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician:
Treat symptomatically and

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
Containers can build up pressure if exposed to heat and/or fire. As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Vapors may form an explosive mixture with air. Vapors can travel to a source of ignition and flash back. Use water spray to keep fire-exposed containers cool. Flammable liquid and vapor. Vapors may be heavier than air. They can spread along the ground and collect in low or confined areas. Containers may explode when heated.
Extinguishing Media:
For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam. Use water spray to cool fire-exposed containers. Water may be ineffective. For large fires, use water spray, fog or alcohol-resistant foam. Contact professional fire-fighters immediately. Cool containers with flooding quantities of water until well after fire is out.
Autoignition Temperature:Not available.
Flash Point: 92 deg C (197.60 deg F)
Explosion Limits, lower:0.8
Explosion Limits, upper:6.7
NFPA Rating: (estimated) Health: 3; Flammability: 4; Reactivity: 0

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks:
Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Remove all sources of ignition. A vapor suppressing foam may be used to reduce vapors. Water spray may reduce vapor but may not prevent ignition in closed spaces.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Wash thoroughly after handling. Use with adequate ventilation. Ground and bond containers when transferring material. Avoid contact with eyes, skin, and clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep container tightly closed. Avoid contact with heat, sparks and flame. Avoid ingestion and inhalation. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames.
Storage:
Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a tightly closed container. Keep from contact with oxidizing materials. Store in a cool, dry, well-ventilated area away from incompatible substances.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits
```
+--------------------+-------------------+-------------------+----------------
-+
| Chemical Name | ACGIH | NIOSH |OSHA - Final PELs|
|--------------------|-------------------|-------------------|----------------
-|
| Ethylbenzene |100 ppm; 125 ppm |100 ppm TWA; 435 |100 ppm TWA; 435 |
| | STEL | mg/m3 TWA 800 |mg/m3 TWA |
| | |ppm IDLH (10 | |
| | | percent lower | |
| | | explosive limit) | |
+--------------------+-------------------+-------------------+----------------
-+
```

OSHA Vacated PELs:
Ethylbenzene:
100 ppm TWA; 435 mg/m3 TWA; 125 ppm STEL; 545 mg/m3 STEL

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin:
Wear appropriate protective gloves and clothing to prevent skin exposure.
Clothing:
Wear appropriate protective gloves and clothing to prevent skin exposure.
Respirators:
Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State: Liquid
Appearance: clear, colorless
Odor: aromatic odor
pH: Not available.
Vapor Pressure: 7.1 mm Hg @ 20 C
Vapor Density: 3.7
Evaporation Rate: <1 (butyl acetate=1)
Viscosity: 0.63 mPa s 20 C
Boiling Point: 277 deg F
Freezing/Melting Point: -139 deg F
Decomposition Temperature: Not available.
Solubility in water: Insoluble.
Specific Gravity/Density: 0.9
Molecular Formula: C8H10
Molecular Weight: 106.07

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
Incompatible materials, ignition sources, excess heat.
Incompatibilities with Other Materials:
Oxidizing agents.
Hazardous Decomposition Products:
Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 100-41-4: DA0700000
LD50/LC50:
CAS# 100-41-4: Draize test, rabbit, eye: 500 mg Severe; Oral, rat: LD50 = 3500 mg/kg; Skin, rabbit: LD50 = 17800 uL/kg.
Carcinogenicity:
Ethylbenzene -
OSHA: Possible Select carcinogen
IARC: Group 2B carcinogen
Epidemiology:
No information available.
Teratogenicity:
No information available.
Reproductive Effects:
No information available.
Neurotoxicity:
No information available.
Mutagenicity:
Mutation in mammalian somatic cells (Rodent,mouse) Lymphocyte = 80 mg/L.
Other Studies:
Standard Draize Test: Administration into the eye (rabbit) = 500 mg (Severe). Standard Draize Tes (Rabbit, Skin) = 15 mg/L; Mild.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:

Shrimp (mysidoposis bahia), LC50=87.6 mg/L/96hr. Sheepshead minnow LC50=275 mg/L/96hr. Fathead minnow LC50=42.3 mg/L/96hr in hard water &48.5 mg/L/96hr in softwater.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste.
US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: ETHYLBENZENE
Hazard Class: 3
UN Number: UN1175
Packing Group: II
Canadian TDG
Shipping Name: ETHYL BENZENE
Hazard Class: 3(9.2)
UN Number: UN1175
Other Information: FLASHPOINT 15C

**** SECTION 15 - REGULATORY INFORMATION ****

US FEDERAL
TSCA
CAS# 100-41-4 is listed on the TSCA inventory.
Health & Safety Reporting List
CAS# 100-41-4: Effective Date: June 19, 1987; Sunset Date: June 19, 1997
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA
Section 302 (RQ)
CAS# 100-41-4: final RQ = 1000 pounds (454 kg)
Section 302 (TPQ)
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 100-41-4: acute, chronic, flammable.
Section 313
This material contains Ethylbenzene (CAS# 100-41-4, 100%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 372.
Clean Air Act:
CAS# 100-41-4 is listed as a hazardous air pollutant (HAP).
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
CAS# 100-41-4 is listed as a Hazardous Substance under the CWA.
CAS# 100-41-4 is listed as a Priority Pollutant under the Clean Water

Act.
CAS# 100-41-4 is listed as a Toxic Pollutant under the Clean Water Act.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
Ethylbenzene can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
California No Significant Risk Level:
None of the chemicals in this product are listed.
European/International Regulations
European Labeling in Accordance with EC Directives
Hazard Symbols: XN F
Risk Phrases:
R 11 Highly flammable.
R 20 Harmful by inhalation.
Safety Phrases:
S 16 Keep away from sources of ignition - No smoking.
S 24/25 Avoid contact with skin and eyes.
S 29 Do not empty into drains.
WGK (Water Danger/Protection)
CAS# 100-41-4: 1
United Kingdom Occupational Exposure Limits
CAS# 100-41-4: OES-United Kingdom, TWA 100 ppm TWA; 441 mg/m3 TWA
CAS# 100-41-4: OES-United Kingdom, STEL 125 ppm STEL; 552 mg/m3 STEL
Canada
CAS# 100-41-4 is listed on Canada's DSL List.
This product has a WHMIS classification of B2, D2B, D2A.
CAS# 100-41-4 is listed on Canada's Ingredient Disclosure List.
Exposure Limits
CAS# 100-41-4: OEL-AUSTRALIA:TWA 100 ppm (435 mg/m3);STEL 125 ppm (545 mg/m3)
OEL-BELGIUM:TWA 100 ppm (434 mg/m3);STEL 125 ppm (543 mg/m3)
OEL-CZECHOSLOVAKIA:TWA 200 mg/m3;STEL 1000 mg/m3
OEL-DENMARK:TWA 50 ppm (217 mg/m3)
OEL-FINLAND:TWA 100 ppm (435 mg/m3);STEL 150 ppm (655 mg/m3)
OEL-FRANCE:TWA 100 ppm (435 mg/m3)
OEL-GERMANY:TWA 100 ppm (440 mg/m3);Skin
OEL-HUNGARY:TWA 100 mg/m3;STEL 200 mg/m3;Skin
OEL-JAPAN:TWA 100 ppm (430 mg/m3)
OEL-THE NETHERLANDS:TWA 100 ppm (435 mg/m3)
OEL-THE PHILIPPINES:TWA 100 ppm (435 mg/m3)
OEL-POLAND:TWA 100 mg/m3
OEL-RUSSIA:TWA 100 ppm;STEL 50 mg/m3
OEL-SWEDEN:TWA 50 ppm (200 mg/m3);STEL 100 ppm (450 mg/m3)
OEL-SWITZERLAND:TWA 100 ppm (435 mg/m3);STEL 500 ppm
OEL-TURKEY:TWA 100 ppm (435 mg/m3)
OEL-UNITED KINGDOM:TWA 100 ppm (435 mg/m3);STEL 125 ppm
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

**** SECTION 16 - ADDITIONAL INFORMATION ****

MSDS Creation Date: 4/28/1999 Revision #2 Date: 8/02/2000

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of

TOSCO – GASOLINE MID-GRADE UNLEADED

MSDS Safety Information

FSC: 9130
MSDS Date: 10/02/1996
MSDS Num: CFLWY
LIIN: 00N079570
Product ID: GASOLINE MID-GRADE UNLEADED
MFN: 01
Responsible Party
Cage: JO521
Name: TOSCO
Address: 72 CUMMINGS POINT RD
City: STAMFORD CT 06901
Info Phone Number: 360-384-1011
Emergency Phone Number: 510-228-1220
Published: Y

Contractor Summary

Cage: JO521
Name: TOSCO
Address: 72 CUMMINGS POINT RD
City: STAMFORD CT 06901
Phone: 360-384-1011
Cage: TXSCX
Name: TOSCO REFINING CO
Address: 2300 CLAYTON RD
City: CONCORD CA 94520
Phone: 800-424-9300 (CHEMTREC)

Ingredients

Cas: 108-88-3
RTECS #: XS5250000
Name: TOLUENE (SARA 313) (CERCLA)
% Wt: 2-8
OSHA PEL: 200 PPM
ACGIH TLV: 50 PPM, S
EPA Rpt Qty: 1000 LBS
DOT Rpt Qty: 1000 LBS

Cas: 71-43-2
RTECS #: CY1400000
Name: BENZENE (SARA 313) (CERCLA)
% Wt: 0-3
OSHA PEL: SEE 1910.1028
ACGIH TLV: 10 PPM; A2
EPA Rpt Qty: 10 LBS
DOT Rpt Qty: 10 LBS

Cas: 95-63-6
RTECS #: DC3325000

Name: BENZENE, 1,2,4-TRIMETHYL-; (1,2,4-TRIMETHYLBENZENE) (SARA 313)
% Wt: 0-2
OSHA PEL: 25 PPM
ACGIH TLV: 25 PPM

Cas: 100-41-4
RTECS #: DA0700000
Name: BENZENE, ETHYL-; (ETHYL BENZENE) (SARA 313)
% Wt: 0-2
OSHA PEL: 100 PPM
ACGIH TLV: 100 PPM/125 STEL
EPA Rpt Qty: 1000 LBS
DOT Rpt Qty: 1000 LBS

Cas: 110-82-7
RTECS #: GU6300000
Name: CYCLOHEXANE (SARA 313) (CERCLA)
% Wt: 0-1
OSHA PEL: 300 PPM
ACGIH TLV: 300 PPM
EPA Rpt Qty: 1000 LBS
DOT Rpt Qty: 1000 LBS

Cas: 64-17-5
RTECS #: KQ6300000
Name: ETHYL ALCOHOL (ETHANOL)
% Wt: 0-11
OSHA PEL: 1000 PPM
ACGIH TLV: 1000 PPM

Cas: 8006-61-9
RTECS #: LX3300000
Name: GASOLINE (CONTAINING INGREDIENTS 1-6; 8-10)
% Wt: 89-100
OSHA PEL: 300 PPM
ACGIH TLV: 300 PPM/500 STEL

Cas: 1634-04-4
RTECS #: KN5250000
Name: ETHER, TERT-BUTYL METHYL-; (METHYL TERT-BUTYL ETHER) (SARA 313) (CERCLA)
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)
EPA Rpt Qty: 1 LB
DOT Rpt Qty: 1 LB

Cas: 637-92-3
RTECS #: KN4730200
Name: ETHER, TERT-BUTYL ETHYL; (ETHYL TERT-BUTYL ETHER)
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)

Cas: 1330-20-7
RTECS #: ZE2100000
Name: XYLENE (SARA 313) (CERCLA)
% Wt: 5-10

Ingestion: YES

Carcinogenicity Inds - NTP: YES

IARC: YES

OSHA: YES

Effects of Exposure: ACUTE:INGS 1 & 10:IRRIT OF LUNGS, THROAT & AIRWAYS. SEV EYE IRRIT. CNS DEPRESS. ING 2:HARMFUL/FATAL. IRRIT TO SKIN & EYE. CNS DEPRESS. ING 3:IRRIT, CNS DEPRESS, BONE MARROW DEPRESS & ANEMIA. ING 4:IRRIT, PULM EDEMA, SENSE OF CONSTRICTION IN CHEST. DMG TO KIDNEYS & LIVER. EXPT TERATOGEN. ING 5:IRRIT. (EFTS OF OVEREXP)

Explanation Of Carcinogenicity: BENZENE: IARC MONO, VOL 7, PG 120, 1987: GROUP 1. NTP 7TH ANNUAL RPT ON CARCINS, 1994: KNOWN TO BE CARCIN.

Signs And Symptions Of Overexposure: HLTH HAZ: ING 6:IRRIT, CNS DEPRESS, REPRO & TERATOGENIC EFTS. ING 7:INHAL CAUSES DROW. CNS DEPRESS. ING 8:IRRIT, CNS DEPRESS, DMG TO LIVER & KIDNEYS, REPRO HAZ & TERATOGEN. INGEST: ASPIR MAY CAUSE PNEUMIT. GI DISTURB. IRRIT, NAUS, VOMIT, DI ARR. CNS SYMPS SIMILAR TO THOSE LISTED UNDER INHAL. SKIN: DERM & POSS

Medical Cond Aggravated By Exposure: NONE SPECIFIED BY MANUFACTURER.

First Aid: EYE:FLUSH W/POTABLE WATER FOR AT LEAST 15 MIN. SEE MD (FP N). SKIN:FLUSH W/COPIOUS AMTS OF WATER. SEE MD (FP N). INHAL:REMOVE TO FRESH AIR. SUPPORT BRTHG (GIVE OXYGEN/ARTF RESP) (FP N). INGEST:CALL MD IMMED (FP N). NOTE TO MD:MOST IMPORTANT SOURCE OF EXPOS IS VIA INHAL. SEVERAL HYDROCARBON COMPONENTS RAPIDLY PASS THRU ALVEOLAR LINING. STOM MUCOSA PROVIDES GREATER BARRIER TO ABSORPTION &

Handling and Disposal

Spill Release Procedures: STOP LEAK. CAUTION. CONTACT CHEMTREC & LOCAL FIRE DEPARTMENT. KEEP AWAY. ISOLATE, DENY ENTRY. STAY UPWIND. VENTILATE. SHUT OFF IGNITION SOURCES. USE WATER SPRAY TO DISPERSE VAPORS. CONTACT NEHC FOR MORE SPECIFIC INFORMATION (FP N).

Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.

Waste Disposal Methods: DISPOSE OF IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS (FP N).

Handling And Storage Precautions: STORE GASOLINE ONLY IN NFPA APPRVD, CLEARLY LABELED CONTRS, TIGHTLY CLSD. NEVER STORE IN GLASS/UNAPPRVD PLASTIC CONTRS. AVOID EYE & SKIN CONT.

Other Precautions: STOR LOCATION MUST BE COOL, DRY, ISOLATED, WELL-VENTD &AWAY FROM HEAT, IGNIT SOURCES & INCOMPATIBLE MATLS. USE GROUNDING WIRES &EQUIP DURING PROD TRANSFER TO REDUCE POSS OF STATIC SPK CAUSED FIRE/EXPLO.CONT NEHC FOR MORE INFO (FP N).

Fire and Explosion Hazard Information

Flash Point Text: -35F,-37C

Lower Limits: 1.4%

Upper Limits: 7.6%

Extinguishing Media: USE DRY CHEMICAL, ALL PURPOSE AFFF, ALCOHOL FOAM OR CARBON DIOXIDE.

Fire Fighting Procedures: WEAR NIOSH APPRVD SCBA & FULL PROT EQUIP (FP N). WATER MAY BE INEFFECTIVE FOR EXTING FIRE BUT MAY BE USED TO COOL FIRE-IMPINGED/EXPANDED CONTRS & (SUP DAT)

Unusual Fire/Explosion Hazard: DANGEROUS WHEN EXPOS TO HEAT/FLAME. VAPS FORM FLAM/EXPLO MIXS W/AIR AT ROOM TEMP, MAY SPREAD TO DIST IGNIT SOURCES & FLASH BACK. CONT NEHC FOR MORE INFO (FP N).

OSHA PEL: 100 PPM
ACGIH TLV: 100 PPM/150 STEL
EPA Rpt Qty: 1000 LBS
DOT Rpt Qty: 1000 LBS

Name: EXPLAN OF CARCIN:OSHA REG:CFR 29 1910.1028. HUMAN:BLOOD. GASOLINE:IARC MONO, VOL 45, PG 159, 1989:GROUP 2B. ANIMAL:SKIN.

Name: EFTS OF OVEREXP: SECONDARY INFECTION. HIGH PRESS SKIN INJECTIONS ARE SERIOUS MED EMER. REQUIRE IMMED MED ATTN.

Name: ING 12: EYE: TRANSIENT IRRIT. INHAL: IRRIT. HARMFUL CNS EFTS. EXCITATION, EUPHORIA, HDCH, DIZZ, DROW, BLURRED

Name: ING 13: VISION, FATG, TREMORS, CONVLS, LOSS OF CONSCIOUSNESS, COMA, RESP ARREST & DEATH. ANEMIA & IRREG HEART

Name: ING 14: RHYTHM. BEHAVIORAL CHANGES. CHRONIC:ING 1:LONG-TERM CHRONIC BRONCH, IRRIT, INCRD SPUTUM, TIGHTNESS OF

Name: ING 15: CHEST, WHEEZING, DECRD ENDURANCE, DMG TO KIDNEYS & LIVER. ING 2:AFFECTS HEMATOPOIETIC SYS, BLOOD

Name: ING 16: DISORDERS, ANEMIA & PANCYTOPENIA. ING 5:CHRONIC BRONCH, INCRD SPUTUM, TIGHT CHEST, WHEEZING, DECRD

Name: ING 17: ENDURANCE. ING 10:DISTURB OF GI TRACT, DMG TO KIDNEYS & LIVER, EXPT REPRO HAZ & TERATOGEN. TOLUENE

Name: ING 18: APPEARS ON THE NAVY OCCUP CHEM REPRO HAZ LIST. SEEK CONSULT FROM APPROP HLTH PROFESSIONALS CONCERNING

Name: ING 19: LATEST HAZ LIST INFO & SAFE HNDLG & EXPOS INFO (FP N). CONTACT NEHC FOR MORE SPECIFIC INFORMATION (FP N).

Name: FIRST AID PROC: SKIN BARRIER IS MOST PROT. IN GEN, THERE IS NO SPECIFIC TREATMENT FOR HYDROCARBON EXPOS.

Name: ING 21: TREATMENT IS SUPPORTIVE. INHAL EXPOS TO GASOLINE VAP MOST COMMONLY OCCURS DURING INAPPROP USE OF

Name: ING 22: GASOLINE AS DEGREASER/SOLV. THIS EXPOS MAY BE EXACERBATED BY WORK IN CONFINED SPACE. GASOLINE COMPONENTS

Name: ING 23: HAVE BOTH IRRIT & ANESTH PROPERTIES. AT HIGH CONCS, IT CAN ACT AS SIMPLE ASPHY. GEN, INDIVIDUALS ACUTELY

Name: ING 24: EXPOSED TO ANESTH LEVELS OF EXPOS CAN REQUIRE RESUSCITATION & RESP SUPPORT. CONT NEHC FOR MORE INFO (FP N).

Health Hazards Data

LD50 LC50 Mixture: LD50 (ORAL RAT): 18.75 ML/KG.
Route Of Entry Inds - Inhalation: YES
Skin: YES

Control Measures

Respiratory Protection: IF EXPOSURE LIMITS ARE EXCEEDED OR IF IRRITATION IS EXPERIENCED, NIOSH APPROVED RESPIRATORY PROTECTION SHOULD BE WORN.
Ventilation: VENTILATION AND OTHER FORMS OF ENGINEERING CONTROLS ARE THE RPEFERRED MEANS FOR CONTROLLING CHEMICAL EXPOSURES.
Protective Gloves: IMPERVIOUS GLOVES (FP N).
Eye Protection: ANSI APPRVD CHEM WORKERS GOGGLES (FP N).
Other Protective Equipment: ANSI APPROVED EMERGENCY EYEWASH AND DELUGE SHOWER (FP N). FACESHIELD, APRON, ARMCOVERS, ETC.
Work Hygienic Practices: WASH WORK CLTHG REGULARLY. DO NOT WEAR CONTAM CLTHG NEAR SOURCES OF IGNIT SUCH AS SPKS/OPEN FLAME, LAUNDER BEFORE REUSE.
Supplemental Safety and Health: FIRE FIGHT PROC: STRUCTURES. WATER MAY BE USED TO PROT PERS & KEEP MATL AWAY FROM IGNIT SOURCES. IF LEAK/SPILL HAS NOT IGNITED, VENT AREA & USE WATER SPRAY TO DISPERSE GAS/VAP & TO PROT PERS. FOAM BLANKETS MAY ALSO BE USED TO REDUCE VAPS & PROT RESPONDING PERS. KEEP MATL OUT OF PUBLIC SEWERS & WATERWAYS.

Physical/Chemical Properties

B.P. Text: >80F,>27C
Vapor Pres: 760 @ 100F
Vapor Density: 1.2
Spec Gravity: 0.72-0.74
Evaporation Rate & Reference: >1
Solubility in Water: NEGLIGIBLE
Appearance and Odor: CLEAR TO AMBER LIQUID WITH A STRONG HYDROCARBON ODOR
Percent Volatiles by Volume: 100

Reactivity Data

Stability Indicator: YES
Stability Condition To Avoid: NONE SPECIFIED BY MANUFACTURER.
Materials To Avoid: AVOID CONTACT WITH STRONG OXIDIZERS.
Hazardous Decomposition Products: COMBUSTION MAY PRODUCE CARBON MONOXIDE, CARBON DIOXIDE, AND REACTIVE HYDROCARBONS.
Hazardous Polymerization Indicator: NO
Conditions To Avoid Polymerization: NOT RELEVANT.

Toxicological Information

Ecological Information

MSDS Transport Information

Regulatory Information

Other Information

HAZCOM Label

Product ID: GASOLINE MID-GRADE UNLEADED
Cage: JO521
Assigned IND: Y
Company Name: TOSCO
Street: 72 CUMMINGS POINT RD
City: STAMFORD CT
Zipcode: 06901
Health Emergency Phone: 510-228-1220
Label Required IND: Y
Date Of Label Review: 10/21/1997
Status Code: C
Label Date: 10/21/1997
Origination Code: G
Chronic Hazard IND: Y
Eye Protection IND: YES
Skin Protection IND: YES
Signal Word: DANGER
Respiratory Protection IND: YES
Health Hazard: Severe
Contact Hazard: Moderate
Fire Hazard: Severe
Reactivity Hazard: None
Hazard And Precautions: EXTREMELY FLAMMABLE. ACUTE: IRRITATING TO LUNGS, THROAT AND AIRWAYS. SEVERE EYE IRRITATION. CENTRAL NERVOUS SYSTEM DEPRESSION. HARMFUL OR FATAL. IRRITATING TO SKIN. BONE MARROW DEPRESSION AND ANEMIA. PULMONARY EDEMA, SENSE OF CONSTRICTION I N CHEST. DAMAGE TO KIDNEYS AND LIVER. INGESTION: MAY CAUSE ASPIRATION HAZARD-PNEUMONITIS, GASTROINTESTINAL DISTURBANCES, NAUSEA, VOMITING, DIARRHEA. CHRONIC: CANCER HAZARD. CONTAINS BENZENE WHICH IS LISTED AS A HUMAN BLOOD CARCINOGEN, AND G ASOLINE WHICH IS LISTED AS AN ANIMAL SKIN CARCINOGEN (FP N). TERATOGEN. KIDNEY AND LIVER DAMAGE.

Disclaimer (provided with this information by the compiling agencies): This information is formulated for use by elements of the Department of Defense. The United States of America in no manner whatsoever expressly or implied warrants, states, or intends said information to have any application, use or viability by or to any person or persons outside the Department of Defense nor any person or persons contracting with any instrumentality of the United States of America and disclaims all liability for such use. Any person utilizing this instruction who is not a military or civilian employee of the United States of America should seek competent professional advice to verify and assume responsibility for the suitability of this information to their particular situation regardless of similarity to a corresponding Department of Defense or other government situation.

TOLUENE

1. Product Identification

Synonyms: Methylbenzene; Toluol; Phenylmethane
CAS No.: 108-88-3
Molecular Weight: 92.14
Chemical Formula: C6H5-CH3
Product Codes:
J.T. Baker: 5375, 5584, 5809, 5812, 9336, 9351, 9364, 9456, 9457, 9459, 9460, 9462, 9466, 9472, 9476
Mallinckrodt: 4483, 8091, 8092, 8604, 8608, 8610, 8611, V560

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Toluene	108-88-3	100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. VAPOR HARMFUL. FLAMMABLE LIQUID AND VAPOR. MAY AFFECT LIVER, KIDNEYS, BLOOD SYSTEM, OR CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

J.T. Baker SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

--

Potential Health Effects

Inhalation:
Inhalation may cause irritation of the upper respiratory tract. Symptoms of overexposure may include fatigue, confusion, headache, dizziness and drowsiness. Peculiar skin sensations (e. g. pins and needles) or numbness may be produced. Very high concentrations may cause unconsciousness and death.

Ingestion:
Swallowing may cause abdominal spasms and other symptoms that parallel over-exposure from inhalation. Aspiration of material into the lungs can cause chemical pneumonitis, which may be fatal.

Skin Contact:
Causes irritation. May be absorbed through skin.

Eye Contact:
Causes severe eye irritation with redness and pain.

Chronic Exposure:
Reports of chronic poisoning describe anemia, decreased blood cell count and bone marrow hypoplasia. Liver and kidney damage may occur. Repeated or prolonged contact has a defatting action, causing drying, redness, dermatitis. Exposure to toluene may affect the developing fetus.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or impaired liver or kidney function may be more susceptible to the effects of this substance. Alcoholic beverage consumption can enhance the toxic effects of this substance.

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4. First Aid Measures

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. CALL A PHYSICIAN IMMEDIATELY.

Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately. If vomiting occurs, keep head below hips to prevent aspiration into lungs.

Skin Contact:
In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician immediately.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Flash point: 7C (45F) CC
Autoignition temperature: 422C (792F)
Flammable limits in air % by volume:
lel: 3.3; uel: 19
Flammable liquid and vapor!
Dangerous fire hazard when exposed to heat or flame. Vapors can flow along surfaces to distant ignition source and flash back.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire or explosion. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool.

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6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

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7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Toluene:
- OSHA Permissible Exposure Limit (PEL):
200 ppm (TWA); 300 ppm (acceptable ceiling conc.); 500 ppm (maximum conc.).
- ACGIH Threshold Limit Value (TLV):
50 ppm (TWA) skin, A4 - Not Classifiable as a Human Carcinogen.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a half-face organic vapor respirator may be worn for up to ten times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

gm/m3/4H; Irritation data: skin rabbit, 500 mg, Moderate; eye rabbit, 2 mg/24H, Severe. Investigated as a tumorigen, mutagen, reproductive effector.

Reproductive Toxicity:

Has shown some evidence of reproductive effects in laboratory animals.

```
--------\Cancer Lists\------------------------------------------------------
                                              ---NTP Carcinogen---
Ingredient                                    Known    Anticipated    IARC Category
------------------------------------------    -----    -----------    -------------
Toluene (108-88-3)                             No          No               3
```

12. Ecological Information

Environmental Fate:

When released into the soil, this material may evaporate to a moderate extent. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released into water, this material may evaporate to a moderate extent. When released into water, this material may biodegrade to a moderate extent. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of less than 1 day. This material is not expected to significantly bioaccumulate. This material has a log octanol-water partition coefficient of less than 3.0. Bioconcentration factor = 13.2 (eels).

Environmental Toxicity:

This material is expected to be toxic to aquatic life. The LC50/96-hour values for fish are between 10 and 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: TOLUENE
Hazard Class: 3
UN/NA: UN1294
Packing Group: II
Information reported for product/size: 390LB

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Aromatic benzene-like.
Solubility:
0.05 gm/100gm water @ 20C (68F).
Specific Gravity:
0.86 @ 20C / 4 C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
111C (232F)
Melting Point:
-95C (-139F)
Vapor Density (Air=1):
3.14
Vapor Pressure (mm Hg):
22 @ 20C (68F)
Evaporation Rate (BuAc=1):
2.24

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Heat, flame, strong oxidizers, nitric and sulfuric acids, chlorine, nitrogen tetraoxide; will attack some forms of plastics, rubber, coatings.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Toxicological Data:
Oral rat LD50: 636 mg/kg; skin rabbit LD50: 14100 uL/kg; inhalation rat LC50: 49

International (Water, I.M.O.)

Proper Shipping Name: TOLUENE
Hazard Class: 3
UN/NA: UN1294
Packing Group: II
Information reported for product/size: 390LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Toluene (108-88-3)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

Ingredient	Korea	--Canada-- DSL	 NDSL	Phil.
Toluene (108-88-3)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\---------------

Ingredient	-SARA 302- RQ	 TPQ	------SARA 313----- List	 Chemical Catg.
Toluene (108-88-3)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\---------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Toluene (108-88-3)	1000	U220	No

```
Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  Yes
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: Yes Pressure: No
Reactivity: No          (Pure / Liquid)
```

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

Australian Hazchem Code: 3[Y]E
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **3** Reactivity: **0**

Label Hazard Warning:

POISON! DANGER! HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. VAPOR HARMFUL. FLAMMABLE LIQUID AND VAPOR. MAY AFFECT LIVER, KIDNEYS, BLOOD SYSTEM, OR CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

Label Precautions:

Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.

Label First Aid:

Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If vomiting occurs, keep head below hips to prevent aspiration into lungs. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician immediately.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 8.

Disclaimer:

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

1.0 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: PARA-XYLENE
MANUFACTURER/SUPPLIER:

Amoco Chemical Company
200 East Randolph Drive
Chicago, Illinois 60601 U.S.A.

EMERGENCY HEALTH INFORMATION:
1 (800) 447-8735
EMERGENCY SPILL INFORMATION:
1 (800) 424-9300 CHEMTREC (USA)
OTHER PRODUCT SAFETY INFORMATION:
(312) 856-3907

2.0 COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS#	Range % by Wt.
P-Xylene	106-42-3	100

(See Section 8.0, "Exposure Controls/Personal Protection", for exposure guidelines)

3.0 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Warning! Flammable. Causes eye and skin irritation. Can be harmful if high concentrations are inhaled. Harmful or fatal if liquid is aspirated into lungs.
POTENTIAL HEALTH EFFECTS:
EYE CONTACT: Causes eye irritation.
SKIN CONTACT: Causes skin irritation.
INHALATION: Can be harmful if high concentrations are inhaled. See "Toxicological Information" section (Section 11.0).
INGESTION: Harmful or fatal if liquid is aspirated into lungs. See "Toxicological Information" section (Section 11.0).
HMIS CODE: (Health:2) (Flammability:3) (Reactivity:0)
NFPA CODE: (Health:2) (Flammability:3) (Reactivity:0)

4.0 FIRST AID MEASURES

EYE: Immediately flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.
SKIN: Wash exposed skin with soap and water. Remove contaminated clothing and thoroughly clean and dry before reuse. Get medical attention if irritation develops.
INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.
INGESTION: If swallowed, do NOT induce vomiting. Get immediate medical attention.

5.0 FIRE FIGHTING MEASURES

FLASHPOINT: 81°F(27°C) ASTM D56
UEL: 7.0%
LEL: 1.1%
AUTOIGNITION TEMPERATURE: 924°F (496°C) (approximate)
FLAMMABILITY CLASSIFICATION: Flammable Liquid.

EXTINGUISHING MEDIA: Agents approved for Class B hazards (e.g., dry chemical, carbon dioxide, foam, steam) or water fog.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Flammable liquid. Vapor may explode if ignited in enclosed area.
FIRE-FIGHTING EQUIPMENT: Firefighters should wear full bunker gear, including a positive pressure self-contained breathing apparatus.
PRECAUTIONS: Keep away from sources of ignition (e.g., heat and open flames). Keep container closed. Use with adequate ventilation.
HAZARDOUS COMBUSTION PRODUCTS: Incomplete burning can produce carbon monoxide and/or carbon dioxide and other harmful products.

6.0 ACCIDENTAL RELEASE MEASURES

Remove or shut off all sources of ignition. Remove mechanically or contain on an absorbent material such as dry sand or earth. Keep out of sewers and waterways.

7.0 HANDLING AND STORAGE

HANDLING: Keep away from ignition sources (e.g., heat, sparks, or open flames). Keep container closed. Use with adequate ventilation.
STORAGE: Store in flammable liquids storage area. Store away from heat, ignition sources, and open flame in accordance with applicable regulations. Keep container closed.

8.0 EXPOSURE CONTROLS / PERSONAL PROTECTION

EYE: Do not get in eyes. Wear chemical goggles.
SKIN: Avoid skin contact. Wear protective clothing and gloves.
INHALATION: Do not breathe mist or vapor. Use with adequate ventilation. If ventilation is inadequate, use NIOSH/MSHA certified respirator that will protect against organic vapor and dust/mist.
ENGINEERING CONTROLS: Control airborne concentrations below the exposure guidelines.
EXPOSURE GUIDELINES:

Component	CAS#	Exposure Limits
P-Xylene	106-42-3	OSHA PEL: 100 ppm (1989)(1971) OSHA STEL: 150 ppm (1989); Not established. (1971) ACGIH TLV-TWA: 100 ppm ACGIH TLV-STEL: 150 ppm

9.0 CHEMICAL AND PHYSICAL PROPERTIES

APPEARANCE AND ODOR: Liquid. Clear. Sweet odor.
pH: Not determined.
VAPOR PRESSURE: 6.4 mm Hg at 20 °C
VAPOR DENSITY: 3.7
BOILING POINT: 282°F(139°C)
MELTING POINT: 56°F(13°C)
SOLUBILITY IN WATER: Negligible, below 0.1%.
SPECIFIC GRAVITY (WATER=1): 0.86

10.0 STABILITY AND REACTIVITY

STABILITY: Burning can be started easily.

CONDITIONS TO AVOID: Keep away from ignition sources (e.g. heat, sparks, and open flames).

MATERIALS TO AVOID: Avoid chlorine, fluorine, and other strong oxidizers.

HAZARDOUS DECOMPOSITION: Burning can produce carbon monoxide and/or carbon dioxide and other harmful products.

HAZARDOUS POLYMERIZATION: Will not occur.

11.0 TOXICOLOGICAL INFORMATION

ACUTE TOXICITY DATA:

EYE IRRITATION: Testing not conducted. See Other Toxicity Data.

SKIN IRRITATION: Testing not conducted. See Other Toxicity Data.

DERMAL LD50: Testing not conducted. See Other Toxicity Data.

ORAL LD50: Testing not conducted. See Other Toxicity Data.

INHALATION LC50: Testing not conducted. See Other Toxicity Data.

OTHER TOXICITY DATA: In humans, overexposure to xylene can cause headache, fatigue, dizziness, listlessness, confusion, irritability, gastrointestinal disturbances (nausea and loss of appetite), flushing of the face, and a feeling of increased body heat. Exposure to xylene vapors above recommended exposure limits (100 ppm - TWA) can cause irritation of the eyes, nose and throat as well as tightening of the chest and staggering gait. Severe overexposure to xylene has been reported to cause irregular heartbeat or rapid incoordinate contractions of the heart, tremors, central nervous system depression, and unconsciousness. Lethality has resulted upon exposure to 10,000 ppm. The odor threshold for xylene is reported to be 1 ppm. Aspiration of this product into the lungs can cause chemical pneumonia and can be fatal. Aspiration into the lung can occur while vomiting after ingestion of this product.

The oral LD50 for xylene is 4300 mg/kg (rat). The inhalation LC50 is 6350 ppm in rats exposed for 4 hours and 3907 ppm in mice exposed for 6 hours.

No significant treatment related effects were seen following inhalation exposure of rats and dogs exposed t0 810 ppm for 13 weeks, whereas liver damage and lung inflammation were reported in guinea pigs exposed to 300 ppm for a total of 64 exposures (4 hours der day, 6 days per week).

Xylenes were not teratogenic in rats exposed via inhalation to 100 and 400 ppm, however, adverse effects upon the unborn have been reported at exposure levels producing toxicity in the mother. Xylenes have produced negative results in various genetic toxicity tests, including the AMES assay, mouse lymphoma assay in vitro, rat bone marrow cytogenetic assay in vivo, and a dominant lethal assay.

No component of this product present at levels greater than 0.1% as a carcinogen by NTP, IARC or OSHA.

12.0 ECOLOGICAL INFORMATION

Ecotoxicity Test Data:

Para-xylene (p-xylene, or 4-xylene) is toxic to fish and other aquatic life. Published test results of the acute toxicity of p-xylene for several aquatic species show that concentrations of 2 to 10 mg/L are acutely toxic to most species tested. Acute toxicity endpoints ranged from 2 to 35 mg/L, with a geometric mean of 7 mg/L. The para-isomer appears to be slightly more toxic than the meta- and ortho-isomers.

Biodegradation Potential:

Xylenes have been shown to be readily biodegradable in water using standard protocols with inocula including sewage, activated sludge, and seawater. Field data indicates biodegradation in several situations. However, reports suggest that p-xylene may persist in some groundwater situations. Rates of degradation are expected to vary with environmental conditions and the extent of adaptation of the microbial population.

Bioconcentration Potential:

P-xylene is not expected to bioconcentrate or bioaccumulate. A bioconcentration factor of 138 to 158 is predicted using the estimated octanol-water partition coefficient (log Kow) of 3.12 to 3.2. A bioconcentration factor of 20 was reported for eels. Metabolism and excretion of xylenes has been demonstrated in several organisms, generally via production of toluic acid. Significant bioconcentrations is unlikely if bioconcentration factors are less than 1000 and the chemical is metabolized.

Other Ecological Information:

P-xylene is expected to volatilize from water and soil with a relatively high Henry's law constant of 0.32, yielding an estimated half-life in water of less than 1 week. Sorption to soil is low to moderate, with the Koc of ortho-xylene being 48-68. Abiotic degradation in air occurs through reaction with photochemically produced hydroxyl radicals, resulting in typical losses of 67-86% per day. Xylenes are likely to move with groundwater from soils and to volatilize from both soil and surface waters.

The potential for long-term ecological effects to intermittent environmental releases is expected to be minimal. However, repeated discharges may cause long-term adverse effects in the aquatic environment.

13.0 DISPOSAL INFORMATION

Disposal must be in accordance with applicable federal, state, or local regulations. Residues and spilled material are hazardous waste due to ignitability.

The container for this product can present explosion or fire hazards, even when emptied! To avoid risk of injury, do not cut, puncture, or weld on or near this container. Since the emptied containers retain product residue, follow label warnings even after container is emptied.

14.0 TRANSPORTATION INFORMATION

U.S. DEPT OF TRANSPORTATION

Shipping Name	Xylenes
Hazard Class	3
Identification Number	UN1307
Packing Group	III
RQ	RQ (Para-Xylene)

INTERNATIONAL INFORMATION:

Sea (IMO/IMDG)

Shipping Name	Xylenes
Class	3.3
Packing Group	III
UN Number	UN1307

Air (ICAO/IATA)

Shipping Name	Xylenes
Class	3
Subsidiary Class	UN1307
Packing Group	III

European Road/Rail (ADR/RID)

Shipping Name	Xylenes
Class	3
Item	31°(C)

Canadian Transportation of Dangerous Goods

Shipping Name	Xylenes
Hazard Class	3.3
Subsidiary Class	9.2
UN Number	UN1307
Packing Group	III

15.0 REGULATORY INFORMATION

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR Part 302.4): This product is reportable under 40 CFR Part 302.4 because it contains the following substance(s):

Component/CAS Number	Weight %	Component Reportable Quantity (RQ)
P-Xylene 106-42-3	100	100 lbs.

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR Part 355): This product is not regulated under Section 302 of SARA and 40 CFR Part 355.

SARA TITLE III SECTIONS 311/312 HAZARDOUS CATEGORIZATION (40 CFR Part 370): This product is defined as hazardous by OSHA under 29 CFR Part 1910.1200(d).

SARA TITLE III SECTION 313 (40 CFR Part 372): This product contains the following substance(s), which is on the Toxic Chemicals List in 40 CFR Part 372:

Component/CAS Number	Weight Percent
P-Xylene 106-42-3	100

U.S. INVENTORY (TSCA): Listed on inventory.

OSHA HAZARD COMMUNICATION STANDARD: Flammable liquid. Irritant.

EC INVENTORY (EINECS/ELINCS): In compliance.

JAPAN INVENTORY (MITI): Not determined.

AUSTRALIA INVENTORY (AICS): Not determined.

KOREA INVENTORY (ECL): Not determined.

CANADA INVENTORY (DSL): Not determined.

PHILIPPINE INVENTORY (PICCS): Not determined.

16.0 OTHER INFORMATION

Prepared by:

Environment, Health and Safety Department
Issued: March 28, 1997
Supersedes: February 27, 1996

This Material Safety Data Sheet conforms to the requirements of ANSI Z400.1.
This material safety data sheet and the information it contains is offered to you in good faith as accurate. We have reviewed any information contained in this data sheet which we received from sources outside

our company. We believe that information to be correct but cannot guarantee its accuracy or completeness. Health and safety precautions in this data sheet may not be adequate for all individuals and/or situations. It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. No statement made in this data sheet shall be construed as a permission or recommendation for the use of any product in a manner that might infringe existing patents. No warranty is made, either express or implied.

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: PAH Contaminated Soil
Catalog Numbers:
SRS103 100, SRS103100
Synonyms:
API separator sludge
Company Identification: Fisher Scientific
1 Reagent Lane
Fairlawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS#
50-32-8	Benzo(a)pyrene	0-2	200-028-5
56-55-3	1,2-Benzanthracene	0-2	200-280-6
83-32-9	Acenaphthene	0-2	201-469-6
85-01-8	Phenanthrene	0-2	201-581-5
86-73-7	Fluorene	0-2	201-695-5
87-86-5	Pentachlorophenol	0-2	201-778-6
91-20-3	Naphthalene	0-2	202-049-5
91-57-6	2-methylnaphthalene	0-2	202-078-3
120-12-7	Anthracene	0-2	204-371-1
129-00-0	Pyrene	0-2	204-927-3
132-64-9	Dibenzofuran	0-2	205-071-3
205-99-2	Benzo(b)fluoranthene	0-2	205-911-9
206-44-0	Fluoranthene	0-2	205-912-4

208-96-8	Acenaphthylene	0-2	205-917-1
218-01-9	1,2-benzphenanthrene	0-2	205-923-4
Not available	Soil	78-99	unlisted

Hazard Symbols: None Listed.
Risk Phrases: None Listed.

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Appearance: not available.
Caution! Causes skin irritation. Causes eye irritation. May cause allergic skin reaction. Causes digestive tract irritation. May cause digestive tract irritation with nausea, vomiting, and diarrhea. May cause cancer based on animal studies.
Target Organs: None.

Potential Health Effects

Eye:
May cause eye irritation.
Skin:
May cause skin irritation. May cause skin sensitization, an allergic reaction, which becomes evident upon re-exposure to this material.
Ingestion:
May cause gastrointestinal irritation with nausea, vomiting and diarrhea.
Naphthalene can cause cataracts, optical neuritis, and cornea injuries. Ingestion of large quantities may cause severe hemolytic anemia and
Inhalation:
Causes respiratory tract irritation. May cause effects similar to those described for ingestion.
Chronic:
May cause cancer according to animal studies. Prolonged exposure to respirable crystalline quartz may cause delayed lung injury/fibrosis (silicosis).

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin:
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists.
Ingestion:
If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid.
Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician:
Treat symptomatically and

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear.
Extinguishing Media:
For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam.
Autoignition Temperature:Not available.
Flash Point: Not available.
Explosion Limits, lower:Not available.
Explosion Limits, upper:Not available.
NFPA Rating: Not published.

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks:
Vacuum or sweep up material and place into a suitable disposal container. Avoid generating dusty conditions.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Wash hands before eating. Use with adequate ventilation. Avoid contact with skin and eyes. Keep container tightly closed. Avoid ingestion and inhalation.
Storage:
Store in a cool, dry place.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Use adequate ventilation to keep airborne concentrations low.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Benzo(a)pyrene	0.2 mg/m3 (as benzene solubles) (listed under ** no name **).	none listed	benzene soluble fraction: 0.2 mg/m3 TWA (includes anthracene, BaP, phenanthrene, acridine, chrysene, and pyrene) (listed under ** no name **).

```
| 1,2-Benzanthracene |none listed |none listed |none listed |
|--------------------|-------------------|-------------------|----------------
-|
| Acenaphthene |none listed |none listed |none listed |
|--------------------|-------------------|-------------------|----------------
-|
| Phenanthrene |0.2 mg/m3 (as |none listed |benzene soluble |
| |benzene solubles) | | fraction: 0.2 |
| | (listed under ** | |mg/m3 TWA |
| |no name **). | | (includes |
| | | |anthracene, BaP, |
| | | |phenanthrene, |
| | | |acridine, |
| | | | chrysene, and |
| | | |pyrene) (listed |
| | | | under ** no |
| | | |name **). |
|--------------------|-------------------|-------------------|----------------
-|
| Fluorene |none listed |none listed |none listed |
|--------------------|-------------------|-------------------|----------------
-|
| Pentachlorophenol |0.5 mg/m3; skin - |0.5 mg/m3 TWA |0.5 mg/m3 TWA |
| |potential for | 2.5 mg/m3 IDLH | |
| |cutaneous | | |
| |absorption | | |
|--------------------|-------------------|-------------------|----------------
-|
| Naphthalene |10 ppm; 15 ppm |10 ppm TWA; 50 |10 ppm TWA; 50 |
| | STEL; skin - | mg/m3 TWA 250 |mg/m3 TWA |
| |potential for |ppm IDLH | |
| |cutaneous | | |
| |absorption | | |
|--------------------|-------------------|-------------------|----------------
-|
| 2-methylnaphthalene|none listed |none listed |none listed |
|--------------------|-------------------|-------------------|----------------
-|
| Anthracene |0.2 mg/m3 (as |none listed |benzene soluble |
| |benzene solubles) | | fraction: 0.2 |
| | (listed under ** | |mg/m3 TWA |
| |no name **). | | (includes |
| | | |anthracene, BaP, |
| | | |phenanthrene, |
| | | |acridine, |
| | | | chrysene, and |
| | | |pyrene) (listed |
| | | | under ** no |
| | | |name **). |
|--------------------|-------------------|-------------------|----------------
-|
| Pyrene |0.2 mg/m3 (as |none listed |benzene soluble |
| |benzene solubles) | | fraction: 0.2 |
| | (listed under ** | |mg/m3 TWA |
| |no name **). | | (includes |
| | | |anthracene, BaP, |
| | | |phenanthrene, |
| | | |acridine, |
| | | | chrysene, and |
| | | |pyrene) (listed |
| | | | under ** no |
```

```
| | | |name **). |
|--------------------|-------------------|-------------------|---------------
-|
| Dibenzofuran |none listed |none listed |none listed |
|--------------------|-------------------|-------------------|---------------
-|
| Benzo(b)fluoranthen|none listed |none listed |none listed |
| e | | | |
|--------------------|-------------------|-------------------|---------------
-|
| Fluoranthene |none listed |none listed |none listed |
|--------------------|-------------------|-------------------|---------------
-|
| Acenaphthylene |none listed |none listed |none listed |
|--------------------|-------------------|-------------------|---------------
-|
| 1,2-benzphenanthren|0.2 mg/m3 (as |none listed |benzene soluble |
| e |benzene solubles) | | fraction: 0.2 |
| | (listed under ** | |mg/m3 TWA |
| |no name **). | | (includes |
| | | |anthracene, BaP, |
| | | |phenanthrene, |
| | | |acridine, |
| | | | chrysene, and |
| | | |pyrene) (listed |
| | | | under ** no |
| | | |name **). |
+--------------------+-------------------+-------------------+---------------
-+
```

OSHA Vacated PELs:
Benzo(a)pyrene:
benzene soluble fraction: 0.2 mg/m3 TWA (anthracene, BaP,
phenathrene, acridine, (listed under ** no name **)
1,2-Benzanthracene:
No OSHA Vacated PELs are listed for this chemical.
Acenaphthene:
No OSHA Vacated PELs are listed for this chemical.
Phenanthrene:
benzene soluble fraction: 0.2 mg/m3 TWA (anthracene, BaP,
phenathrene, acridine, (listed under ** no name **)
Fluorene:
No OSHA Vacated PELs are listed for this chemical.
Pentachlorophenol:
0.5 mg/m3 TWA
Naphthalene:
10 ppm TWA; 50 mg/m3 TWA; 15 ppm STEL; 75 mg/m3 STEL
2-methylnaphthalene:
No OSHA Vacated PELs are listed for this chemical.
Anthracene:
benzene soluble fraction: 0.2 mg/m3 TWA (anthracene, BaP,
phenathrene, acridine, (listed under ** no name **)
Pyrene:
benzene soluble fraction: 0.2 mg/m3 TWA (anthracene, BaP,
phenathrene, acridine, (listed under ** no name **)
Dibenzofuran:
No OSHA Vacated PELs are listed for this chemical.
Benzo(b)fluoranthene:
No OSHA Vacated PELs are listed for this chemical.
Fluoranthene:
No OSHA Vacated PELs are listed for this chemical.

Acenaphthylene:
No OSHA Vacated PELs are listed for this chemical.
1,2-benzphenanthrene:
benzene soluble fraction: 0.2 mg/m3 TWA (anthracene, BaP, phenathrene, acridine, (listed under ** no name **)

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin:
Wear appropriate gloves to prevent skin exposure.
Clothing:
Wear appropriate protective clothing to prevent skin exposure.
Respirators:
Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State: Solid
Appearance: not available
Odor: none reported
pH: Not available.
Vapor Pressure: Not applicable.
Vapor Density: Not available.
Evaporation Rate: Not applicable.
Viscosity: Not applicable.
Boiling Point: Not available.
Freezing/Melting Point: Not available.
Decomposition Temperature: Not available.
Solubility in water: Insoluble in water.
Specific Gravity/Density: Not available.
Molecular Formula: Mixture
Molecular Weight: 0

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
High temperatures.
Incompatibilities with Other Materials:
None reported.
Hazardous Decomposition Products:
No data available.
Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 50-32-8: DJ3675000
CAS# 56-55-3: CV9275000

CAS# 83-32-9: AB1000000
CAS# 85-01-8: SF7175000
CAS# 86-73-7: LL5670000
CAS# 87-86-5: SM6300000
CAS# 91-20-3: QJ0525000
CAS# 91-57-6: QJ9635000
CAS# 120-12-7: CA9350000
CAS# 129-00-0: UR2450000
CAS# 132-64-9: HP4430000
CAS# 205-99-2: CU1400000
CAS# 206-44-0: LL4025000
CAS# 208-96-8: AB1254000
CAS# 218-01-9: GC0700000
LD50/LC50:
Not available.
Not available.
Not available.
CAS# 85-01-8: Oral, mouse: LD50 = 700 mg/kg.
CAS# 86-73-7.
CAS# 87-86-5: Draize test, rabbit, eye: 100 uL/24 Mild; Inhalation, mouse: LC50 = 225 mg/m3; Inhalation, rat: LC50 = 355 mg/m3; Oral, mouse: LD50 = 36 mg/kg; Oral, rat: LD50 = 27 mg/kg; Skin, rat: LD50 = 96 mg/kg.
CAS# 91-20-3: Draize test, rabbit, eye: 100 mg Mild; Inhalation, rat: LC50 = >340 mg/m3/1H; Oral, mouse: LD50 = 533 mg/kg; Oral, rat: LD50 = 490 mg/kg; Skin, rabbit: LD50 = >20 gm/kg; Skin, rat: LD50 = >2500 mg/kg.
CAS# 91-57-6: Oral, rat: LD50 = 1630 mg/kg.
CAS# 120-12-7.
CAS# 129-00-0: Draize test, rabbit, skin: 500 mg/24H Mild; Inhalation, rat: LC50 = 170 mg/m3; Oral, mouse: LD50 = 800 mg/kg; Oral, rat: LD50 = 2700 mg/kg.
CAS# 132-64-9.
CAS# 205-99-2.
CAS# 206-44-0: Oral, rat: LD50 = 2 gm/kg; Skin, rabbit: LD50 = 3180 mg/kg.
CAS# 208-96-8: Oral, mouse: LD50 = 1760 mg/kg.
CAS# 218-01-9.
Carcinogenicity:
Benzo(a)pyrene -
ACGIH: A2 - Suspected Human Carcinogen
California: carcinogen; initial date 7/1/87
NIOSH: occupational carcinogen (listed as ** undefined **)
NTP: Suspect carcinogen
OSHA: Possible Select carcinogen
IARC: Group 2A carcinogen
1,2-Benzanthracene -
ACGIH: A2 - Suspected Human Carcinogen
California: carcinogen; initial date 7/1/87
NTP: Suspect carcinogen
OSHA: Possible Select carcinogen
IARC: Group 2A carcinogen
Acenaphthene -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Phenanthrene -
ACGIH: A1 - Confirmed Human Carcinogen (Benzene soluble aerosol)
NIOSH: occupational carcinogen (listed as ** undefined **)
OSHA: Select carcinogen (listed as ** undefined **).
IARC: Group 3 carcinogen
Fluorene -
IARC: Group 3 carcinogen

Pentachlorophenol -
ACGIH: A3 - Animal Carcinogen
California: carcinogen; initial date 1/1/90
Naphthalene -
ACGIH: A4 - Not Classifiable as a Human Carcinogen
2-methylnaphthalene -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Anthracene -
ACGIH: A1 - Confirmed Human Carcinogen (Benzene soluble aerosol)
NIOSH: occupational carcinogen (listed as ** undefined **)
OSHA: Select carcinogen (listed as ** undefined **).
IARC: Group 3 carcinogen
Pyrene -
ACGIH: A1 - Confirmed Human Carcinogen (Benzene soluble aerosol)
NIOSH: occupational carcinogen (listed as ** undefined **)
OSHA: Select carcinogen (listed as ** undefined **).
IARC: Group 3 carcinogen
Dibenzofuran -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Benzo(b)fluoranthene -
ACGIH: A2 - Suspected Human Carcinogen
California: carcinogen; initial date 7/1/87
NTP: Suspect carcinogen
OSHA: Possible Select carcinogen
IARC: Group 2B carcinogen
Fluoranthene -
IARC: Group 3 carcinogen
Acenaphthylene -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
1,2-benzphenanthrene -
ACGIH: A3 - Animal Carcinogen
California: carcinogen; initial date 1/1/90
NIOSH: occupational carcinogen (listed as ** undefined **)
OSHA: Select carcinogen (listed as ** undefined **).
IARC: Group 3 carcinogen

**** SECTION 12 - ECOLOGICAL INFORMATION ****

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste.
US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: CAS# 50-32-8: waste number U022. CAS# 56-55-3: waste number U018. CAS# 91-20-3: waste number U165. CAS# 206-44-0: waste number U120. CAS# 218-01-9: waste number U050.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
No information available
Canadian TDG

No information available.

**** SECTION 15 - REGULATORY INFORMATION ****

US FEDERAL
TSCA
CAS# 50-32-8 is listed on the TSCA inventory.
CAS# 56-55-3 is listed on the TSCA inventory.
CAS# 83-32-9 is listed on the TSCA inventory.
CAS# 85-01-8 is listed on the TSCA inventory.
CAS# 86-73-7 is listed on the TSCA inventory.
CAS# 87-86-5 is listed on the TSCA inventory.
CAS# 91-20-3 is listed on the TSCA inventory.
CAS# 91-57-6 is listed on the TSCA inventory.
CAS# 120-12-7 is listed on the TSCA inventory.
CAS# 129-00-0 is listed on the TSCA inventory.
CAS# 132-64-9 is listed on the TSCA inventory.
CAS# 205-99-2 is not listed on the TSCA inventory.
It is for research and development use only.
CAS# 206-44-0 is listed on the TSCA inventory.
CAS# 208-96-8 is listed on the TSCA inventory.
CAS# 218-01-9 is listed on the TSCA inventory.
Health & Safety Reporting List
CAS# 91-20-3: Effective Date: June 1, 1987; Sunset Date: June 1, 1997
CAS# 129-00-0: Effective Date: June 1, 1987; Sunset Date: June 1, 1997
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA
Section 302 (RQ)
CAS# 50-32-8: final RQ = 1 pound (0.454 kg)
CAS# 56-55-3: final RQ = 10 pounds (4.54 kg)
CAS# 83-32-9: final RQ = 100 pounds (45.4 kg)
CAS# 85-01-8: final RQ = 5000 pounds (2270 kg)
CAS# 86-73-7: final RQ = 5000 pounds (2270 kg)
CAS# 87-86-5: final RQ = 10 pounds (4.54 kg)
CAS# 91-20-3: final RQ = 100 pounds (45.4 kg)
CAS# 120-12-7: final RQ = 5000 pounds (2270 kg)
CAS# 129-00-0: final RQ = 5000 pounds (2270 kg)
CAS# 132-64-9: final RQ = 100 pound (45.4 kg)
CAS# 205-99-2: final RQ = 1 pound (0.454 kg)
CAS# 206-44-0: final RQ = 100 pounds (45.4 kg)
CAS# 208-96-8: final RQ = 5000 pounds (2270 kg)
CAS# 218-01-9: final RQ = 100 pounds (45.4 kg)
Section 302 (TPQ)
CAS# 129-00-0: TPQ = 1000/10,000 pounds; RQ = 5000 pounds (calculated TPQ changed after technic al review as described in the technical support document)
SARA Codes
CAS # 50-32-8: acute, chronic.
CAS # 83-32-9: acute.
CAS # 85-01-8: acute.
CAS # 91-20-3: acute, chronic, flammable.
CAS # 91-57-6: acute.
CAS # 120-12-7: acute.
CAS # 129-00-0: acute, chronic.
CAS # 206-44-0: acute.

Section 313
This chemical is not at a high enough concentration to be reportable under Section 313.
This chemical is not at a high enough concentration to be reportable under Section 313.
This chemical is not at a high enough concentration to be reportable under Section 313.
This material contains Pentachlorophenol (CAS# 87-86-5, 0 2%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 372.
This chemical is not at a high enough concentration to be reportable under Section 313.
This chemical is not at a high enough concentration to be reportable under Section 313.
This chemical is not at a high enough concentration to be reportable under Section 313.
This chemical is not at a high enough concentration to be reportable under Section 313.
This chemical is not at a high enough concentration to be reportable under Section 313.
This chemical is not at a high enough concentration to be reportable under Section 313.
Clean Air Act:
CAS# 87-86-5 is listed as a hazardous air pollutant (HAP).
CAS# 91-20-3 is listed as a hazardous air pollutant (HAP).
CAS# 132-64-9 is listed as a hazardous air pollutant (HAP).
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
CAS# 87-86-5 is listed as a Hazardous Substance under the CWA.
CAS# 91-20-3 is listed as a Hazardous Substance under the CWA.
CAS# 50-32-8 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 56-55-3 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 83-32-9 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 85-01-8 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 86-73-7 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 87-86-5 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 91-20-3 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 120-12-7 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 129-00-0 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 205-99-2 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 206-44-0 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 208-96-8 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 218-01-9 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 83-32-9 is listed as a Toxic Pollutant under the Clean Water Act.
CAS# 87-86-5 is listed as a Toxic Pollutant under the Clean Water Act.

CAS# 91-20-3 is listed as a Toxic Pollutant under the Clean Water Act.

CAS# 206-44-0 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

Benzo(a)pyrene can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

1,2-Benzanthracene can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

Acenaphthene can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Massachusetts.

Phenanthrene can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, (listed as ** no name **), Massachusetts.

Fluorene can be found on the following state right to know lists: New Jersey, Pennsylvania, Massachusetts.

Pentachlorophenol can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

Naphthalene can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

2-methylnaphthalene is not present on state lists from CA, PA, MN, MA, FL, or NJ.

Anthracene can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, (listed as ** no name **), Massachusetts.

Pyrene can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, (listed as ** no name **), Massachusetts.

Dibenzofuran can be found on the following state right to know lists: New Jersey, Pennsylvania, Massachusetts.

Benzo(b)fluoranthene can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

Fluoranthene can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Massachusetts.

Acenaphthylene can be found on the following state right to know lists: New Jersey, Pennsylvania, Massachusetts.

1,2-benzphenanthrene can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:

WARNING: This product contains Benzo(a)pyrene, a chemical known to the state of California to cause cancer.

WARNING: This product contains 1,2-Benzanthracene, a chemical known to the state of California to cause cancer.

WARNING: This product contains Pentachlorophenol, a chemical known to the state of California to cause cancer.

WARNING: This product contains Benzo(b)fluoranthene, a chemical known to the state of California to cause cancer.

WARNING: This product contains 1,2-benzphenanthrene, a chemical known to the state of California to cause cancer.

California No Significant Risk Level:

CAS# 50-32-8: no significant risk level = 0.06 ug/day

CAS# 87-86-5: no significant risk level = 40 ug/day
European/International Regulations
European Labeling in Accordance with EC Directives
Hazard Symbols: Not available.
Risk Phrases:
Safety Phrases:
WGK (Water Danger/Protection)
CAS# 50-32-8: No information available.
CAS# 56-55-3: No information available.
CAS# 83-32-9: No information available.
CAS# 85-01-8: No information available.
CAS# 86-73-7: No information available.
CAS# 87-86-5: 3
CAS# 91-20-3: 2
CAS# 91-57-6: No information available.
CAS# 120-12-7: 2
CAS# 129-00-0: No information available.
CAS# 132-64-9: No information available.
CAS# 205-99-2: No information available.
CAS# 206-44-0: No information available.
CAS# 208-96-8: No information available.
CAS# 218-01-9: No information available.
United Kingdom Occupational Exposure Limits
CAS# 87-86-5: OES-United Kingdom, TWA 0.5 mg/m3 TWA
CAS# 87-86-5: OES-United Kingdom, STEL 1.5 mg/m3 STEL
CAS# 91-20-3: OES-United Kingdom, TWA 10 ppm TWA; 53 mg/m3 TWA
CAS# 91-20-3: OES-United Kingdom, STEL 15 ppm STEL; 80 mg/m3 STEL
CAS# 91-20-3: OES-United Kingdom, STEL 15 ppm STEL; 80 mg/m3 STEL

Canada
CAS# 50-32-8 is listed on Canada's DSL List.
CAS# 56-55-3 is listed on Canada's NDSL List.
CAS# 83-32-9 is listed on Canada's DSL List.
CAS# 85-01-8 is listed on Canada's DSL List.
CAS# 86-73-7 is listed on Canada's DSL List.
CAS# 87-86-5 is listed on Canada's DSL List.
CAS# 91-20-3 is listed on Canada's DSL List.
CAS# 91-57-6 is listed on Canada's DSL List.
CAS# 120-12-7 is listed on Canada's DSL List.
CAS# 129-00-0 is listed on Canada's DSL List.
CAS# 132-64-9 is listed on Canada's DSL List.
CAS# 206-44-0 is listed on Canada's NDSL List.
CAS# 208-96-8 is listed on Canada's NDSL List.
CAS# 218-01-9 is listed on Canada's DSL List.
This product has a WHMIS classification of D2A.
CAS# 50-32-8 is listed on Canada's Ingredient Disclosure List.
CAS# 56-55-3 is listed on Canada's Ingredient Disclosure List.
CAS# 83-32-9 is listed on Canada's Ingredient Disclosure List.
CAS# 85-01-8 is listed on Canada's Ingredient Disclosure List.
CAS# 86-73-7 is not listed on Canada's Ingredient Disclosure List.
CAS# 87-86-5 is not listed on Canada's Ingredient Disclosure List.
CAS# 91-20-3 is listed on Canada's Ingredient Disclosure List.
CAS# 91-57-6 is not listed on Canada's Ingredient Disclosure List.
CAS# 120-12-7 is listed on Canada's Ingredient Disclosure List.
CAS# 129-00-0 is listed on Canada's Ingredient Disclosure List.
CAS# 132-64-9 is not listed on Canada's Ingredient Disclosure List.
CAS# 205-99-2 is listed on Canada's Ingredient Disclosure List.
CAS# 206-44-0 is listed on Canada's Ingredient Disclosure List.
CAS# 208-96-8 is not listed on Canada's Ingredient Disclosure List.
CAS# 218-01-9 is listed on Canada's Ingredient Disclosure List.
Exposure Limits

CAS# 50-32-8: OEL-AUSTRALIA;Carcinogen
OEL-BELGIUM;Carcinogen
OEL-FINLAND:TWA 0.01 mg/m3;Skin;Carcinogen
OEL-FRANCE;Carcinogen
OEL-GERMANY;Carcinogen
OEL-RUSSIA:STEL 0.00015 mg/m3;Carcinogen
OEL-SWEDEN:TWA 0.005 mg/m3;STEL 0.03 mg/m3;Skin
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV
CAS# 56-55-3: OEL-FRANCE;Carcinogen
CAS# 83-32-9: OEL-RUSSIA:STEL 10 mg/m3
CAS# 85-01-8 (listed as ** undefined **): OEL-UNITED KINGDOM:TWA 0.14 mg/m3 JANUARY 1993
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV
CAS# 86-73-7: Not available.
CAS# 87-86-5: OEL-AUSTRALIA:TWA 0.5 mg/m3;Skin
OEL-BELGIUM:TWA 0.5 mg/m3;Skin
OEL-DENMARK:TWA 0.05 ppm (0.5 mg/m3);Skin
OEL-FINLAND:TWA 0.5 mg/m3;STEL 1.5 mg/m3;Skin
OEL-FRANCE:TWA 0.5 mg/m3;Skin
OEL-GERMANY:TWA 0.005 ppm (0.05 mg/m3);Skin
OEL-HUNGARY:TWA 0.2 mg/m3;STEL 0.4 mg/m3;Skin
OEL-JAPAN:TWA 0.5 mg/m3;Skin
OEL-THE NETHERLANDS:TWA 0.5 mg/m3;Skin
OEL-THE PHILIPPINES:TWA 0.5 mg/m3;Skin
OEL-RUSSIA:STEL 0.1 mg/m3;Skin
OEL-SWEDEN:TWA 0.5 mg/m3;STEL 1.5 mg/m3;Skin JAN9
OEL-SWITZERLAND:TWA 0.05 ppm (0.5 mg/m3);STEL 0.1 ppm;Skin
OEL-TURKEY:TWA 0.5 mg/m3;Skin
OEL-UNITED KINGDOM:TWA 0.5 mg/m3;STEL 1.5 mg/m3;Skin
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV
CAS# 91-20-3: OEL-ARAB Republic of Egypt:TWA 10 ppm (50 mg/m3)
OEL-AUSTRALIA:TWA 10 ppm (50 mg/m3);STEL 15 ppm (75 mg/m3)
OEL-BELGIUM:TWA 10 ppm (52 mg/m3);STEL 15 ppm (79 mg/m3)
OEL-DENMARK:TWA 10 ppm (50 mg/m3)
OEL-FINLAND:TWA 10 ppm (50 mg/m3);STEL 20 ppm (10 mg/m3)
OEL-FRANCE:TWA 10 ppm (50 mg/m3)
OEL-GERMANY:TWA 10 ppm (50 mg/m3)
OEL-HUNGARY:TWA 40 mg/m3;STEL 80 mg/m3;Skin
OEL-THE NETHERLANDS:TWA 10 ppm (50 mg/m3)
OEL-THE PHILIPPINES:TWA 10 ppm (50 mg/m3)
OEL-POLAND:TWA 20 mg/m3
OEL-RUSSIA:STEL 20 mg/m3
OEL-SWITZERLAND:TWA 10 ppm (50 mg/m3)
OEL-UNITED KINGDOM:TWA 10 ppm (50 mg/m3);STEL 15 ppm (75 mg/m3)
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV
CAS# 91-57-6: OEL-RUSSIA:STEL 20 mg/m3
CAS# 120-12-7 (listed as ** undefined **): OEL-UNITED KINGDOM:TWA 0.14 mg/m3 JANUARY 1993
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV
CAS# 129-00-0 (listed as ** undefined **): OEL-UNITED KINGDOM:TWA 0.14 mg/m3 JANUARY 1993
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV
CAS# 205-99-2: OEL-FRANCE;Carcinogen
OEL-GERMANY;Carcinogen
CAS# 206-44-0: Not available.

CAS# 208-96-8: Not available.
CAS# 218-01-9: OEL-AUSTRALIA;Carcinogen
OEL-BELGIUM;Carcinogen
OEL-GERMANY;Carcinogen
OEL-SWITZERLAND;Carcinogen
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

**** SECTION 16 - ADDITIONAL INFORMATION ****

MSDS Creation Date: 9/02/1997 Revision #2 Date: 8/02/2000

```
ENVIRONMENTAL RESOURCE ASSOC -- PCBS IN SOIL (LAB STD), AROCLOR 1260 -- 6665-
00N069068
=======================================================
MSDS Safety Information
=======================================================
FSC: 6665
MSDS Date: 06/09/1994
MSDS Num: CCBVL
LIIN: 00N069068
Tech Review: 03/13/1996
Product ID: PCBS IN SOIL (LAB STD), AROCLOR 1260
Responsible Party
Cage: 1R664
Name: ENVIRONMENTAL RESOURCE ASSOC
Address: 5540 MARSHALL ST
City: ARVADA CA 80002 US
Info Phone Number: 303-431-8454
Emergency Phone Number: 303-431-8454
Review Ind: N
=======================================================
Contractor Summary
=======================================================
Cage: 1R664
Name: ENVIRONMENTAL RESOURCE ASSOCIATES
Address: 5540 MARSHALL STREET
City: ARVADA CO 80002 US
Phone: 303-431-8454
=======================================================
Ingredients
=======================================================
Cas: 1336-36-3
RTECS #: TQ1350000
Name: POLYCHLORINATED BIPHENYLS (PCBS); (POLYCHLOROBIPHENYLS) (SARA 313)
  (CERCLA)
% by Wt: <0.01
OSHA PEL: N/K (FP N)
ACGIH TLV: 1 MG/M3
EPA Rpt Qty: 1 LB
DOT Rpt Qty: 1 LB
Ozone Depleting Chemical: N
------------------------------
Name: SOIL; (CLEAN SOIL)
% by Wt: >99.0
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)
-----------------------------
Cas: 11096-82-5
RTECS #: TQ1362000
Name: POLYCHLORINATED BIPHENYL (AROCCLOR 1260); (AROCLOR 1260) (SARA 313)
  (CERCLA)
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)
EPA Rpt Qty: 1 LB
DOT Rpt Qty: 1 LB
Ozone Depleting Chemical: N
------------------------------
Name: SUPDAT:CARCINS, 1994:ANTIC TO BE CARCIN. ANIMAL:LIVER.
=======================================================
Health Hazards Data
=======================================================
LD50 LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
```

Route Of Entry Inds - Inhalation: YES

Skin: YES

Ingestion: YES

Carcinogenicity Inds - NTP: YES

IARC: YES

OSHA: NO

Effects of Exposure: PRIMARY IRRIT. IRRIT & DMGS ALL TISS. MAY CAUSE LIVER, KIDNEY & LUNG DAMAGE. MAY CAUSE CARDIAC ARRHY, MAY SENSIT HEART TO EPINEPHRINE. MAY CAUSE ALLERGIC DERM/CHLORACNE. MAY CAUSE CANCER OF LIVER OR H EMATOPOEITIC SYS. SYMPS:RED, DRY SCALY SKIN; CRACKING & WEEPING SKIN, COUGH & WHEEZING. JAUNDICE, NAUS (EFTS OF OVEREXP)

Explanation Of Carcinogenicity: POLYCHLOROBIPHENYLS:IARC MONOGRAPHS, SUPP, VOL 7, PG 322, 1987:GROUP 2A. NTP 7TH ANNUAL RPT ON CARCINS. 1994:(SUPDAT)

Signs And Symptions Of Overexposure: EFTS OF OVEREXP:& VOMIT; UREMIA. MAY CAUSE CHLORACNE. CHLOROCARB MATLS HAVE PRDCED SENSIT OF MYOCARDIUM TO EPINEPHRINE IN LAB ANIMALS & COULD HAVE SIMILAR EFT IN HUMANS. ADRENOMIMETICS (E.G., EPINEPHR INE) MAY BE CONTRAINDICATED EXCEPT FOR LIFE-SUSTAINING USES IN HUMANS ACUTELY/CHRONICALLY EXPOSED TO CHLOROCARBS(SUPDAT)

Medical Cond Aggravated By Exposure: DERMATITIS, LIVER DISEASE, KIDNEY DISEASE, ANEMIAS AND LEUKOPENIAS.

First Aid: EYES:IMMEDIATELY FLUSH W/POTABLE WATER FOR A MINIMUM OF 15 MINUTES, SEEK ASSISTANCE FROM MD (FP N). INHALATION:REMOVE FROM EXPOSURE. INGESTION:GIVE SYRUP OF IPECAC 30 CC AND 180 CC (6 OZ) WATER IF SWA LLOWED. SKIN:WASH SKIN.

Handling and Disposal

Spill Release Procedures: VENTILATE AREA. DAMPEN WITH WATER SPRAY TO PREVENT DUST DISPERSION. CALL CLEANUP TEAM. DO NOT FLUSH TO DRAIN OR OPEN WATER.

Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.

Waste Disposal Methods: DISPOSAL MUST BE I/A/W FEDERAL, STATE & LOCAL REGULATIONS (FP N). INCINERATE OR DISPOSE AS HAZARDOUS WASTE.

Handling And Storage Precautions: ONLY 1 AROCLOR WILL BE PRESENT IN EACH SAMPLE. AROCLORS ARE ABSORBED TO INERT MICRO-PARTICULATE CLAY. HANDLE WITH CARE. MATERIAL CONTAINS CARCINOGENS.

Other Precautions: NO SMOKING IN AREA OF USE. DO NOT USE IN GEN VICIN OF ARC WELDING, OPEN FLAMES/HOT SURFS. HEAT &/OR UV RADIA MAY CAUSE FORM OF HCL &/OR PHOSGENE (FP N). AVOID BREAKAGE. USE IN AREA WHERE SPILLS CAN BE CONTAINED.

Fire and Explosion Hazard Information

Flash Point Text: NON-FLAMMABLE

Extinguishing Media: MEDIA SUITABLE FOR SURROUNDING FIRE (FP N).

Fire Fighting Procedures: WEAR NIOSH/MSHA APPROVED PRESSURE DEMAND SCBA & FULL PROTECTIVE EQUIPMENT (FP N).

Unusual Fire/Explosion Hazard: MAY FORM CARBON MONOXIDE, PHOSGENE, AND CARBONYL BROMIDE IN FIRE. (SIGNIFICANT ONLY IF LG QTY INVOLVED). THERMAL DECOMPOSITION PRODS MAY INCLUDE HCL (FP N).

Control Measures

Respiratory Protection: NIOSH/MSHA APPROVED PARTICULATE OR COMBINED VAPOR/PARTICULATE FULL FACE RESPIRATOR OR NIOSH/MSHA APPROVED SELF CONT/POSITIVE PRESSURE FULL FACE UNIT.

Ventilation: LOCAL EXHAUST:USE IN HOOD. SPECIAL:VENTILATE SPILLS.

Protective Gloves: VITON OR NEOPRENE GLOVES.

Eye Protection: ANSI APPROVED CHEM WORKERS GOGGS (FP N).

Other Protective Equipment: ANSI APPRVD EMER EYEWASH & DELUGE SHOWER (FP N). CHEM IMPERVIOUS CLTHG IF LG AMTS USED. LAB COAT, IMPERVIOUS (SUP DAT)

Work Hygienic Practices: USE CAREFUL LABORATORY TECHNIQUE. AVOID CONTACT.

Supplemental Safety and Health: EFTS OF OVEREXP:(FP N). SEVERAL POLYCHLOROBIPHENYLS ARE ANIMAL POS, HUMAN SUSPECT, CARCINS. THESE SAMPLES SHOULD BE HNDLD W/GREAT CARE. OTHER PROT EQUIP:APRON W/SLEEVE & CLSD SHOES. EXPLAN OF CARCINS: ANTIC TO BE CARCIN. ANIMAL:TUMORS OF LIVER, PITUITARY GLAND, LEUKEMIA. AROCLOR 1260:NTP 7TH ANNUAL RPT ON (ING 4)

Physical/Chemical Properties

Solubility in Water: INSOLUBLE

Appearance and Odor: FINE GREY POWDER; ODORLESS.

Reactivity Data

Stability Indicator: YES

Stability Condition To Avoid: NONE

Materials To Avoid: NONE SPECIFIED BY MANUFACTURER.

Hazardous Decomposition Products: HCL, PHOSGENE (FP N).

Hazardous Polymerization Indicator: NO

Conditions To Avoid Polymerization: NOT RELEVANT

Toxicological Information

Ecological Information

MSDS Transport Information

Regulatory Information

Other Information

HAZCOM Label

Product ID: PCBS IN SOIL (LAB STD), AROCLOR 1260

Cage: 1R664

Company Name: ENVIRONMENTAL RESOURCE ASSOCIATES

Street: 5540 MARSHALL STREET

City: ARVADA CO

Zipcode: 80002 US

Health Emergency Phone: 303-431-8454

Date Of Label Review: 03/13/1996

Label Date: 03/13/1996

Chronic Hazard IND: Y

Skin Protection IND: YES

Signal Word: WARNING

Respiratory Protection IND: YES

Health Hazard: Moderate

Contact Hazard: Moderate

Fire Hazard: None

Reactivity Hazard: None

Hazard And Precautions: DECOMPOSITION PRODUCTS MAY BE HAZARDOUS. ACUTE:INHALATION OF VAPORS MAY CONTRIBUTE TO THE OCCURRENCE OF IRREGULAR

HEARTBEAT (FP N). PRIMARY IRRITANT. IRRITATES AND DAMAGES ALL TISSUES. MAY CAUSE LIVER , KIDNEY AND LUNG DAMAGE. MAY CAUSE CARDIAC ARRHYTHMIA, MAY SENSITIZE THE HEART TO EPINEPHRINE. MAY CAUSE ALLERGIC DERMATITIS OR CHLORACNE. SYMPTOMS:RED, DRY SCALY SKIN; CRACKING AND WEEPING SKIN, COUGH AND WHEEZING. JAUNDICE, NAUSEA AND VOMITING; UREMIA. MAY CAUSE CHLORACNE. CHRONIC:CANCER HAZARD. CONTAINS POLYCHLOROBIPHENYLS WHICH ARE LISTED AS ANIMAL LIVER CARCINOGENS (FP N).

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Disclaimer (provided with this information by the compiling agencies): This information is formulated for use by elements of the Department of Defense. The United States of America in no manner whatsoever expressly or implied warrants, states, or intends said information to have any application, use or viability by or to any person or persons outside the Department of Defense nor any person or persons contracting with any instrumentality of the United States of America and disclaims all liability for such use. Any person utilizing this instruction who is not a military or civilian employee of the United States of America should seek competent professional advice to verify and assume responsibility for the suitability of this information to their particular situation regardless of similarity to a corresponding Department of Defense or other government situation.

APPENDIX D

AIR MONITORING EQUIPMENT CALIBRATION AND MAINTENANCE

AIR MONITORING EQUIPMENT CALIBRATION AND MAINTENANCE

All monitoring instruments must be calibrated and maintained periodically. The limitations and possible sources of errors for each instrument must be understood by the operator. It is important that the operator ensures that the instrument responds properly to the substances it was designed to monitor. Portable air quality monitoring equipment that measures total ionizables present, such as the Photovac Micro-TIP HL-2000, must be calibrated at least once each day using a 10 ppm Isobutylene standard. The appropriate response factor shall be utilized to correspond to the material(s) of concern being monitored. Combustible gas/oxygen/%LEL meters (CGIs) such as the MSA Five Star must be calibrated at least once each week. Real time aerosol monitors, such as the MINI-RAM, must be zeroed at the beginning of each sampling period. The specific instructions for calibration and maintenance provided for each instrument should be followed. The logs maintained for calibration of instruments shall be kept on site. Any malfunctioning equipment will be replaced within 24 hours, or fieldwork will be terminated.

APPENDIX E

ACTIVITY HAZARD ANALYSIS

Project Identification NIMO Site	**Location**	**Estimated Dates** 2002 - 2003
Phase of Work General Site Hazards	**Page 1 of 2**	**Analysis Approved by**
TASKS	**HAZARDS**	**CONTROL MEASURES**
1. General Site Work	a. Slips/trips/falls.	a. Slips/trips/falls. ♦ Maintain good housekeeping, inform workers of trip and fall hazards.
	b. Manual lifting and material handling.	b. Manual lifting and material handling. ♦ Use proper lifting techniques, lift with legs not back. Never bend and twist at the waist while lifting, move your feet.. ♦ Team lifting will be used for heavy loads or use mechanical lifting devices.
	c. Temperature extremes.	c. Temperature extremes. ♦ Train personnel of signs/symptoms of heat stress ♦ Monitor air temperatures when extreme weather conditions are present ♦ Stay in visual and verbal contact with your buddy
	d. Hand & power tool usage.	d. Hand & power tool usage. ♦ Daily inspections will be performed; ♦ Remove broken or damaged tools from service; ♦ Use the tool for its intended purpose; and ♦ Use in accordance with manufacturers instructions.
	e. Biological hazards.	e. Biological hazards. ♦ Be alert to the presence of biological hazards; ♦ Avoid contact with these hazards; ♦ For ticks: ♦ Self/Buddy check of neck, hairline, groin and body after working in areas that may contain deer ticks ♦ Be alert for signs of stinging insects; and ♦ Keep bee/wasp killer on hand.
	f. Railroad crossing.	f. Railroad crossing. ♦ Instruct personnel to be aware of their surroundings; ♦ Maintain alertness to location of tracks; ♦ Stop, look and listen prior to entering crossways; ♦ Do not stop vehicles on tracks; ♦ Only cross if there is no sign of train traffic.

Project Identification NIMO Site	**Location**	**Estimated Dates** 2002 - 2003
Phase of Work General Site Hazards	**Page 2 of 2**	**Analysis Approved by**
TASKS	**HAZARDS**	**CONTROL MEASURES**
	g. Contact with Electricity	g. Contact with Electricity ♦ Ground Fault Circuit Interrupters (GFCI) shall be utilized for all cord and plug equipment. ♦ All extension cords shall have a three-blade grounding plug. ♦ Personnel shall not use extension cords with damaged outer covers, exposed inner wires, or splices. ♦ Electrical cords shall not be laid across roads where vehicular traffic may damage the cord. ♦ The Construction Manager shall halt outdoor site operations whenever lightning becomes a hazard, outdoor work will not resume until 30 minutes after the last sighting of lightening.
	h. Striking Underground Utilities	h. Striking Underground Utilities ♦ White line area for drilling or excavating ♦ Call the One Call center to have underground utilities located and marked ♦ On private property a private locatoe will be used. ♦ Work with NIMO personnel in locating underground utility lines.

Project Identification NIMO Site	**Location**	**Estimated Dates** 2002 - 2003
Phase of Work Mobilization/Demobilization	**Page 1 of 1**	**Analysis Approved by**
TASKS	**HAZARDS**	**CONTROL MEASURES**
1. Mobilization and demobilization of equipment, Site tools and personnel.	a. Fall from same level on uneven ground. b. Fall from vehicle/equipment	a. Fall from same level on uneven ground. ♦ Maintain good housekeeping, inform workers of trip and fall hazards. b. Fall from vehicle/equipment ♦ Drivers/Equipment operators use caution on mounting and dismounting the equipment. Check surface before stepping down. Maintain three point contact while climbing onto/from vehicle.
2. Unloading/Loading of vehicles/equipment.	a. Overexertion	a. Overexertion ♦ Utilize rest breaks, provide mechanical equipment for moving material.
3. Unloading/Loading of tools and materials.	a. Contact with electricity	b. Contact with electricity ♦ Only licensed and experienced electricians should work on electrically powered equipment. ♦ Lock Out and Tag Out all equipment and electric circuits before working on them.
4. Working near operating equipment/vehicles.	a. Caught in/on equipment.	a. Caught in/on equipment. ♦ Workers will not wear loose clothing around operating equipment. ♦ All equipment will be properly guarded and pinch points marked with signage.
	b. Caught between vehicles	b. Caught between vehicles ♦ Drivers must maintain workers on foot in vision, if you can't see someone, stop. ♦ Workers on foot must not position themselves between vehicles.
	c. Struck by vehicle	c. Struck by vehicle ♦ Drivers must maintain workers on foot in vision, if you can't see someone, stop. ♦ Workers on foot must avoid vehicle blind spots and maintain a safe distance from moving or stopped vehicles/equipment.
	d. Equipment failure	d. Equipment failure ♦ All equipment should be inspected before use. If any safety problems are noted the equipment should be tagged and removed from service until repaired or replaced.

Project Identification NIMO Site	**Location**	**Estimated Dates** 2002 - 2003
Phase of Work Soil Gas Sampling and Excavation of Test Pits and Geophysical Investigation.	**Page 1 of 1**	**Analysis Approved by**
TASK	HAZARDS	CONTROL MEASURES
1. Soil Gas Sampling	a. Exposure to soil gas	a. Exposure to soil gas b. Follow air sampling in Monitoring Section 3.3. c. Wear proper PPE as per Table 3-1.
2. Excavation of Test Pits	a. Striking Underground Utilities	a. Striking Underground Utilities ◆ White line area to be excavated. ◆ Contact "One Call" number to have underground utilities located and marked. ◆ On private property a private locating company will be needed and/or a Geophysical Survey will be done. ◆ Maintain reference numbers in the files and update. ◆ Maintain markings for underground utilities. ◆ Hand dig where necessary to ensure location of utility.
	b. Contact with contaminants/ chemical hazards.	b. Contact with contaminants/chemical hazards ◆ Wear appropriate PPE per Table 3-1 ◆ Practice contamination avoidance ◆ Conduct real-time air monitoring ◆ Follow proper decontamination procedures ◆ Wash hands/face before eating, drinking or smoking
	c. Struck by Heavy Equipment.	c. Struck by Heavy Equipment. ◆ Drivers/operators must maintain workers on foot in vision, if you can't see someone, stop. ◆ Workers on foot must maintain a safe distance from heavy equipment. ◆ Workers must stay clear of swing radius.
3. Geophysical Investigation	a. Struck by GPR and/or equipment	a. Struck by GPR and/or equipment ◆ Use caution with GPR equipment, ensure ground is not rutted.

Project Identification NIMO Site	**Location**	**Estimated Dates** 2002 - 2003
Phase of Work Abandoned underground pipe sampling, Tank investigation	**Page 1 of 1**	**Analysis Approved by**
TASK	**HAZARDS**	**CONTROL MEASURES**
1. Sample fluid from underground pipes.	a. Exposure to fluids	a. Exposure to fluids ♦ Conduct air monitoring as per Table 3-2 ♦ Wear PPE as specified in Table 3-1 Poly or Saran coveralls.
	b. Entering excavation	b. Entering excavation ♦ Follow OSHA Excavation and Trenching regulations ♦ Employees shall not enter excavation unless no other way to accomplish sampling is available. ♦ Excavations shall have sides sloped and/or shoring or shielding protection before any entrance.
	c. Overexertion	a. Overexertion ♦ Train workers in proper lifting practices and avoiding unusual postures while sampling or other activity. Lift with legs not with back. Never bend, lift and twist in one motion. ♦ Make mechanical equipment available for material handling when needed.
2. Tank investigation	a. Slip/Trip and Fall	g. Slip/Trip and Fall ♦ Maintain alertness to slip/trip/fall hazards; ♦ Maintain good housekeeping; ♦ Use fall protection when over 6' high.
	b. Exposure to tank contents	h. Exposure to tank contents ♦ Conduct air monitoring as per Table 3-2

Project Identification NIMO Site	**Location**	**Estimated Dates** 2002 - 2003
Phase of Work Indoor air monitoring and sampling and On site and Off site investigations.	**Page 1 of 1**	**Analysis Approved by**
TASK	**HAZARDS**	**CONTROL MEASURES**
1. Indoor air monitoring and sampling	a. Exposure to contaminants. b. Hand and power tools	a. Exposure to contaminants. ◆ See 1. (a) above b. Hand and power tools ◆ Inspect tools daily prior to use ◆ Use the proper tool for the job. ◆ Do not lift power tools by cord or hose.
2. Conduct on site investigation 3. Conduct off site investigation.	a. Exposure to contaminants, chemical hazards. b. Heat c. Trip/fall Hazards	a. Exposure to contaminants, chemical hazards. ◆ Wear appropriate PPE per Table 3-1. ◆ Practice contamination avoidance. ◆ Follow proper decontamination procedures. b. Heat ◆ Train personnel about symptoms of heat stress. ◆ Ensure personnel drink plenty of fluids. ◆ Establish work/ rest regimen c. Trip/fall Hazards ◆ Maintain alertness to slip/trip/fall hazards. ◆ Maintain good housekeeping.

Project Identification NIMO Site	**Location**	**Estimated Dates** 2002 -2003
Phase of Work Water and Sediment sampling and Decontamination	**Page 1 of 1**	**Analysis Approved by**
TASK	**HAZARDS**	**CONTROL MEASURES**
1. Water and Sediment sampling.	a. Exposure to contaminants b. Feet caught in mud	a. Exposure to contaminants ♦ See 1 (a) in above AHA b. Feet caught in mud ♦ Wear "Mudders" to enable walking in muddy conditions.
2. Sample handling. a. Samples to be placed in transportation container with ballast.	a. Equipment failure.	a. Equipment failure. ♦ Daily inspections will be performed; ♦ Remove broken or damaged equipment from service and tag; ♦ Use the tool for its intended purpose; and ♦ Use in accordance with manufacturers instructions.
3. Decontamination/ Steam cleaning.	a. Struck by steam/ hot water	a. Struck by steam/hot water ♦ Workers not directly engaged in steam cleaning operations must stay clear. ♦ Workers using steam cleaning equipment should be trained on operation and safety devices/ procedures using the owners/operators manual. ♦ Use face shield and safety glasses or goggles ♦ Stay out of the splash/steam radius ♦ Do not direct steam at anyone ♦ Do not hold objects with your feet or hands ♦ Ensure that direction of spray minimizes spread of constituents of concern ♦ Use shielding as necessary.

APPENDIX F

OSHA HEAT STRESS FACT SHEET

INTRODUCTION.

Operations involving high air temperatures, radiant heat sources, high humidity, direct physical contact with hot objects, or strenuous physical activities have a high potential for inducing heat stress in employees engaged in such operations. Such places include: iron and steel foundries, nonferrous foundries, brick-firing and ceramic plants, glass products facilities, rubber products factories, electrical utilities (particularly boiler rooms), bakeries, confectioneries, commercial kitchens, laundries, food canneries, chemical plants, mining sites, smelters, and steam tunnels.

Outdoor operations conducted in hot weather, such as construction, refining, asbestos removal, and hazardous waste site activities, especially those that require workers to wear semi-permeable or impermeable protective clothing, are also likely to cause heat stress among exposed workers.

CAUSAL FACTORS.

Age, weight, degree of physical fitness, degree of acclimatization, metabolism, use of alcohol or drugs, and a variety of medical conditions such as hypertension all affect a person's sensitivity to heat. However, even the type of clothing worn must be considered. Prior heat injury predisposes an individual to additional injury.

It is difficult to predict just who will be affected and when, because individual susceptibility varies. In addition, environmental factors include more than the ambient air temperature. Radiant heat, air movement, conduction, and relative humidity all affect an individual's response to heat.

DEFINITIONS.

The American Conference of Governmental Industrial Hygienists (1992) states that workers should not be permitted to work when their deep body temperature exceeds 38°C (100.4°F).

Heat is a measure of energy in terms of quantity.

A calorie is the amount of heat required to raise 1 gram of water 1°C (based on a standard temperature of 16.5 to 17.5°C).

Conduction is the transfer of heat between materials that contact each other. Heat passes from the warmer material to the cooler material. For example, a worker's skin can transfer heat to a contacting surface if that surface is cooler, and vice versa.

Convection is the transfer of heat in a moving fluid. Air flowing past the body can cool the body if the air temperature is cool. On the other hand, air that exceeds 35°C (95°F) can increase the heat load on the body.

Evaporative cooling takes place when sweat evaporates from the skin. High humidity reduces the rate of evaporation and thus reduces the effectiveness of the body's primary cooling mechanism.

Radiation is the transfer of heat energy through space. A worker whose body temperature is greater than the temperature of the surrounding surfaces radiates heat to these surfaces. Hot surfaces and infrared light sources radiate heat that can increase the body's heat load.

Globe temperature is the temperature inside a blackened, hollow, thin copper globe.

Metabolic heat is a by-product of the body's activity.

Natural wet bulb (NWB) temperature is measured by exposing a wet sensor, such as a wet cotton wick fitted over the bulb of a thermometer, to the effects of evaporation and convection. The term natural refers to the movement of air around the sensor.

Dry bulb (DB) temperature is measured by a thermal sensor, such as an ordinary mercury-in-glass thermometer, that is shielded from direct radiant energy sources.

HEAT DISORDERS AND HEALTH EFFECTS.

HEAT STROKE occurs when the body's system of temperature regulation fails and body temperature rises to critical levels. This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict. Heat stroke is a medical emergency. The primary signs and symptoms of heat stroke are confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature, e.g., a rectal temperature of 41°C (105.8°F). If body temperature is too high, it causes death. The elevated metabolic temperatures caused by a combination of work load and environmental heat load, both of which contribute to heat stroke, are also highly variable and difficult to predict.

If a worker shows signs of possible heat stroke, professional medical treatment should be obtained immediately. The worker should be placed in a shady area and the outer clothing should be removed. The worker's skin should be wetted and air movement around the worker should be increased to improve evaporative cooling until professional methods of cooling are initiated and the seriousness of the condition can be assessed. Fluids should be replaced as soon as possible. The medical outcome of an episode of heat stroke depends on the victim's physical fitness and the timing and effectiveness of first aid treatment.

Regardless of the worker's protests, no employee suspected of being ill from heat stroke should be sent home or left unattended unless a physician has specifically approved such an order.

HEAT EXHAUSTION. The signs and symptoms of heat exhaustion are headache, nausea, vertigo, weakness, thirst, and giddiness. Fortunately, this condition responds readily to prompt treatment. Heat exhaustion should not be dismissed lightly, however, for several reasons. One is that the fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that should not be left unattended; moreover, the victim may be injured when he or she faints. Also, the signs and symptoms seen in heat exhaustion are similar to those of heat stroke, a medical emergency.

Workers suffering from heat exhaustion should be removed from the hot environment and given fluid replacement. They should also be encouraged to get adequate rest.

HEAT CRAMPS are usually caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. It is important to understand that cramps can be caused by both too much and too little salt. Cramps appear to be caused by the lack of water replenishment. Because sweat is a hypotonic solution (±0.3% NaCl), excess salt can build up in the body if the water lost through sweating is not replaced. Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments.

Under extreme conditions, such as working for 6 to 8 hours in heavy protective gear, a loss of sodium may occur. Recent studies have shown that drinking commercially available carbohydrate-electrolyte replacement liquids is effective in minimizing physiological disturbances during recovery.

HEAT COLLAPSE ("Fainting"). In heat collapse, the brain does not receive enough oxygen because blood pools in the extremities. As a result, the exposed individual may lose consciousness. This reaction is similar to that of heat exhaustion and does not affect the body's heat balance. However, the onset of heat collapse is rapid and unpredictable. To prevent heat collapse, the worker should gradually become acclimatized to the hot environment.

HEAT RASHES are the most common problem in hot work environments. Prickly heat is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickling sensation. Prickly heat occurs in skin that is persistently wetted by unevaporated sweat, and heat rash papules may become infected if they are not treated. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

HEAT FATIGUE. A factor that predisposes an individual to heat fatigue is lack of acclimatization. The use of a program of acclimatization and training for work in hot environments is advisable. The signs and symptoms of heat fatigue include impaired performance of skilled sensory-motor, mental, or vigilance jobs. There is no treatment for heat fatigue except to remove the heat stress before a more serious heat-related condition develops.

INVESTIGATION GUIDELINES.

These guidelines for evaluating employee heat stress approximate those found in the 1992-1993 ACGIH publication, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.

EMPLOYER AND EMPLOYEE INTERVIEWS.

The inspector will review the OSHA 200 Log and, if possible, the OSHA 101 forms for indications of prior heat stress problems.

Following are some questions for employer interviews: What type of action, if any, has the employer taken to prevent heat stress problems? What are the potential sources of heat? What employee complaints have been made?

Following are some questions for employee interviews: What heat stress problems have been experienced? What type of action has the employee taken to minimize heat stress? What is the employer's involvement, i.e., does employee training include information on heat stress? (Appendix III:4-1 lists factors to be evaluated when reviewing a heat stress situation, and Appendix III:4-2 contains a follow-up checklist.)

WALKAROUND INSPECTION. During the walk around inspection, the investigator will: determine building and operation characteristics; determine whether engineering controls are functioning properly; verify information obtained from the employer and employee interviews; and perform temperature measurements and make other determinations to identify potential sources of heat stress. Investigators may wish to discuss any operations that have the potential to cause heat stress with engineers and other knowledgeable personnel. The walk around inspection should cover all affected areas. Heat sources, such as furnaces, ovens, and boilers, and relative heat load per employee should be noted.

WORK-LOAD ASSESSMENT.

Under conditions of high temperature and heavy workload, the CSHO should determine the work-load category of each job (Table III:4-1 and Figure III:4-1). Work-load category is determined by averaging metabolic rates for the tasks and then ranking them:

Light work: up to 200 kcal/hour
Medium work: 200-350 kcal/hour
Heavy work: 350-500 kcal/hour

Cool Rest Area: Where heat conditions in the rest area are different from those in the work area, the metabolic rate (M) should be calculated using a time-weighted average, as follows:
Equation III:4-1. Average Metabolic Rate

where: M = metabolic rate
t = time in minutes

In some cases, a videotape is helpful in evaluating work practices and metabolic load.

FIGURE III:4-1. ACTIVITY EXAMPLES Light hand work: writing, hand knitting

Heavy hand work: typewriting

Heavy work with one arm: hammering in nails (shoemaker, upholsterer)

Light work with two arms: filing metal, planing wood, raking the garden

Moderate work with the body: cleaning a floor, beating a carpet

Heavy work with the body: railroad track laying, digging, barking trees

Sample Calculation: Assembly line work using a heavy hand tool

Walking along 2.0 kcal/min
Intermediate value between heavy work with two arms and light work with the body 3.0 kcal/min
Add for basal metabolism 1.0 kcal/min
Total: 6.0 kcal/min

Source: ACGIH 1992.

TABLE III:4-1. ASSESSMENT OF WORK
Body position and movement kcal/min*

Sitting 0.3
Standing 0.6
Walking 2.0-3.0
Walking uphill add 0.8 for every meter (yard) rise

Type of work Average kcal/min Range kcal/min

Hand work
Light 0.4 0.2-1.2
Heavy 0.9

Work: One arm
Light 1.0 0.7-2.5
Heavy 1.7

Work: Both arms
Light 1.5 1.0-3.5
Heavy 2.5

Work: Whole body
Light 3.5 2.5-15.0
Moderate 5.0
Heavy 7.0

Very heavy 9.0

* For a "standard" worker of 70 kg body weight (154 lbs.) and 1.8m2 body surface (19.4 ft2).

Source: ACGIH 1992.

SAMPLING METHODS.

BODY TEMPERATURE MEASUREMENTS. Although instruments are available to estimate deep body temperature by measuring the temperature in the ear canal or on the skin, these instruments are not sufficiently reliable to use in compliance evaluations.

ENVIRONMENTAL MEASUREMENTS. Environmental heat measurements should be made at, or as close as possible to, the specific work area where the worker is exposed. When a worker is not continuously exposed in a single hot area but moves between two or more areas having different levels of environmental heat, or when the environmental heat varies substantially at a single hot area, environmental heat exposures should be measured for each area and for each level of environmental heat to which employees are exposed.

WET BULB GLOBE TEMPERATURE INDEX.

Wet Bulb Globe Temperature (WBGT) should be calculated using the appropriate formula in Appendix III:4-2. The WBGT for continuous all-day or several hour exposures should be averaged over a 60-minute period. Intermittent exposures should be averaged over a 120-minute period. These averages should be calculated using the following formula:
Equation III:4-2. Average Web Bulb Globe Temperature (WBGT)

For indoor and outdoor conditions with no solar load, WBGT is calculated as:

$$WBGT = 0.7NWB + 0.3GT$$

For outdoors with a solar load, WBGT is calculated as

$$WBGT = 0.7NWB + 0.2GT + 0.1DB$$

where: WBGT = Wet Bulb Globe Temperature Index
NWB = Nature Wet-Bulb Temperature

DB = Dry-Bulb Temperature
GT = Globe Temperature

The exposure limits in Table III:4-2 are valid for employees wearing light clothing. They must be adjusted for the insulation from clothing that impedes sweat evaporation and other body cooling mechanisms. Use Table III:4-3 to correct Table III:4-2 for various kinds of clothing.

Use of Table III:4-2 requires knowledge of the WBGT and approximate workload. Workload can be estimated using the data in Table III:4-1, and sample calculations are presented in Figure III:4-1.

MEASUREMENT. Portable heat stress meters or monitors are used to measure heat conditions. These instruments can calculate both the indoor and outdoor WBGT index according to established ACGIH Threshold Limit Value equations. With this information and information on the type of work being performed, heat stress meters can determine how long a person can safely work or remain in a particular hot environment. See Appendix III:4-2 for an alternate method of calculation.

TABLE III:4-2. PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUES

	------------ Work Load* ------------		
Work/rest regimen	Light	Moderate	Heavy
Continuous work	30.0°C (86°F)	26.7°C (80°F)	25.0°C (77°F)
75% Work, 25% rest, each hour	30.6°C (87°F)	28.0°C (82°F)	25.9°C (78°F)
50% Work, 50% rest, each hour	31.4°C (89°F)	29.4°C (85°F)	27.9°C (82°F)
25% Work, 75% rest, each hour	32.2°C (90°F)	31.1°C (88°F)	30.0°C (86°F)

*Values are in °C and °F, WBGT.

These TLV's are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38°C (100.4° F). They are also based on the assumption that the WBGT of the resting place is the same or very close to that of the workplace. Where the WBGT of the work area is different from that of the rest area, a time-weighted average should be used (consult the ACGIH 1992-1993 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices (1992).

These TLV's apply to physically fit and acclimatized individuals wearing light summer clothing. If heavier clothing that impedes sweat or has a higher insulation value is required, the permissible heat exposure TLV's in Table III:4-2 must be reduced by the corrections shown in Table III:4-3.

Source: ACGIH 1992.

OTHER THERMAL STRESS INDICES.

The Effective Temperature index (ET) combines the temperature, the humidity of the air, and air velocity. This index has been used extensively in the field of comfort ventilation and air-conditioning. ET remains a useful measurement technique in mines and other places where humidity is high and radiant heat is low.

The Heat-Stress Index (HSI) was developed by Belding and Hatch in 1965. Although the HSI considers all environmental factors and work rate, it is not completely satisfactory for determining an individual worker's heat stress and is also difficult to use.

TABLE III:4-3. WBGT CORRECTION FACTORS IN °C

Clothing type	Clo* value	WBGT correction
Summer lightweight working clothing	0.6	0
Cotton coveralls	1.0	-2
Winter work clothing	1.4	-4
Water barrier, permeable	1.2	-6

*Clo: Insulation value of clothing. One clo = 5.55 kcal/m2/hr of heat exchange by radiation and convection for each degree °C difference in temperature between the skin and the adjusted dry bulb temperature.

Note: Deleted from the previous version are trade names and "fully encapsulating suit, gloves, boots and hood" including its clo value of 1.2 and WBGT correction of -10.

Source: ACGIH 1992.

CONTROL.

Ventilation, air cooling, fans, shielding, and insulation are the five major types of engineering controls used to reduce heat stress in hot work environments. Heat reduction can also be achieved by using power assists and tools that reduce the physical demands placed on a worker.

However, for this approach to be successful, the metabolic effort required for the worker to use or operate these devices must be less than the effort required without them. Another method is to reduce the effort necessary to operate power assists. The worker should be allowed to take frequent rest breaks in a cooler environment.

ACCLIMATIZATION.

The human body can adapt to heat exposure to some extent. This physiological adaptation is called acclimatization. After a period of acclimatization, the same activity will produce fewer cardiovascular demands. The worker will sweat more efficiently (causing better evaporative cooling), and thus will more easily be able to maintain normal body temperatures.

A properly designed and applied acclimatization program decreases the risk of heat-related illnesses. Such a program basically involves exposing employees to work in a hot environment for progressively longer periods. NIOSH (1986) says that, for workers who have had previous experience in jobs where heat levels are high enough to produce heat stress, the regimen should be 50% exposure on day one, 60% on day two, 80% on day three, and 100% on day four. For new workers who will be similarly exposed, the regimen should be 20% on day one, with a 20% increase in exposure each additional day.

FLUID REPLACEMENT. Cool (50°-60°F) water or any cool liquid (except alcoholic beverages) should be made available to workers to encourage them to drink small amounts frequently, e.g., one cup every 20 minutes. Ample supplies of liquids should be placed close to the work area. Although some commercial replacement drinks contain salt, this is not necessary for acclimatized individuals because most people add enough salt to their summer diets.

ENGINEERING CONTROLS.

General ventilation is used to dilute hot air with cooler air (generally cooler air that is brought in from the outside). This technique clearly works better in cooler climates than in hot ones. A permanently installed ventilation system usually handles large areas or entire buildings. Portable or local exhaust systems may be more effective or practical in smaller areas.

Air treatment/air cooling differs from ventilation because it reduces the temperature of the air by removing heat (and sometimes humidity) from the air.

Air conditioning is a method of air cooling, but it is expensive to install and operate. An alternative to air conditioning is the use of chillers to circulate cool water through heat exchangers over which air from the ventilation system is then passed; chillers are more efficient in cooler climates or in dry climates where evaporative cooling can be used.

Local air cooling can be effective in reducing air temperature in specific areas. Two methods have been used successfully in industrial settings. One type, cool rooms, can be used to enclose a specific workplace or to offer a recovery area near hot jobs. The second type is a portable blower with built-in air chiller. The main advantage of a blower, aside from portability, is minimal set-up time.

Another way to reduce heat stress is to increase the air flow or convection using fans, etc. in the work area (as long as the air temperature is less than the worker's skin temperature). Changes in air speed can help workers stay cooler by increasing both the convective heat exchange (the exchange between the skin surface and the surrounding air) and the rate of evaporation. Because this method does not actually cool the air, any increases in air speed must impact the worker directly to be effective.

If the dry bulb temperature is higher than 35°C (95°F), the hot air passing over the skin can actually make the worker hotter. When the temperature is more than 35°C and the air is dry, evaporative cooling may be improved by air movement, although this improvement will be offset by the convective heat. When the temperature exceeds 35°C and the relative humidity is 100%, air movement will make the worker hotter. Increases in air speed have no effect on the body temperature of workers wearing vapor-barrier clothing.

Heat conduction methods include insulating the hot surface that generates the heat and changing the surface itself.

Simple engineering controls, such as shields, can be used to reduce radiant heat, i.e. heat coming from hot surfaces within the worker's line of sight. Surfaces that exceed 35°C (95°F) are sources of infrared radiation that can add to the worker's heat load. Flat black surfaces absorb heat more than smooth, polished ones. Having cooler surfaces surrounding the worker assists in cooling because the worker's body radiates heat toward them.
With some sources of radiation, such as heating pipes, it is possible to use both insulation and surface modifications to achieve a substantial reduction in radiant heat. Instead of reducing radiation from the source, shielding can be used to interrupt the path between the source and the worker. Polished surfaces make the best barriers, although special glass or metal mesh surfaces can be used if visibility is a problem.

Shields should be located so that they do not interfere with air flow, unless they are also being used to reduce convective heating. The reflective surface of the shield should be kept clean to maintain its effectiveness.

ADMINISTRATIVE CONTROLS AND WORK PRACTICES.

Training is the key to good work practices. Unless all employees understand the reasons for using new, or changing old, work practices, the chances of such a program succeeding are greatly reduced.

NIOSH (1986) states that a good heat stress training program should include at least the following components:

Knowledge of the hazards of heat stress;
Recognition of predisposing factors, danger signs, and symptoms;
Awareness of first-aid procedures for, and the potential health effects of, heat stroke;
Employee responsibilities in avoiding heat stress;
Dangers of using drugs, including therapeutic ones, and alcohol in hot work environments;
Use of protective clothing and equipment; and
Purpose and coverage of environmental and medical surveillance programs and the advantages of worker participation in such programs.

Hot jobs should be scheduled for the cooler part of the day, and routine maintenance and repair work in hot areas should be scheduled for the cooler seasons of the year.

WORKER MONITORING PROGRAMS.

Every worker who works in extraordinary conditions that increase the risk of heat stress should be personally monitored. These conditions include wearing semi-permeable or impermeable clothing when the temperature exceeds 21°C (69.8°F), working at extreme metabolic loads (greater than 500 kcal/hour), etc.

Personal monitoring can be done by checking the heart rate, recovery heart rate, oral temperature, or extent of body water loss.

To check the heart rate, count the radial pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work period by one third and maintain the same rest period.

The recovery heart rate can be checked by comparing the pulse rate taken at 30 seconds (P1) with the pulse rate taken at 2.5 minutes (P3) after the rest break starts. The two pulse rates can be interpreted using Table III:4-4.

Oral temperature can be checked with a clinical thermometer after work but before the employee drinks water. If the oral temperature taken under the tongue exceeds 37.6°C, shorten the next work cycle by one third.

Body water loss can be measured by weighing the worker on a scale at the beginning and end of each work day. The worker's weight loss should not exceed 1.5% of total body weight in a work day. If a weight loss exceeding this amount is observed, fluid intake should increase.

OTHER ADMINISTRATIVE CONTROLS. The following administrative controls can be used to reduce heat stress:

Reduce the physical demands of work, e.g., excessive lifting or digging with heavy objects;
Provide recovery areas, e.g., air-conditioned enclosures and rooms;
Use shifts, e.g., early morning, cool part of the day, or night work;
Use intermittent rest periods with water breaks;
Use relief workers;
Use worker pacing; and
Assign extra workers and limit worker occupancy, or the number of workers present, especially in confined or enclosed spaces.

TABLE III:4-4. HEART RATE RECOVERY CRITERIA Heart rate recovery pattern P3 Difference between P1 and P3
Satisfactory recovery
High recovery (Conditions may require further study)
No recovery (May indicate too much stress) <90
90
90 --
10
<10

PERSONAL PROTECTIVE EQUIPMENT.

REFLECTIVE CLOTHING, which can vary from aprons and jackets to suits that completely enclose the worker from neck to feet, can stop the skin from absorbing radiant heat. However, since most reflective clothing does not allow air exchange through the garment, the reduction of radiant heat must more than offset the corresponding loss in evaporative cooling. For this reason, reflective clothing should be worn as loosely as possible. In situations where radiant heat is high, auxiliary cooling systems can be used under the reflective clothing.

AUXILIARY BODY COOLING.

Commercially available ice vests, though heavy, may accommodate as many as 72 ice packets, which are usually filled with water. Carbon dioxide (dry ice) can also be used as a coolant. The cooling offered by ice packets lasts only 2 to 4 hours at moderate to heavy heat loads, and frequent replacement is necessary. However, ice vests do not encumber the worker and thus permit maximum mobility. Cooling with ice is also relatively inexpensive.

Wetted clothing is another simple and inexpensive personal cooling technique. It is effective when reflective or other impermeable protective clothing is worn. The clothing may be wetted terry cloth coveralls or wetted two-piece, whole-body cotton suits. This approach to auxiliary cooling can be quite effective under conditions of high temperature and low humidity, where evaporation from the wetted garment is not restricted.

Water-cooled garments range from a hood, which cools only the head, to vests and "long johns," which offer partial or complete body cooling. Use of this equipment requires a battery-driven circulating pump, liquid-ice coolant, and a container.

Although this system has the advantage of allowing wearer mobility, the weight of the components limits the amount of ice that can be carried and thus reduces the effective use time. The heat transfer rate in liquid cooling systems may limit their use to low-activity jobs; even in such jobs, their service time is only about 20 minutes per pound of cooling ice. To keep outside heat from melting the ice, an outer insulating jacket should be an integral part of these systems.

Circulating air is the most highly effective, as well as the most complicated, personal cooling system. By directing compressed air around the body from a supplied air system, both evaporative and convective cooling are improved. The greatest advantage occurs when circulating air is used with impermeable garments or double cotton overalls.

One type, used when respiratory protection is also necessary, forces exhaust air from a supplied-air hood ("bubble hood") around the neck and down inside an impermeable suit. The air then escapes through openings in the suit. Air can also be supplied directly to the suit without using a hood in three ways:

by a single inlet;
by a distribution tree; or
by a perforated vest.

In addition, a vortex tube can be used to reduce the temperature of circulating air. The cooled air from this tube can be introduced either under the clothing or into a bubble hood. The use of a vortex tube separates the air stream into a hot and cold stream; these tubes also can be used to supply heat in cold climates. Circulating air, however, is noisy and requires a constant source of compressed air supplied through an attached air hose.

One problem with this system is the limited mobility of workers whose suits are attached to an air hose. Another is that of getting air to the work area itself. These systems should therefore be used in work areas where workers are not required to move around much or to climb. Another concern with these systems is that they can lead to dehydration. The cool, dry air feels comfortable and the worker may not realize that it is important to drink liquids frequently.

RESPIRATOR USAGE. The weight of a self-contained breathing apparatus (SCBA) increases stress on a worker, and this stress contributes to overall heat stress. Chemical protective clothing such as totally encapsulating chemical protection suits will also add to the heat stress problem.

APPENDIX III: 4-2. HEAT STRESS-RELATED ILLNESS OR ACCIDENT FOLLOW-UP.

Describe events leading up to the episode.

Evaluation/comments by other workers at the scene.

Work at time of episode (heavy, medium, light)?
How long was affected employee working at site prior to episode?
Medical history of affected worker, if known.

Appropriate engineering controls in place?

Appropriate engineering controls in operation?

Appropriate work practices used by affected employee(s)?

Appropriate personal protective equipment available?

Appropriate personal protective equipment in use?

Medical screening for heat stress and continued surveillance for signs of heat stress given other employees?

Additional comments regarding specific episode(s): (Use additional pages as needed.)

APPENDIX III: 4-3. MEASUREMENT OF WET BULB GLOBE TEMPERATURE.

Measurement is often required of those environmental factors that most nearly correlate with deep body temperature and other physiological responses to heat. At the present time, the Wet Bulb Globe Temperature Index (WBGT) is the most used technique to measure these environmental factors. WBGT values are calculated by the following equations:

Equation III:4-4. Indoor or Outdoor Wet Bulb Globe Temperature Indexes (WBGI)

Indoor or outdoors with no solar load

$$WBGT = 0.7NWB + 0.3GT$$

Outdoors with solar load

$$WBGT = 0.7NWB + 0.2GT + 0.1DB$$

where: WBGT = Wet Bulb Globe Temperature Index
NWB = Natural Wet-Bulb Temperature
DB = Dry-Bulb (air) Temperature
GT = Globe Thermometer Temperature

The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry-bulb thermometer. The measurement of environmental factors shall be performed as follows:

1. The range of the dry and the natural wet-bulb thermometers should be -5°C to +50°C, with an accuracy of ±0.5°C. The dry bulb thermometer must be shielded from the sun and the other radiant surfaces of the environment without restricting the airflow around the bulb. The wick of the natural wet bulb thermometer should be kept wet with distilled water for at least one-half hour before the temperature reading is made. It is not enough to immerse the other end of the wick into a reservoir of distilled water and wait until the whole wick becomes wet by capillary. The wick must be wetted by direct application of water from a syringe one-half hour before each reading. The wick must cover the bulb of the thermometer and an equal length of additional wick must cover the stem above the bulb. The wick should always be clean, and new wicks should be washed before using.

2. A globe thermometer, consisting of a 15 cm (6-inch) in diameter hollow copper sphere painted on the outside with a matte black finish, or equivalent, must be used. The bulb or sensor of a thermometer (range -5°C to +100°C with an accuracy of ±0.5°C) must be fixed in the center of the sphere. The globe thermometer should be exposed at least 25 minutes before it is read.

3. A stand should be used to suspend the three thermometers so that they do not restrict free air flow around the bulbs and the wet-bulb and globe thermometer are not shaded.

4. It is permissible to use any other type of temperature sensor that gives a reading similar to that of a mercury thermometer under the same conditions.

5. The thermometers must be placed so that the readings are representative of the employee's work or rest areas, as appropriate.

Once the WBGT has been estimated, employers can estimate workers' metabolic heat load (see Tables III:4-1 and III:4-2) and use the ACGIH method to determine the appropriate work/rest regimen, clothing, and equipment to use to control the heat exposures of workers in their facilities.

APPENDIX D

SITE CHARACTERIZATION DATA SUMMARY
MALONE (AMSDEN STREET) FORMER MANUFACTURED GAS PLANT SITE

Site Characterization Summary
Malone Former MGP Site

1.0 INTRODUCTION

A Site Characterization (SC) program was performed by TRC Environmental Corporation (TRC) at the former manufactured gas plant (MGP) site located on Amsden Street, in Malone, New York (Site). The SC investigation was performed for Niagara Mohawk, A National Grid Company (NM), under an existing site-specific work plan developed by Foster Wheeler Environmental Corporation.

The Site is currently owned by NM, having been purchased back from a prior owner in 2002, and is being evaluated by NM under an existing Consent Order with New York State Department of Environmental Conservation (NYSDEC). The Site is located in a mixed commercial and residential neighborhood, approximately one block north of the center of the Village of Malone on the west bank of the Salmon River. The majority of the former MGP facilities were located adjacent to Amsden Street, however, immediately east of the primary former plant, grade drops sharply to the east, toward the river. Several former MGP structures remain on-site, including a concrete and cinderblock former production/purification building and an historic stone building, which formerly served as an electrical substation. An above-grade gas holder foundation slab and the remnant foundation of a former power house are still evident east of the primary MGP, closer to the river. Site access is presently restricted by complete fencing with a locked gate surrounding the former primary MGP; access to the remainder of the Site is partially restricted through partial fencing and locked gates. A Site Plan is provided as Figure 1.

Based upon the physical conditions encountered during the SC investigation, Site geology appears to consist of a thin veneer of overburden, over shallow bedrock. Overburden on-site consists of fill, fine-grained sand/silt/clay, and a thin layer of till. Fill was encountered on-site, extending to a depth of approximately 6 feet below ground surface (bgs) across the Site; the fill consisted of native sand, silt and/or gravel mixed with a wide assortment of demolition debris, cinders and ash. The silt/sand unit ranges from 15 feet in thickness, near Amsden Street (SB-01) to approximately ten feet closer to the river. Beneath this unit, a thin till layer (consisting of sand, some gravel and/or cobbles and occasional boulders) was encountered immediately above bedrock. Bedrock ranged in depth from grade, to approximately 22 feet bgs adjacent to Amsden Street, to 10 feet bgs close to the river (SB-4). Figure 2 depicts the on-site investigation sample locations, and one geologic cross-section depicting the general subsurface conditions characterized on-site during the investigation

2.0 SUMMARY OF FINDINGS

The following section provides a brief summary of the physical and analytical findings associated with the field investigation. The investigation field program consisted of exploratory test pits, soil borings, collection and analysis of surface and subsurface soil samples, installation of two monitoring wells, collection and analysis of one round of groundwater samples, and a full site survey. These activities were performed from July 16 and October 3, 2003. Findings from each field task are discussed below.

2.1 *Exploratory Test Pit Program*

Test pit excavations were performed by Lyon Drilling Company, under TRC's direction. A total of eight test pits were completed. Primary focus was the evaluation of two former holders (TP-1, TP-2, TP-5 and TP-6), a former tar well (TP-3), former retort house (TP-4), and nature of shallow soils down gradient from the former MGP facilities (TP-7 and TP-8). Test pit logs are provided as part of Attachment 2; a summary of physical indications of MGP-related impacts is provided in Table 1.

Results of the test pit program included the location and physical evaluation of the southernmost gas holder foundation. Test pits TP-1 and TP-2 were excavated to locate and characterize this holder and contents. Construction of the holder wall consisted of a two-foot thick mortared brick wall. In addition, a four-inch concrete pipe containing weathered tar was encountered five feet bgs, extending northeast from the holder towards the former tar well. Within TP-2, which intersected the eastern edge of the holder, tar impacts were noted from a depth of 2.5 to the bottom of the excavation at 4.5 feet bgs, where heavy tar impacts were observed

Test pit TP-3 was excavated in the location of a former tar well, adjacent to the existing stone building near Amsden Street. Stiff, weathered tar was noted in the shallow subsurface (0-2 feet bgs). The eastern wall of the brick structure was exposed, as well as a portion of the interior of the circular structure. A combination of weathered and mobile product was noted within the structure, to a depth of three feet (determined with a hand probe). Calculations based upon measurements of the radius of the exposed wall indicate that the structure is approximately 7.5 feet wide and three feet deep; based on these values, the tar well is estimated to contain approximately five cubic yards of tar-impacted material. Additional indications of tar impacts outside of the structure, and extensive signs of weathered tar around the structure were also observed in the vicinity of this test pit.

Test pit TP-4 was excavated to evaluate the approximate location of the former Retort House. The apparent original foundation of this building was encountered at seven feet bgs. Significant demolition debris and fill materials were encountered throughout the excavation; however, no MGP residual impacts were noted in this location.

Test pits TP-5 and TP-6 were excavated to evaluate the exposed foundation of the second, northernmost holder. TP-5 was excavated within a sump, located on the foundation, where limited weathered tar was observed on the inner surface of the sump. TP-6A and TP-6B were excavated along the eastern edge of the foundation to determine construction of the foundation and evaluate downgradient soil conditions for presence of MGP residuals. The eastern edge of the foundation extends from three feet above grade at the top, to three feet bgs. Heavily weathered tar, slag, and coke fragments were noted at the surface of both excavations, however no deeper indications of contamination were noted in the native soil encountered beneath.

Test pits TP-7 and TP-8 were located downhill from the primary MGP facility to evaluate shallow subsurface conditions. Extensive evidence of fill material associated with the former MGP and/or adjacent Power House (i.e., ash, coal fragments, clinkers) was encountered in both excavations. In TP-2, located east of the southern holder, significant evidence of tar-related impacts were observed, consisting of some weathered tar near the surface and more-mobile tar at depth. Fill appears to extend to a depth of 6 feet, with native soils beneath consisting of till (combination of silt, sand, gravel, cobbles and boulders)

2.2 Soil Investigation

A total of 8 soil borings were completed to determine the presence or absence of MGP-related impacts on-site. All borings were completed using standard hollow-stem auger (HSA) methods, in accordance with the NYSDEC-specified procedures regarding continuous split-spoon sampling. Drilling was performed by Lyon Drilling, under field supervision by TRC, using a track-mounted Bombardier rig. All borings were characterized with respect to soils encountered, and physical evidence of MGP impacts; in addition, analytical samples were collected from selected intervals for chemical analysis. Detailed physical findings for each boring are summarized in the boring logs provided in Attachment 2.

Summary of the geological conditions encountered on-site during the boring program were summarized in Section 1.0, above. Bedrock was encountered at depths ranging between 6 and 22 feet bgs, depending upon location. Summary of physical evidence of contaminant impacts is provided in Table 1, below.

Analytical samples were collected from each soil boring, at approximate five-foot intervals. Samples were submitted to CHEMTECH for laboratory analysis of a combination of BTEX, PAHs, total cyanide and Total Organic Carbon (TOC). Selected samples were submitted for full VOC, SVOC, and TAL metals analysis. Summary of the analytical results for the samples collected throughout the completed soil borings is provided in Tables 1 through 8, attached. In general, these laboratory results are consistent with the observed extent of physical impacts noted during the boring program. Visual summaries of Total BTEX and Total Carcinogenic PAH concentrations detected in the soil boring samples are provided in Figures 3 and 4, respectively. Review of these two figures clearly indicates the detection of these contaminants of concern in the identified heavily impacted areas of the Site, at elevated levels.

For screening purposes, all analytical data was compared to the current NYSDEC TAGM 4046 Cleanup Criteria, where applicable. Exceedances of the TAGM soil criteria for organic constituents are summarized in Table 2. Exceedances of at least one TAGM criterion were detected in one or more soil samples collected from 7 of the 8 borings. Except for the southern holder, identified impacts appear to be primarily limited to shallow soils.

2.3 *Surface Soil Sample Program*

Collection of surface soil samples (0 to 2 inches bgs) was performed on-site as well as off-site, where background samples were collected. A total of eight on-site and five off-site samples were collected and analyzed. All samples were submitted for VOC, SVOC, TAL metal, and TOC analysis. Of note during sample collection was the widespread surficial evidence of weathered tar across much of the embankment between the primary former MGP and the river. Surface soil samples in this area were collected from the miscellaneous fill/soil material.

Total carcinogenic PAH (cPAH) concentrations detected in surface soils are depicted in Figure 5 (for on-site samples) and Figure 6 (for off-site samples). In all surface soil samples (on-and off-site), at least two or more individual PAH TAGM criterion was exceeded. All off-site sample total cPAH concentrations were below the TAGM criterion of 10 mg/Kg. On-site, all but one of the samples collected on the primary MGP parcel yielded Total cPAHs under the criterion of 10 mg/Kg, however concentrations were much greater (e.g., maximum Total cPAHs of 643 mg/Kg) in the three samples collected from the embankment immediately to the east (samples SS-6, SS-7 and SS-8).

2.4 *Groundwater Investigation*

Originally, four monitoring wells were planned, however saturated conditions were typically encountered close to or at the depth of bedrock. These encountered conditions indicated that bedrock wells would be required to adequately intercept shallow groundwater; installation of bedrock wells was outside of the scope of the planned SC investigation. In addition, the NYSDEC requested that a bedrock seep sample be collected adjacent to the river, where an ongoing water seep had been observed discharging from shallow bedrock. Locations of the two installed wells and the seep sample location are depicted in Figure 7.

During the soil boring program, depth to the water table ranged from approximately seven feet bgs within the southern holder (most likely perched conditions within the holder) to 20+ feet bgs in boring SB-3; depth varied with location and surface grade. The wells were installed to intercept the water table. The location and elevation of well casings have also been performed as part of the Site-wide survey, and water levels were determined in each well prior to initiation of sample collection during two sample events. During the second groundwater sampling event, insufficient well recharge and low water table conditions precluded collection of samples from the two wells as well as the seep location. Based on the absence of sufficient data, no groundwater contour map can be developed at this time. However, based upon the available data and observation of site grades, direction of shallow groundwater flow is inferred to be generally east, toward the Salmon River.

One round of groundwater sampling was completed, in accordance with the approved SC Work Plan, on August 29, 2003. The second planned sampling event was attempted, unsuccessfully, on October 3, 2003. Samples were analyzed for VOCs, SVOCs, and TAL metals. Analytical results for the single completed sampling round are presented in Table 7. In addition, summaries of detected Total BTEX, Total PAH, and Total Carcinogenic PAH concentrations are presented in Figure 6.

In summary, Technical and Operational Guidance Series (TOGs) exceedances were detected in both well samples. The sample from MW-3 yielded TAGM exceedances for 0-Cresol, Naphthalene, and Dibenzofuran. The sample from MW-4 yielded TAGM exceedances for Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene, and Indeno(1,2,3-cd)pyrene. Based on these results, groundwater quality downgradient of the former MGP appears somewhat degraded. Potential for off-site impacts is not known, although the sample collected at the seep location directly downgradient of the MGP yielded no detectable MGP constituents.

TABLE 1: SUMMARY OF CONTAMINATION NOTED IN SOIL BORINGS

Location	Final Depth (bgs)	Description of Impacts*
TEST PITs		
TP-1	8.2 feet	Three-inch thick tar seam at 2 feet. Slight to moderate tar odor and black staining. Four-inch diameter concrete pipe containing viscous tar encountered outside of holder foundation.
TP-2	4.5 feet	Weathered tar noted from 2.5 to 4.5 feet (bottom of excavation).
TP-3	4 feet	Hard, weathered tar noted on surface, from 1 to 2 feet. Top edge of former tar well encountered at 2.5 feet. Viscous, flowable tar noted within structure to depth of 3+ feet bgs (possible bottom of well).
TP-4	7 feet	No distinct impacts noted.
TP-5	2 feet	Dry, weathered tar noted on surface of concrete, within sump.
TP-6	7 feet	Hard, weathered tar noted at surface.
TP-7	6.2 feet	Weathered tar noted at surface. Ten-inch thick tar seam at 3 feet. Combination of non-flowable (weathered) and flowable tar within fill from 0.2 to 4 feet.
TP-8	6 feet	Slight tar odor noted in saturated material at the bottom of the excavation.
SOIL BORINGS		
SB-1	24 feet	No distinct impacts noted.
SB-2	16 feet	Small amount of hard, weathered tar in surficial fill.
SB-3	21.4 feet	Strong tar odor and blebs noted at 0.9 feet. Strong tar odor with visible tar at 2 to 2.1 feet. Tar odor and/or black staining from 4 to 10 feet.
SB-4	8 feet	Black staining and odor noted from 6.5 to 8 feet. Staining, strong tar odor, sheen and tar noted at bottom of boring (refusal).
SB-5	19.8 feet	Slight odor from 8 to 12 feet. Strong tar odor and visible, viscous tar noted at 12.4 to 13.3 feet (holder bottom). Viscous tar also observed from 16.2 to 16.5 feet.
SB-6	16.6 feet	Viscous, weathered tar at 2.8 to 3 feet and 6.7 to 6.9 feet. Tar impacts (some mobile, some viscous) noted down to depth of holder bottom at 16+ feet.
SB-7	20.3 feet	No distinct impacts noted.
SB-8	10.2 feet	Small amount of hard, weathered tar in surficial fill.
MW-3	12.5 feet	Black staining and strong odor at 11 to 12 feet (only interval sampled).

***Note**: depths presented with respect to feet below ground surface)

TABLE 2: SUMMARY OF TAGM EXCEEDANCES FOR ORGANIC CONSTITUENTS IN SOILS

Boring Location (depth)	Location	NYSDEC TAGM Constituent(s) Exceeded
SOIL BORINGS		
SB-1(8-10)	Southeast corner of Site	Benz0(a)pyrene
SB-2(4-6)	Northeast of former Tar Well	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene
SB-2(8-10)	Northeast of former Tar Well	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene
SB-3(2-4)	Immediately east of southern holder	Benzene, Naphthalene, Acenaphthylene, Phenanthrene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene
SB-3(8-10)	Immediately east of southern holder	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene
SB-4(6-8)	North of former Power House foundation	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene, Naphthalene
SB-5(12-14)	Within southern holder foundation	Benzene, Toluene, Ethylbenzene, Naphthalene, Acenaphthylene, Acenaphthene, Anthracene, Phenanthrene, Fluoranthene, Fluorene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(g.h.i)perylene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene,
SB-6(2-4)	Within southern holder foundation	Benzene, Naphthalene, Acenaphthylene, Acenaphthene, Anthracene, Phenanthrene, Fluoranthene, Fluorene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(g.h.i)perylene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene,
SB-6(8-10)	Within southern holder foundation	Benzene, Toluene, Ethylbenzene, Cresol, Phenol, Naphthalene, 2-Methylnaphthalene, Acenaphthylene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(g,h,i)perylene
SB-6(12-14)	Within southern holder foundation	Benzene, Toluene, Phenanthrene, Fluoranthene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene,
SB-8(0-2)	Immediately southeast of northern holder foundation	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene
SURFACE SOILS		

TABLE 2: SUMMARY OF TAGM EXCEEDANCES FOR ORGANIC CONSTITUENTS IN SOILS

Boring Location (depth)	Location	NYSDEC TAGM Constituent(s) Exceeded
On-Site Sample Locations		
SS-1	Northeast of existing cinderblock building	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene
SS-2	Within former coal storage Area	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene
SS-3	Vicinity of southern holder	Chrysene, Benzo(a)pyrene
SS-4	North of former Tar Well	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene
SS-5	North of northern holder foundation	Benzo(a)anthracene, Chrysene, Benzo(a)pyrene
SS-6	East of northern holder foundation	Dibenzofuran, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene
SS-7	Vicinity of former Power House foundation	Cresol, Phenol, Naphthalene, Dibenzofuran, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene
SS-8	Southwest of former Power House foundation	Fluoranthene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene
Off-Site Sample Locations		
SS-9	Off-site, north on Amsden Street	Benzo(a)pyrene
SS-10	Off-site, located adjacent to railroad tracks on Railroad Street	Benzo(a)anthracene, Benzo(a)pyrene
SS-11	Off-site, located on Rockland Street	Benzo(a)anthracene, Chrysene, Benzo(a)pyrene
SS-12	Off-site, located on Academy Street	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene
SS-13	Off-site, located in park on Elm Street	Benzo(a)anthracene, Chrysene, Benzo(a)pyrene

Legend:

●	Found Iron 5/8" Rebar
— - - —	Property Line
	Utility Pole
◆ MW-1	Monitor Well (Designation, Elevation)
● SB-1	Soil Boring (Designation, Elevation)
■ SS-4	Surface Sample (Designation, Elevation)
○	Historic MGP Structure

General Notes:

1) This survey is referenced horizontally to the North American Datum of 1983 (NAD83) and projected on the New York State Plane Coordinate System (East Zone) and vertically to the North American Vertical Datum of 1988 (NAVD88).

2) North arrow as shown indicates Grid North referenced to NAD83 and projected on the New York State Plane Coordinate System (East Zone).

3) Base information taken from drawing by Thew Associates, PLLC titled " Map Showing Existing Topography Former MGP Facility Niagara Mohawk Power Corporation Malone, New York" project number CL2727A-03-03

0 30 60
GRAPHIC SCALE

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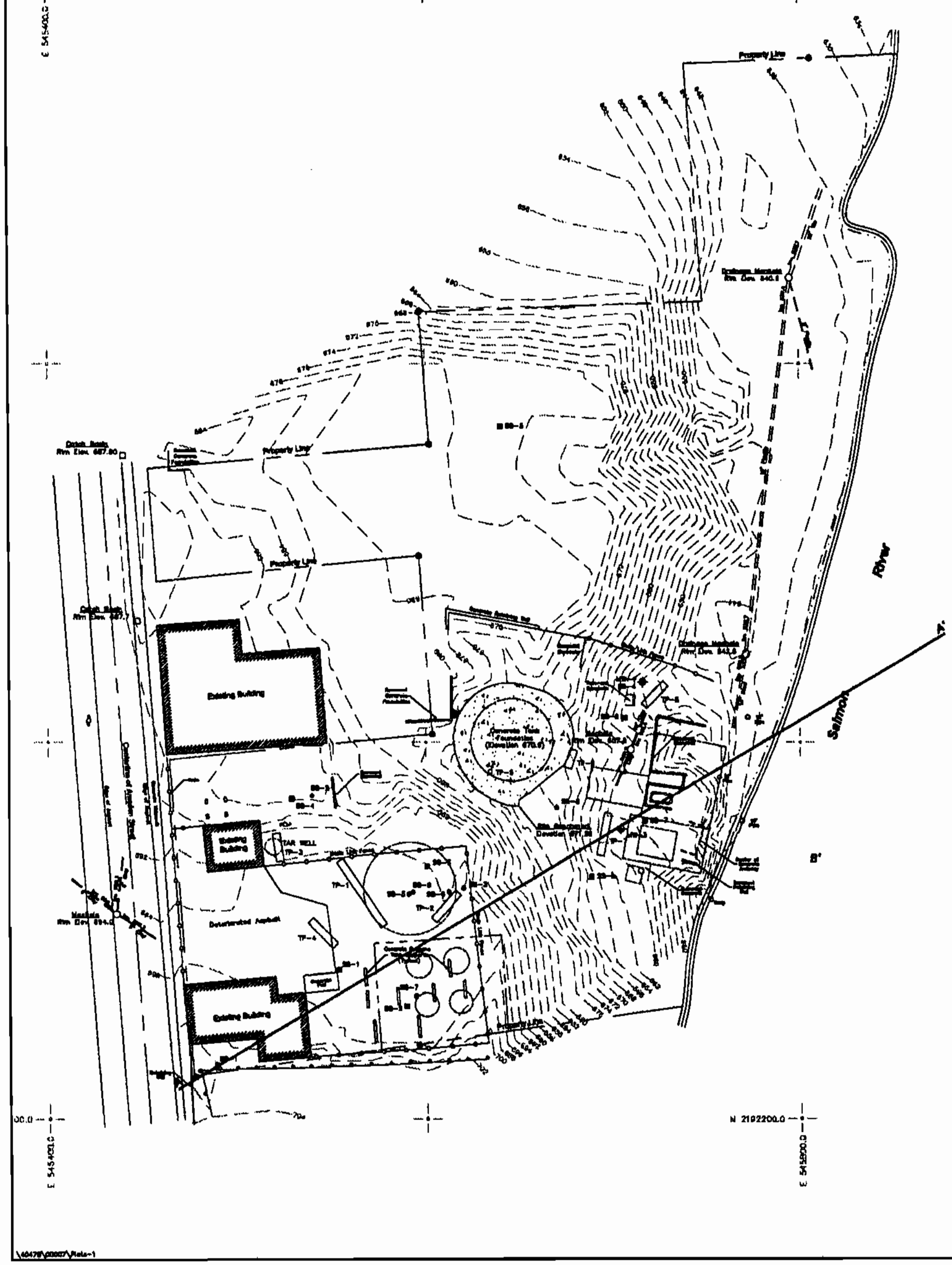
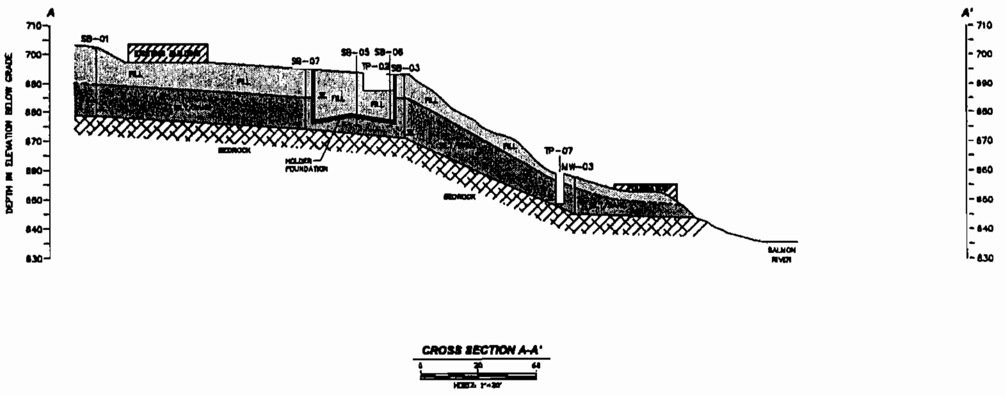
NIAGARA MOHAWK – A NATIONAL GRID COMPANY
FORMER MGP SITE
MALONE, NEW YORK

FIGURE 1
SITE PLAN

Date 12/03 | Project No. 38278-1000-00010





CROSS SECTION A-A'

HORIZ: 1"=20'

Legend

●	Found Iron 5/8" Rebar
— - - —	Property Line
⊙	Utility Pole
◈ MW-1	Monitor Well (Designation, Elevation)
● SB-1	Soil Boring (Designation, Elevation)
▨ SS-1	Surface Sample (Designation, Elevation)
○	Historic MGP Structure

General Notes:

1) This survey is referenced horizontally to the North American Datum of 1983 (NAD83) and projected on the New York State Plane Coordinate System (East Zone) and vertically to the North American Vertical Datum of 1988 (NAVD88).

2) North arrow as shown indicates Grid North referenced to NAD83 and projected on the New York State Plane Coordinate System (East Zone).

3) Base information taken from drawing by Thew Associates, PLLC title: " Map Showing Existing Topography Former MGP Facility Niagara Mohawk Power Corporation Malone, New York" project number CR2727A-03-03

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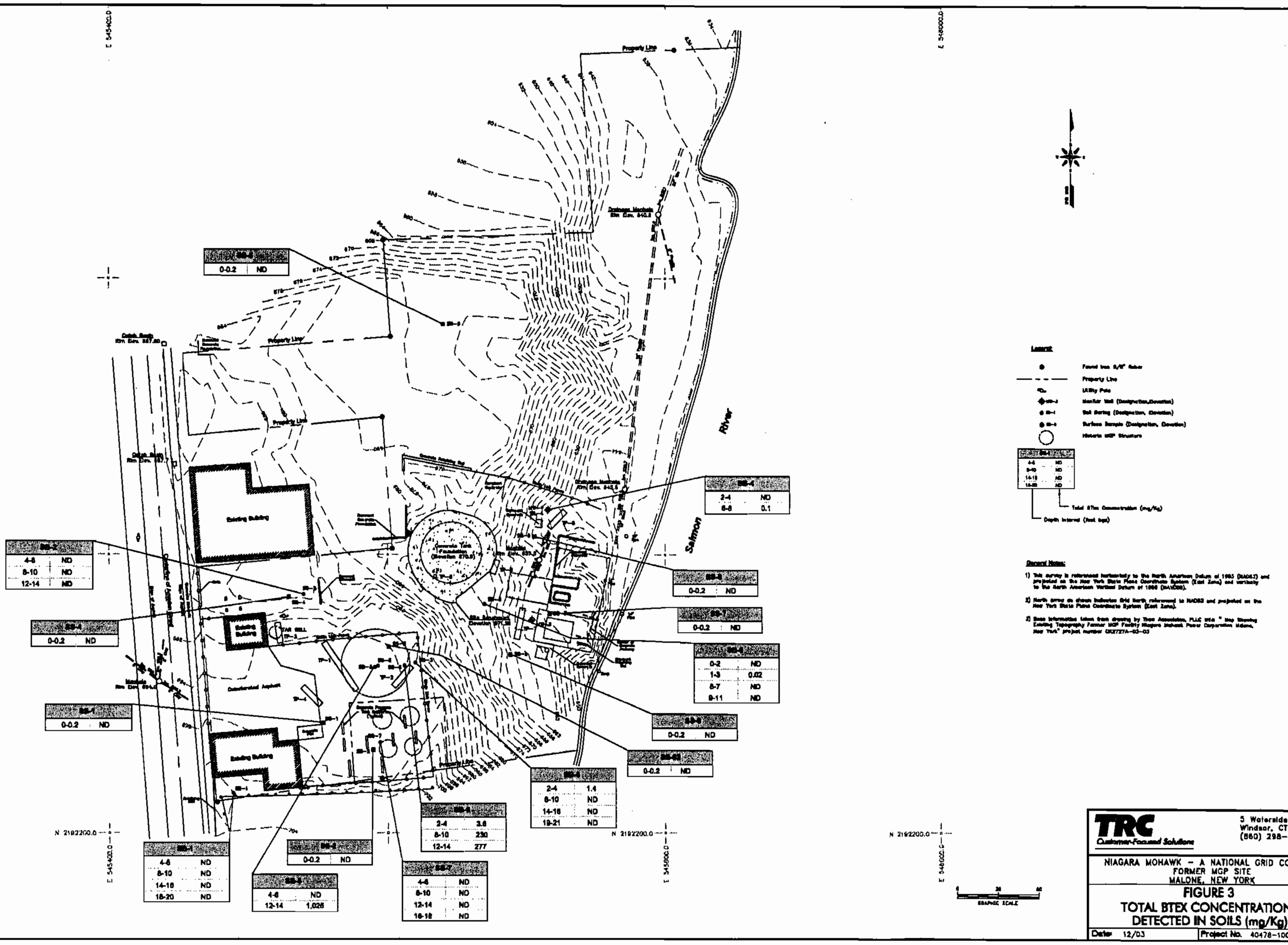
NIAGARA MOHAWK – A NATIONAL GRID COMPANY
FORMER MGP SITE
MALONE, NEW YORK

FIGURE 2
GEOLOGIC CROSS-SECTIONS

Date: 12/03
Project No. 40478-1000-00007

\40478\00007\Rela-1



General Notes:

1) This survey is referenced horizontally to the North American Datum of 1983 (NAD83) and projected on the New York State Plane Coordinate System (East Zone) and vertically to the North American Vertical Datum of 1988 (NAVD88).

2) North arrow as shown indicates Grid North referenced to NAD83 and projected on the New York State Plane Coordinate System (East Zone).

3) Base information taken from drawing by Thew Associates, PLLC title " Map Showing Existing Topography Former MGP Facility Niagara Mohawk Power Corporation Malone, New York" project number CR2727A-03-03

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NIAGARA MOHAWK – A NATIONAL GRID COMPANY
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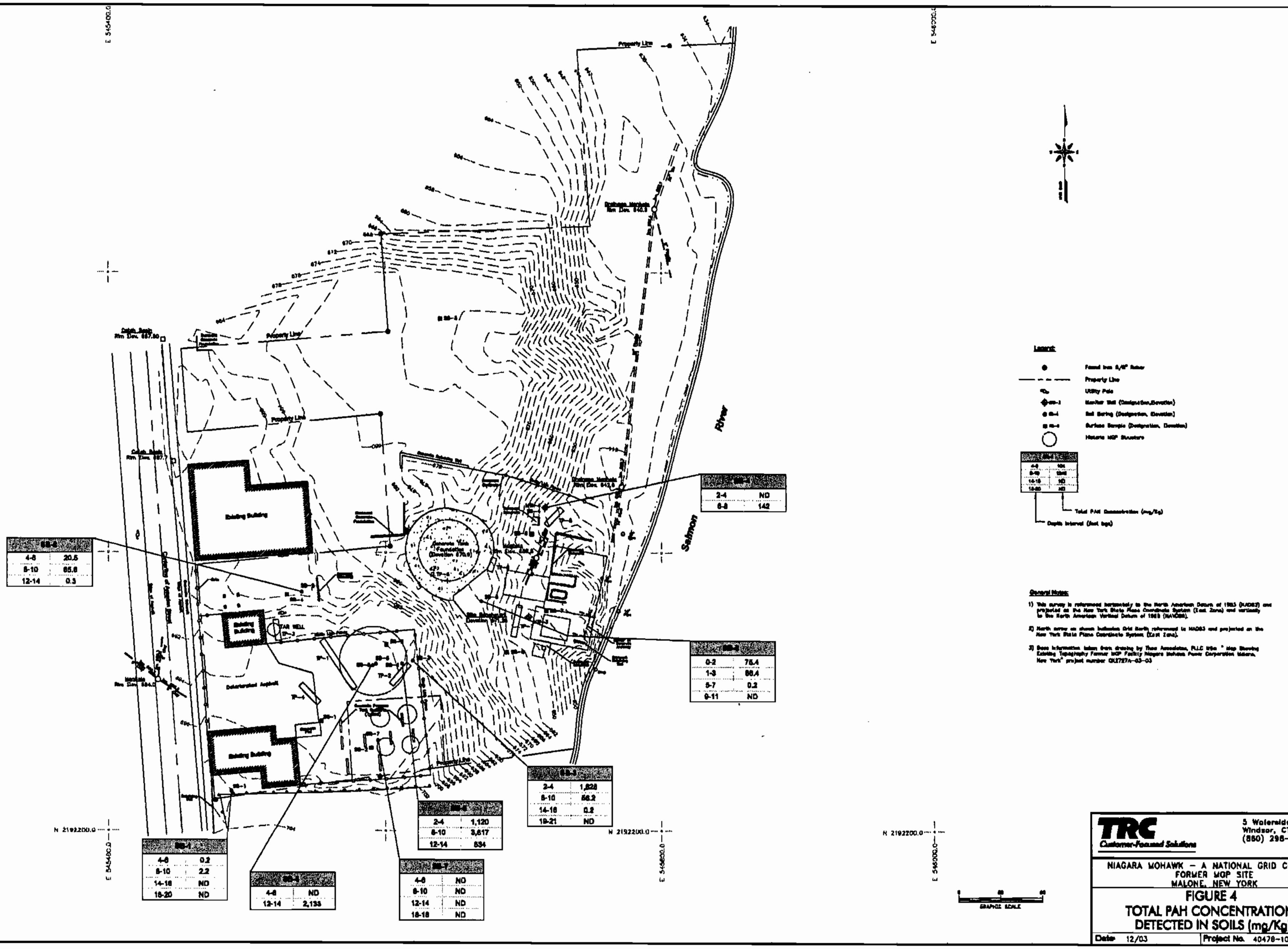
MALONE, NEW YORK

FIGURE 3
TOTAL BTEX CONCENTRATIONS DETECTED IN SOILS (mg/Kg)

Date: 12/03
Project No. 40478-1000-00007



General Notes:

1) This survey is referenced horizontally to the North American Datum of 1983 (NAD83) and projected on the New York State Plane Coordinate System (East Zone) and vertically to the North American Vertical Datum of 1988 (NAVD88).

2) North arrow as shown indicates Grid North referenced to NAD83 and projected on the New York State Plane Coordinate System (East Zone).

3) Base information taken from drawing by Thew Associates, PLLC title " Map Showing Existing Topography Former MGP Facility Niagara Mohawk Power Corporation Malone, New York" project number OL2727A-03-03

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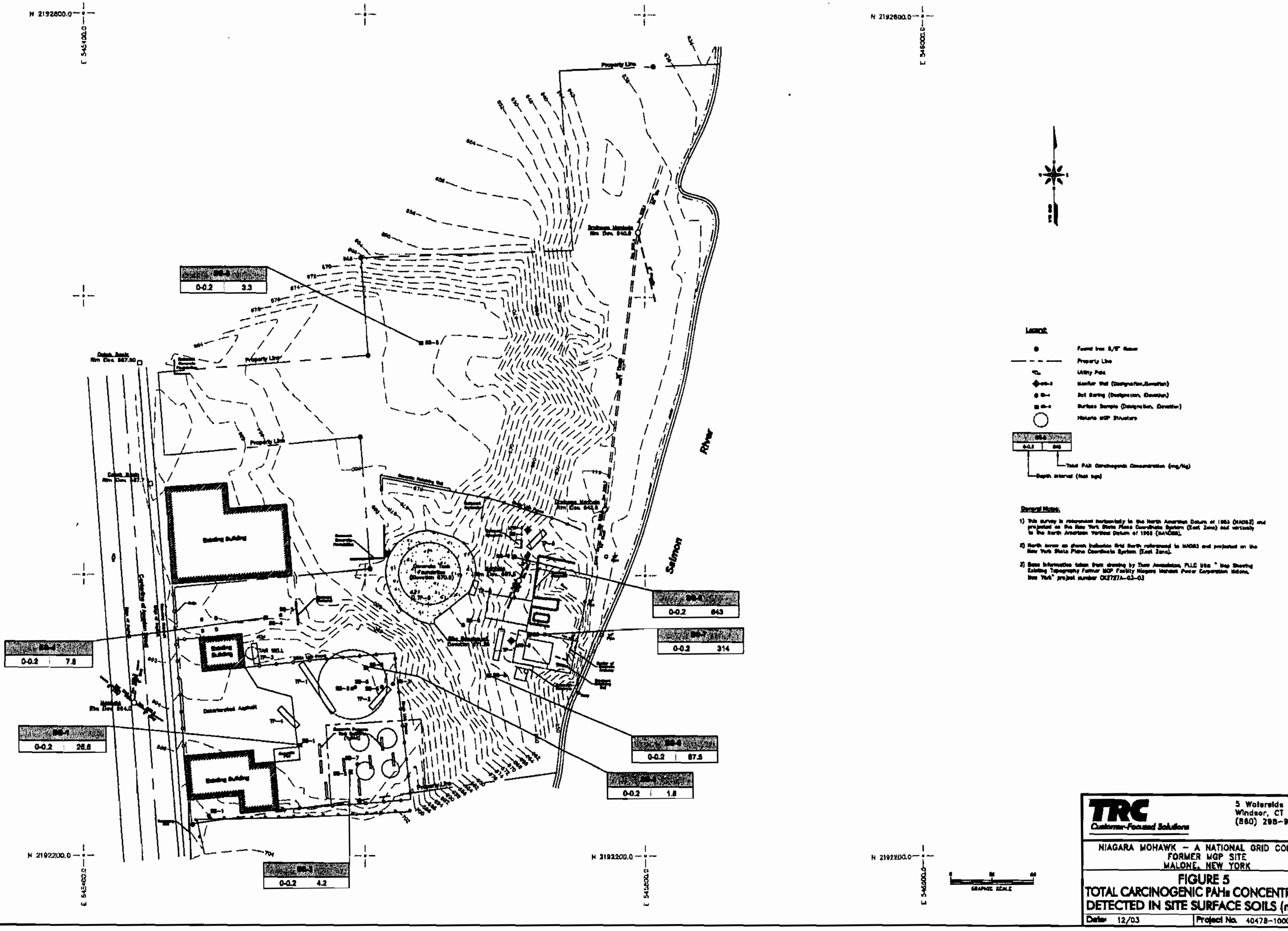
FIGURE 4
TOTAL PAH CONCENTRATIONS
DETECTED IN SOILS (mg/Kg)

Date 12/03 | Project No. 40478-1000-00007



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NIAGARA MOHAWK – A NATIONAL GRID COMPANY
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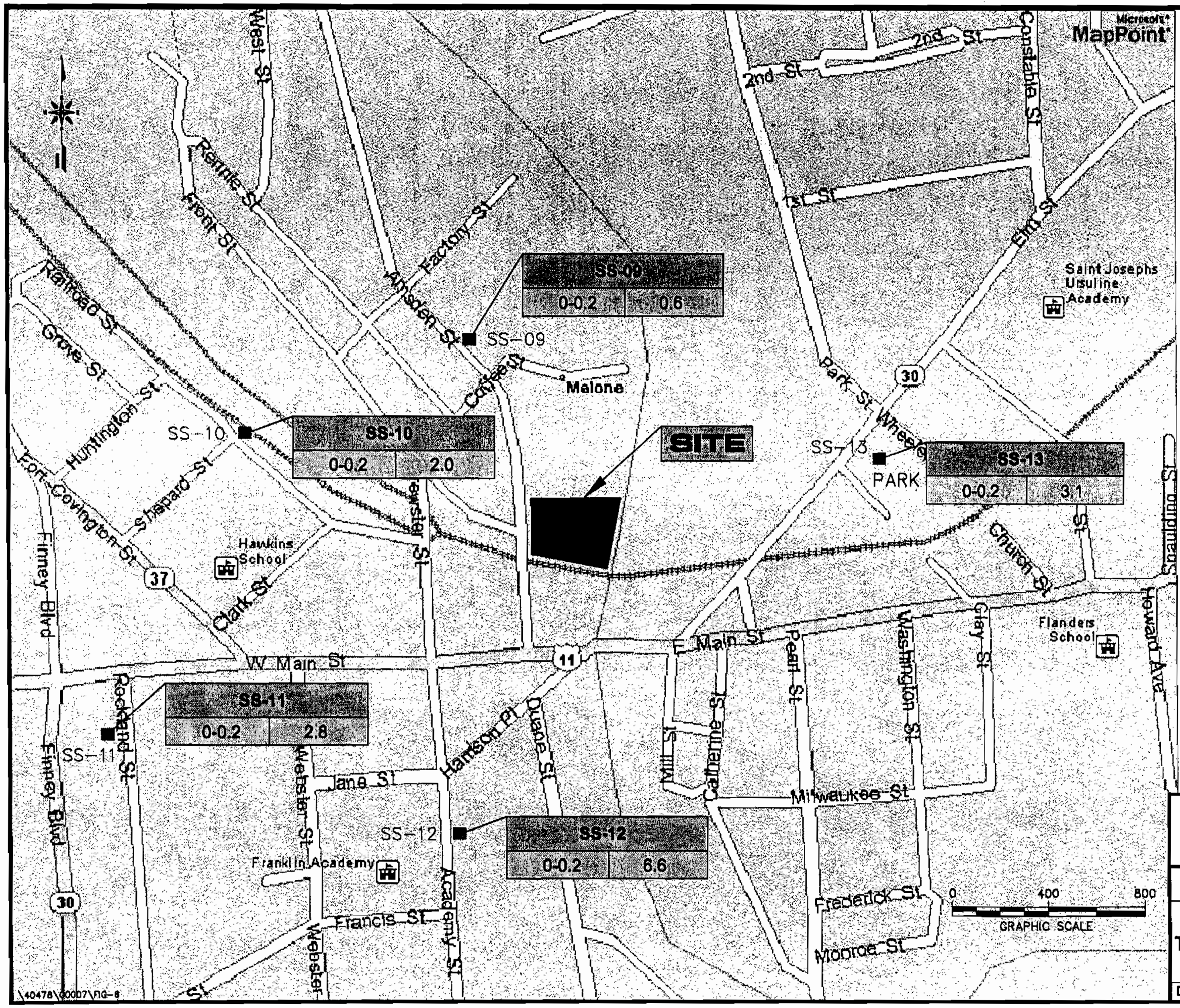
MALONE, NEW YORK

FIGURE 5
TOTAL CARCINOGENIC PAHs CONCENTRATIONS DETECTED IN SITE SURFACE SOILS (mg/Kg)

Date 12/03 | Project No. 40478-1000-00007



LEGEND

■SS-13 OFF-SITE SURFACE SOIL SAMPLE LOCATION

SS-13	
0-0.2	3.1

TOTAL CARCINOGENIC PAHs CONCENTRATION (mg/Kg)

SAMPLE INTERVAL DEPTH (feet below ground surface)

0 400 800
GRAPHIC SCALE

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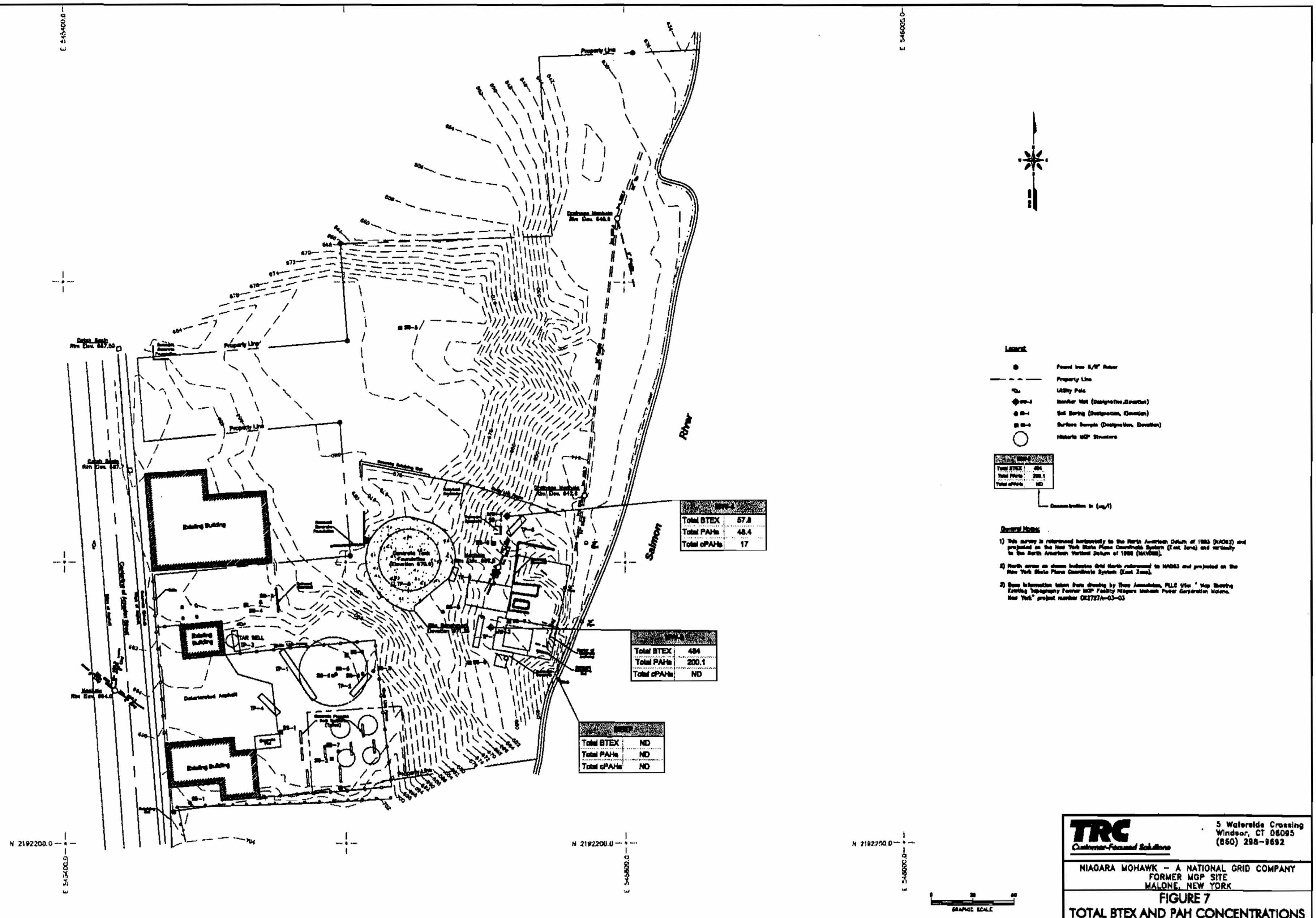
MALONE, NEW YORK

FIGURE 6
TOTAL CARCINOGENIC PAHs DETECTED IN OFF-SITE SURFACE SOILS (mg/Kg)

Date: 12/03 Project No. 40478-1000-00007



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NIAGARA MOHAWK – A NATIONAL GRID COMPANY
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FIGURE 7
TOTAL BTEX AND PAH CONCENTRATIONS DETECTED IN GROUNDWATER

Date: 12/03 | Project No. 40478-1000-00007

SUMMARY TABLES

TABLE A: SUMMARY OF CONTAMINATION NOTED IN SOIL BORINGS		
Location	**Final Depth (bgs)**	**Description of Impacts***
TEST PITs		
TP-1	8.2 feet	Three-inch thick tar seam at 2 feet. Slight to moderate tar odor and black staining. Four-inch diameter concrete pipe containing viscous tar encountered outside of holder foundation.
TP-2	4.5 feet	Weathered tar noted from 2.5 to 4.5 feet (bottom of excavation).
TP-3	4 feet	Hard, weathered tar noted on surface, from 1 to 2 feet. Top edge of former tar well encountered at 2.5 feet. Viscous, flowable tar noted within structure to depth of 3+ feet bgs (possible bottom of well).
TP-4	7 feet	No distinct impacts noted.
TP-5	2 feet	Dry, weathered tar noted on surface of concrete, within sump.
TP-6	7 feet	Hard, weathered tar noted at surface.
TP-7	6.2 feet	Weathered tar noted at surface. Ten-inch thick tar seam at 3 feet. Combination of non-flowable (weathered) and flowable tar within fill from 0.2 to 4 feet.
TP-8	6 feet	Slight tar odor noted in saturated material at the bottom of the excavation.
SOIL BORINGS		
SB-1	24 feet	No distinct impacts noted.
SB-2	16 feet	Small amount of hard, weathered tar in surficial fill.
SB-3	21.4 feet	Strong tar odor and blebs noted at 0.9 feet. Strong tar odor with visible tar at 2 to 2.1 feet. Tar odor and/or black staining from 4 to 10 feet.
SB-4	8 feet	Black staining and odor noted from 6.5 to 8 feet. Staining, strong tar odor, sheen and tar noted at bottom of boring (refusal).
SB-5	19.8 feet	Slight odor from 8 to 12 feet. Strong tar odor and visible, viscous tar noted at 12.4 to 13.3 feet (holder bottom). Viscous tar also observed from 16.2 to 16.5 feet.
SB-6	16.6 feet	Viscous, weathered tar at 2.8 to 3 feet and 6.7 to 6.9 feet. Tar impacts (some mobile, some viscous) noted down to depth of holder bottom at 16+ feet.
SB-7	20.3 feet	No distinct impacts noted.
SB-8	10.2 feet	Small amount of hard, weathered tar in surficial fill.
MW-3	12.5 feet	Black staining and strong odor at 11 to 12 feet (only interval sampled).

***Note**: depths presented with respect to feet below ground surface)

TABLE B: SUMMARY OF TAGM EXCEEDANCES FOR ORGANIC CONSTITUENTS IN SOILS		
Boring Location (depth)	**Location**	**NYSDEC TAGM Constituent(s) Exceeded**
SOIL BORINGS		
SB-1(8-10)	Southeast corner of Site	Benz0(a)pyrene
SB-2(4-6)	Northeast of former Tar Well	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene
SB-2(8-10)	Northeast of former Tar Well	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene
SB-3(2-4)	Immediately east of southern holder	Benzene, Naphthalene, Acenaphthylene, Phenanthrene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene
SB-3(8-10)	Immediately east of southern holder	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene
SB-4(6-8)	North of former Power House foundation	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene, Naphthalene
SB-5(12-14)	Within southern holder foundation	Benzene, Toluene, Ethylbenzene, Naphthalene, Acenaphthylene, Acenaphthene, Anthracene, Phenanthrene, Fluoranthene, Fluorene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(g.h.i)perylene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene,
SB-6(2-4)	Within southern holder foundation	Benzene, Naphthalene, Acenaphthylene, Acenaphthene, Anthracene, Phenanthrene, Fluoranthene, Fluorene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(g.h.i)perylene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene,
SB-6(8-10)	Within southern holder foundation	Benzene, Toluene, Ethylbenzene, Cresol, Phenol, Naphthalene, 2-Methylnaphthalene, Acenaphthylene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(g,h,i)perylene
SB-6(12-14)	Within southern holder foundation	Benzene, Toluene, Phenanthrene, Fluoranthene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene,
SB-8(0-2)	Immediately southeast of northern holder foundation	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene

TABLE B: SUMMARY OF TAGM EXCEEDANCES FOR ORGANIC CONSTITUENTS IN SOILS		
Boring Location (depth)	**Location**	**NYSDEC TAGM Constituent(s) Exceeded**
SURFACE SOILS		
On-Site Sample Locations		
SS-1	Northeast of existing cinderblock building	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene
SS-2	Within former coal storage Area	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene
SS-3	Vicinity of southern holder	Chrysene, Benzo(a)pyrene
SS-4	North of former Tar Well	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene
SS-5	North of northern holder foundation	Benzo(a)anthracene, Chrysene, Benzo(a)pyrene
SS-6	East of northern holder foundation	Dibenzofuran, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene
SS-7	Vicinity of former Power House foundation	Cresol, Phenol, Naphthalene, Dibenzofuran, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene
SS-8	Southwest of former Power House foundation	Fluoranthene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene
Off-Site Sample Locations		
SS-9	Off-site, north on Amsden Street	Benzo(a)pyrene
SS-10	Off-site, located adjacent to railroad tracks on Railroad Street	Benzo(a)anthracene, Benzo(a)pyrene
SS-11	Off-site, located on Rockland Street	Benzo(a)anthracene, Chrysene, Benzo(a)pyrene
SS-12	Off-site, located on Academy Street	Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene
SS-13	Off-site, located in park on Elm Street	Benzo(a)anthracene, Chrysene, Benzo(a)pyrene

DATA TABLES

Table 1
Malone Former MGP Site
Soil Analyses - VOC Results

Constituent	NYSDEC TAGM	Location	SB-1	SB-6	SB-8
		Sample ID	MALO-SB01-1416	MALO-SB06-0810	MALO-SB08-02
		Date/Time	07/22/2003 / 10:10	07/23/2003 / 16:10	07/28/2003 / 15:00
		Depth (ft)	15	9	1
Dichlorodifluoromethane		(ug/kg)	1.000U	1600.000U	1.0U
Methyl chloride		(ug/kg)	2.000U	1600.000U	2.1U
Vinyl chloride	200	(ug/kg)	1.000U	1600.000U	1.2U
Methyl bromide		(ug/kg)	1.000U	1600.000U	1.3U
Chloroethane	1900	(ug/kg)	2.000U	1600.000U	1.6U
Trichlorofluoromethane		(ug/kg)	2.000UJ	1600.000UJ	1.6U
1,1-Dichloroethylene	400	(ug/kg)	1.000U	1600.000U	1.4U
Freon 113	6000	(ug/kg)	1.000U	1600.000U	1.4U
Acetone		(ug/kg)	4.000U	1600.000U	4.4U
Carbon disulfide	2700	(ug/kg)	2.000U	1600.000U	1.6U
Methyl Acetate		(ug/kg)	1.000U	1600.000U	1.3U
Methylene chloride	100	(ug/kg)	2.000U	1600.000U	1.6U
Ethene, 1,2-dichloro-, (E)-	300	(ug/kg)	1.000U	1600.000U	1.3U
Methyl tert-butyl ether		(ug/kg)	1.000U	1600.000U	1.1U
1,1-Dichloroethane	200	(ug/kg)	1.000U	1600.000U	1.2U
cis-1,2-Dichloroethylene		(ug/kg)	1.000U	1600.000U	1.1U
Methyl ethyl ketone	300	(ug/kg)	7.000U	1600.000U	6.6U
Chloroform	300	(ug/kg)	1.000U	1600.000U	1.2U
1,1,1-trichloroethane	800	(ug/kg)	1.000U	1600.000U	1.3U
Cyclohexane		(ug/kg)	2.000U	1600.000U	1.7U
Carbon tetrachloride	600	(ug/kg)	3.000U	1600.000U	2.5U
Benzene	60	(ug/kg)	1.000U	**[370000]**	1.3U
1,2-Dichloroethane	100	(ug/kg)	1.000U	1600.000U	1.4U
Trichloroethene	700	(ug/kg)	2.4J	1600.000U	1.2U
Methylcyclohexane		(ug/kg)	1.000U	1600.000U	1.2U
1,2-Dichloropropane		(ug/kg)	1.000U	1600.000U	0.96U
Bromodichloromethane		(ug/kg)	1.000U	1600.000U	1.0U
cis-1,3-Dichloropropene		(ug/kg)	1.000U	1600.000U	1.1U
Methyl isobutyl ketone (MIBK)	1000	(ug/kg)	5.000U	1600.000U	5.0U
Toluene	1500	(ug/kg)	1.000U	**[250000]**	1.4U
Trans-1,3-Dichloropropene		(ug/kg)	1.000U	1600.000U	1.3U
1,1,2-Trichloroethane		(ug/kg)	1.000U		1.4U
Tetrachloroethylene	1400	(ug/kg)	2.000U	1600.000U	1.5U
2-Hexanone		(ug/kg)	7.000U	1600.000U	7.4U
Dibromochloromethane		(ug/kg)	1.000U	1600.000U	1.1U
EDB		(ug/kg)	1.000U	1600.000U	1.2U
Chlorobenzene	1700	(ug/kg)	1.000U	1600.000U	1.3U
Ethylbenzene	5500	(ug/kg)	1.000U	**[16000]J**	1.3U
Styrene		(ug/kg)	2.000U	75000	1.8U
Bromoform		(ug/kg)	1.000U	1600.000U	1.3U
Benzene, 1-methylethyl-		(ug/kg)	1.000U	1600.000U	1.4U
1,1,2,2-Tetrachloroethane	600	(ug/kg)	1.000U	1600.000U	1.2U
m-Dichlorobenzene	1600	(ug/kg)	1.000U	1600.000U	1.3U
p-Dichlorobenzene	8500	(ug/kg)	1.000U	1600.000U	1.0U
o-Dichlorobenzene	7900	(ug/kg)	1.000U	1600.000U	1.1U
DBCP		(ug/kg)	1.000U	1600.000U	1.2U
1,2,4-Trichlorobenzene	3400	(ug/kg)	2.000U	1600.000U	1.8U
m/p-xylene		(ug/kg)	3.000U	200000	3.4U
o-Xylene		(ug/kg)	1.000U	73000	1.3U
4-Bromofluorobenzene		(ug/kg)	54.000U	8100.000U	270U
Total BTEX			0	729000	0

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criterion

Table 1
Malone Former MGP Site
Soil Analyses - VOC Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-8 MALO-SB08-13 07/28/2003 / 15:10 2	SS-01 MALO-SS01 10/02/2003 / 15:00 0.5	SS-02 MALO-SS02 10/02/2003 / 15:20 0.5
Dichlorodifluoromethane		(ug/kg)	1.0U	13U	11U
Methyl chloride		(ug/kg)	2.1U	13U	11U
Vinyl chloride	200	(ug/kg)	1.2U	13U	11U
Methyl bromide		(ug/kg)	1.3U	13U	11U
Chloroethane	1900	(ug/kg)	1.6U	13U	11U
Trichlorofluoromethane		(ug/kg)	1.6U	13U	11U
1,1-Dichloroethylene	400	(ug/kg)	1.4U	13U	11U
Freon 113	6000	(ug/kg)	1.4U	13U	11U
Acetone		(ug/kg)	4.4U	63U	11J
Carbon disulfide	2700	(ug/kg)	1.6U	13U	11U
Methyl Acetate		(ug/kg)	1.3U	13U	11U
Methylene chloride	100	(ug/kg)	1.6U	13UJ	11U
Ethene, 1,2-dichloro-, (E)-	300	(ug/kg)	1.3U	13U	11U
Methyl tert-butyl ether		(ug/kg)	1.1U	13U	11U
1,1-Dichloroethane	200	(ug/kg)	1.2U	13U	11U
cis-1,2-Dichloroethylene		(ug/kg)	1.1U	13U	11U
Methyl ethyl ketone	300	(ug/kg)	6.6U	63U	54U
Chloroform	300	(ug/kg)	1.2U	13U	11U
1,1,1-trichloroethane	800	(ug/kg)	1.3U	13U	11U
Cyclohexane		(ug/kg)	1.7U	13U	11U
Carbon tetrachloride	600	(ug/kg)	2.5U	13U	11U
Benzene	60	(ug/kg)	1.3U	13U	11U
1,2-Dichloroethane	100	(ug/kg)	1.4U	13U	11U
Trichloroethene	700	(ug/kg)	1.2U	13U	11U
Methylcyclohexane		(ug/kg)	1.2U	13U	11U
1,2-Dichloropropane		(ug/kg)	0.96U	13U	11U
Bromodichloromethane		(ug/kg)	1.0U	13U	11U
cis-1,3-Dichloropropene		(ug/kg)	1.1U	13U	11U
Methyl isobutyl ketone (MIBK)	1000	(ug/kg)	5.0U	63U	54U
Toluene	1500	(ug/kg)	1.4U	13U	11U
Trans-1,3-Dichloropropene		(ug/kg)	1.3U	13U	11U
1,1,2-Trichloroethane		(ug/kg)	1.4U	13U	11U
Tetrachloroethylene	1400	(ug/kg)	1.5U	13U	11U
2-Hexanone		(ug/kg)	7.4U	63U	54U
Dibromochloromethane		(ug/kg)	1.1U	13U	11U
EDB		(ug/kg)	1.2U	13U	11U
Chlorobenzene	1700	(ug/kg)	1.3U	13U	11U
Ethylbenzene	5500	(ug/kg)	1.3U	13U	11U
Styrene		(ug/kg)	1.8U	13U	11U
Bromoform		(ug/kg)	1.3U	13U	11U
Benzene, 1-methylethyl-		(ug/kg)	1.4U	13U	11U
1,1,2,2-Tetrachloroethane	600	(ug/kg)	1.2U	13U	11U
m-Dichlorobenzene	1600	(ug/kg)	1.3U	13U	11U
p-Dichlorobenzene	8500	(ug/kg)	1.0U	13U	11U
o-Dichlorobenzene	7900	(ug/kg)	1.1U	13U	11U
DBCP		(ug/kg)	1.2U	13U	11U
1,2,4-Trichlorobenzene	3400	(ug/kg)	1.8U	13U	11U
m/p-xylene		(ug/kg)	3.4U	13U	11U
o-Xylene		(ug/kg)	1.3U	13U	11U
4-Bromofluorobenzene		(ug/kg)	270U	410U	350U
Total BTEX			0	0	0

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criteri

Table 1
Malone Former MGP Site
Soil Analyses - VOC Results

Constituent	NYSDEC TAGM	Location	SS-03	SS-04	SS-04
		Sample ID	MALO-SS03	MALO-SS04	MALO-SS14
		Date/Time	10/02/2003 / 15:38	10/02/2003 / 16:05	10/02/2003 / 16:10
		Depth (ft)	0.5	0.5	0.5
Dichlorodifluoromethane		(ug/kg)	12U	12U	11U
Methyl chloride		(ug/kg)	12U	12U	11U
Vinyl chloride	200	(ug/kg)	12U	12U	11U
Methyl bromide		(ug/kg)	12U	12U	11U
Chloroethane	1900	(ug/kg)	12U	12U	11U
Trichlorofluoromethane		(ug/kg)	12U	12U	11U
1,1-Dichloroethylene	400	(ug/kg)	12U	12U	11U
Freon 113	6000	(ug/kg)	12U	12U	11U
Acetone		(ug/kg)	62U	58U	57U
Carbon disulfide	2700	(ug/kg)	12U	12U	11U
Methyl Acetate		(ug/kg)	12U	12U	11U
Methylene chloride	100	(ug/kg)	12UJ	12UJ	11UJ
Ethene, 1,2-dichloro-, (E)-	300	(ug/kg)	12U	12U	11U
Methyl tert-butyl ether		(ug/kg)	12U	12U	11U
1,1-Dichloroethane	200	(ug/kg)	12U	12U	11U
cis-1,2-Dichloroethylene		(ug/kg)	12U	12U	11U
Methyl ethyl ketone	300	(ug/kg)	62U	58U	57U
Chloroform	300	(ug/kg)	12U	12U	11U
1,1,1-trichloroethane	800	(ug/kg)	12U	12U	11U
Cyclohexane		(ug/kg)	12U	12U	11U
Carbon tetrachloride	600	(ug/kg)	12U	12U	11U
Benzene	60	(ug/kg)	12U	12U	11U
1,2-Dichloroethane	100	(ug/kg)	12U	12U	11U
Trichloroethene	700	(ug/kg)	12U	12U	11U
Methylcyclohexane		(ug/kg)	12U	12U	11U
1,2-Dichloropropane		(ug/kg)	12U	12U	11U
Bromodichloromethane		(ug/kg)	12U	12U	11U
cis-1,3-Dichloropropene		(ug/kg)	12U	12U	11U
Methyl isobutyl ketone (MIBK)	1000	(ug/kg)	62U	58U	57U
Toluene	1500	(ug/kg)	12U	12U	11U
Trans-1,3-Dichloropropene		(ug/kg)	12U	12U	11U
1,1,2-Trichloroethane		(ug/kg)	12U	12U	11U
Tetrachloroethylene	1400	(ug/kg)	12U	12U	11U
2-Hexanone		(ug/kg)	62U	58U	57U
Dibromochloromethane		(ug/kg)	12U	12U	11U
EDB		(ug/kg)	12U	12U	11U
Chlorobenzene	1700	(ug/kg)	12U	12U	11U
Ethylbenzene	5500	(ug/kg)	12U	12U	11U
Styrene		(ug/kg)	12U	12U	11U
Bromoform		(ug/kg)	12U	12U	11U
Benzene, 1-methylethyl-		(ug/kg)	12U	12U	11U
1,1,2,2-Tetrachloroethane	600	(ug/kg)	12U	12U	11U
m-Dichlorobenzene	1600	(ug/kg)	12U	12U	11U
p-Dichlorobenzene	8500	(ug/kg)	12U	12U	11U
o-Dichlorobenzene	7900	(ug/kg)	12U	12U	11U
DBCP		(ug/kg)	12U	12U	11U
1,2,4-Trichlorobenzene	3400	(ug/kg)	12U	12U	11U
m/p-xylene		(ug/kg)	12U	12U	11U
o-Xylene		(ug/kg)	12U	12U	11U
4-Bromofluorobenzene		(ug/kg)	410U	380U	380U
Total BTEX			0	0	0

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criteri

Table 1
Malone Former MGP Site
Soil Analyses - VOC Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SS-05 MALO-SS05 10/02/2003 / 16:50 0.5	SS-06 MALO-SS06 10/02/2003 / 17:05 0.5	SS-07 MALO-SS07 10/02/2003 / 17:20 0.5
Dichlorodifluoromethane		(ug/kg)	12U	15U	16U
Methyl chloride		(ug/kg)	12U	15U	16U
Vinyl chloride	200	(ug/kg)	12U	15U	16U
Methyl bromide		(ug/kg)	12U	15U	16U
Chloroethane	1900	(ug/kg)	12U	15U	16U
Trichlorofluoromethane		(ug/kg)	12U	15U	16U
1,1-Dichloroethylene	400	(ug/kg)	12U	15U	16U
Freon 113	6000	(ug/kg)	12U	15U	16U
Acetone		(ug/kg)	9.2J	75U	81U
Carbon disulfide	2700	(ug/kg)	12U	15U	16U
Methyl Acetate		(ug/kg)	12U	15U	16U
Methylene chloride	100	(ug/kg)	12U	15UJ	16U
Ethene, 1,2-dichloro-, (E)-	300	(ug/kg)	12U	15U	16U
Methyl tert-butyl ether		(ug/kg)	12U	15U	16U
1,1-Dichloroethane	200	(ug/kg)	12U	15U	16U
cis-1,2-Dichloroethylene		(ug/kg)	12U	15U	16U
Methyl ethyl ketone	300	(ug/kg)	60U	75U	81U
Chloroform	300	(ug/kg)	12U	15U	16U
1,1,1-trichloroethane	800	(ug/kg)	12U	15U	16U
Cyclohexane		(ug/kg)	12U	15U	16U
Carbon tetrachloride	600	(ug/kg)	12U	15U	16U
Benzene	60	(ug/kg)	12U	15U	16U
1,2-Dichloroethane	100	(ug/kg)	12U	15U	16U
Trichloroethene	700	(ug/kg)	12U	15U	2.9J
Methylcyclohexane		(ug/kg)	12U	15U	16U
1,2-Dichloropropane		(ug/kg)	12U	15U	16U
Bromodichloromethane		(ug/kg)	12U	15U	16U
cis-1,3-Dichloropropene		(ug/kg)	12U	15U	16U
Methyl isobutyl ketone (MIBK)	1000	(ug/kg)	60U	75U	81U
Toluene	1500	(ug/kg)	12U	15U	16U
Trans-1,3-Dichloropropene		(ug/kg)	12U	15U	16U
1,1,2-Trichloroethane		(ug/kg)	12U	15U	16U
Tetrachloroethylene	1400	(ug/kg)	12U	15U	16U
2-Hexanone		(ug/kg)	60U	75U	81U
Dibromochloromethane		(ug/kg)	12U	15U	16U
EDB		(ug/kg)	12U	15U	16U
Chlorobenzene	1700	(ug/kg)	12U	15U	16U
Ethylbenzene	5500	(ug/kg)	12U	15U	16U
Styrene		(ug/kg)	12U	15U	16U
Bromoform		(ug/kg)	12U	15U	16U
Benzene, 1-methylethyl-		(ug/kg)	12U	15U	16U
1,1,2,2-Tetrachloroethane	600	(ug/kg)	12U	15U	16U
m-Dichlorobenzene	1600	(ug/kg)	12U	15U	16U
p-Dichlorobenzene	8500	(ug/kg)	12U	15U	16U
o-Dichlorobenzene	7900	(ug/kg)	12U	15U	16U
DBCP		(ug/kg)	12U	15U	16U
1,2,4-Trichlorobenzene	3400	(ug/kg)	12U	15U	16U
m/p-xylene		(ug/kg)	12U	15U	16U
o-Xylene		(ug/kg)	12U	15U	16U
4-Bromofluorobenzene		(ug/kg)	390U	2500U	2700U
Total BTEX			0	0	0

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criteri

Table 1
Malone Former MGP Site
Soil Analyses - VOC Results

		Location	SS-08	SS-09	SS-10
	NYSDEC	Sample ID	MALO-SS08	MALO-SS09	MALO-SS10
Constituent	TAGM	Date/Time	10/02/2003 / 17:45	10/03/2003 / 08:45	10/03/2003 / 09:05
		Depth (ft)	0.5	0.5	0.5
Dichlorodifluoromethane		(ug/kg)	16U	11U	13U
Methyl chloride		(ug/kg)	16U	11U	13U
Vinyl chloride	200	(ug/kg)	16U	11U	13U
Methyl bromide		(ug/kg)	16U	11U	13U
Chloroethane	1900	(ug/kg)	16U	11U	13U
Trichlorofluoromethane		(ug/kg)	16U	11U	13U
1,1-Dichloroethylene	400	(ug/kg)	16U	11U	13U
Freon 113	6000	(ug/kg)	16U	11U	13U
Acetone		(ug/kg)	82U	56U	65U
Carbon disulfide	2700	(ug/kg)	16U	11U	13U
Methyl Acetate		(ug/kg)	16U	11U	13U
Methylene chloride	100	(ug/kg)	16UJ	11U	13UJ
Ethene, 1,2-dichloro-, (E)-	300	(ug/kg)	16U	11U	13U
Methyl tert-butyl ether		(ug/kg)	16U	11U	13U
1,1-Dichloroethane	200	(ug/kg)	16U	11U	13U
cis-1,2-Dichloroethylene		(ug/kg)	16U	11U	13U
Methyl ethyl ketone	300	(ug/kg)	82U	56U	65U
Chloroform	300	(ug/kg)	16U	11U	13U
1,1,1-trichloroethane	800	(ug/kg)	16U	11U	13U
Cyclohexane		(ug/kg)	16U	11U	13U
Carbon tetrachloride	600	(ug/kg)	16U	11U	13U
Benzene	60	(ug/kg)	16U	11U	13U
1,2-Dichloroethane	100	(ug/kg)	16U	11U	13U
Trichloroethene	700	(ug/kg)	16U	11U	13U
Methylcyclohexane		(ug/kg)	16U	11U	13U
1,2-Dichloropropane		(ug/kg)	16U	11U	13U
Bromodichloromethane		(ug/kg)	16U	11U	13U
cis-1,3-Dichloropropene		(ug/kg)	16U	11U	13U
Methyl isobutyl ketone (MIBK)	1000	(ug/kg)	82U	56U	65U
Toluene	1500	(ug/kg)	16U	11U	13U
Trans-1,3-Dichloropropene		(ug/kg)	16U	11U	13U
1,1,2-Trichloroethane		(ug/kg)	16U	11U	13U
Tetrachloroethylene	1400	(ug/kg)	16U	11U	13U
2-Hexanone		(ug/kg)	82U	56U	65U
Dibromochloromethane		(ug/kg)	16U	11U	13U
EDB		(ug/kg)	16U	11U	13U
Chlorobenzene	1700	(ug/kg)	16U	11U	13U
Ethylbenzene	5500	(ug/kg)	16U	11U	13U
Styrene		(ug/kg)	16U	11U	13U
Bromoform		(ug/kg)	16U	11U	13U
Benzene, 1-methylethyl-		(ug/kg)	16U	11U	13U
1,1,2,2-Tetrachloroethane	600	(ug/kg)	16U	11U	13U
m-Dichlorobenzene	1600	(ug/kg)	16U	11U	13U
p-Dichlorobenzene	8500	(ug/kg)	16U	11U	13U
o-Dichlorobenzene	7900	(ug/kg)	16U	11U	13U
DBCP		(ug/kg)	16U	11U	13U
1,2,4-Trichlorobenzene	3400	(ug/kg)	16U	11U	13U
m/p-xylene		(ug/kg)	16U	11U	13U
o-Xylene		(ug/kg)	16U	11U	13U
4-Bromofluorobenzene		(ug/kg)	540U	360U	430U
Total BTEX			0	0	0

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criteri

Table 1
Malone Former MGP Site
Soil Analyses - VOC Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SS-11 MALO-SS11 10/03/2003 / 09:25 0.5	SS-12 MALO-SS12 10/03/2003 / 10:10 0.5	SS-13 MALO-SS13 10/03/2003 / 10:30 0.5
Dichlorodifluoromethane		(ug/kg)	12U	12U	12U
Methyl chloride		(ug/kg)	12U	12U	12U
Vinyl chloride	200	(ug/kg)	12U	12U	12U
Methyl bromide		(ug/kg)	12U	12U	12U
Chloroethane	1900	(ug/kg)	12U	12U	12U
Trichlorofluoromethane		(ug/kg)	12U	12U	12U
1,1-Dichloroethylene	400	(ug/kg)	12U	12U	12U
Freon 113	6000	(ug/kg)	12U	12U	12U
Acetone		(ug/kg)	12J	58U	61U
Carbon disulfide	2700	(ug/kg)	12U	12U	12U
Methyl Acetate		(ug/kg)	12U	12U	12U
Methylene chloride	100	(ug/kg)	12U	12UJ	12UJ
Ethene, 1,2-dichloro-, (E)-	300	(ug/kg)	12U	12U	12U
Methyl tert-butyl ether		(ug/kg)	12U	12U	12U
1,1-Dichloroethane	200	(ug/kg)	12U	12U	12U
cis-1,2-Dichloroethylene		(ug/kg)	12U	12U	12U
Methyl ethyl ketone	300	(ug/kg)	61U	58U	61U
Chloroform	300	(ug/kg)	12U	12U	12U
1,1,1-trichloroethane	800	(ug/kg)	12U	12U	12U
Cyclohexane		(ug/kg)	12U	12U	12U
Carbon tetrachloride	600	(ug/kg)	12U	12U	12U
Benzene	60	(ug/kg)	12U	12U	12U
1,2-Dichloroethane	100	(ug/kg)	12U	12U	12U
Trichloroethene	700	(ug/kg)	12U	12U	12U
Methylcyclohexane		(ug/kg)	12U	12U	12U
1,2-Dichloropropane		(ug/kg)	12U	12U	12U
Bromodichloromethane		(ug/kg)	12U	12U	12U
cis-1,3-Dichloropropene		(ug/kg)	12U	12U	12U
Methyl isobutyl ketone (MIBK)	1000	(ug/kg)	61U	58U	61U
Toluene	1500	(ug/kg)	12U	12U	12U
Trans-1,3-Dichloropropene		(ug/kg)	12U	12U	12U
1,1,2-Trichloroethane		(ug/kg)	12U	12U	12U
Tetrachloroethylene	1400	(ug/kg)	12U	12U	12U
2-Hexanone		(ug/kg)	61U	58U	61U
Dibromochloromethane		(ug/kg)	12U	12U	12U
EDB		(ug/kg)	12U	12U	12U
Chlorobenzene	1700	(ug/kg)	12U	12U	12U
Ethylbenzene	5500	(ug/kg)	12U	12U	12U
Styrene		(ug/kg)	12U	12U	12U
Bromoform		(ug/kg)	12U	12U	12U
Benzene, 1-methylethyl-		(ug/kg)	12U	12U	12U
1,1,2,2-Tetrachloroethane	600	(ug/kg)	12U	12U	12U
m-Dichlorobenzene	1600	(ug/kg)	12U	12U	12U
p-Dichlorobenzene	8500	(ug/kg)	12U	12U	12U
o-Dichlorobenzene	7900	(ug/kg)	12U	12U	12U
DBCP		(ug/kg)	12U	12U	12U
1,2,4-Trichlorobenzene	3400	(ug/kg)	12U	12U	12U
m/p-xylene		(ug/kg)	12U	12U	12U
o-Xylene		(ug/kg)	12U	12U	12U
4-Bromofluorobenzene		(ug/kg)	400U	380U	400U
Total BTEX			0	0	0

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criteri

Tabl
Malone Former MGP Site
Soil Analyses - BTEX Results

		Location	SB-1	SB-1	SB-1	SB-1	SB-1	SB-2
	NYSDEC	Sample ID	MALO-SB01-46	MALO-SB01-0810	MALO-SB01-0809	MALO-SB01-1416	MALO-SB01-1820	MALO-SB02-46
Constituent	TAGM	Date/Time	07/22/2003 / 09:15	07/22/2003 / 09:35	07/22/2003 / 09:38	07/22/2003 / 10:10	07/22/2003 / 10:45	07/24/2003 / 10:30
		Depth (ft)	5	9	8.5	15	19	5
Benzene	60	(ug/kg)	1.000U	1.000U	1.000U	1.000U	1.000U	1.000UJ
Toluene	1500	(ug/kg)	1.000U	1.000U	1.000U	1.000U	1.000U	1.000UJ
Ethylbenzene	5500	(ug/kg)	1.000U	1.000U	1.000U	1.000U	1.000U	1.000UJ
m/p-xylene		(ug/kg)	3.000U	3.000U	3.000U	4.000U	3.000U	3.000UJ
o-Xylene		(ug/kg)	1.000U	1.000U	1.000U	1.000U	1.000U	1.000UJ
Total BTEX		(ug/kg)	ND	ND	ND	ND	ND	ND

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criterion

Table 2
Malone Former MGP Site
Soil Analyses - BTEX Results

		Location	SB-2	SB-2	SB-3	SB-3	SB-3	SB-3
	NYSDEC	Sample ID	MALO-SB02-0810	MALO-SB02-1214	MALO-SB03-24	MALO-SB03-0810	MALO-SB03-1416	MALO-SB03-1921
Constituent	TAGM	Date/Time	07/24/2003 / 10:50	07/24/2003 / 11:15	07/22/2003 / 14:30	07/22/2003 / 15:25	07/22/2003 / 15:50	07/22/2003 / 16:40
		Depth (ft)	9	13	3	9	15	20
Benzene	60	(ug/kg)	1.000U	1.000UJ	**[200]**	1.000U	1.000U	1.000U
Toluene	1500	(ug/kg)	1.000U	1.000UJ	350	1.000U	1.000U	1.000U
Ethylbenzene	5500	(ug/kg)	1.000U	1.000UJ	39	1.000U	1.000U	1.000U
m/p-xylene		(ug/kg)	3.000U	3.000UJ	590	3.000U	3.000U	3.000U
o-Xylene		(ug/kg)	1.000U	1.000UJ	260	1.000U	1.000U	1.000U
Total BTEX		(ug/kg)	ND	ND	1439	ND	ND	ND

NOTE: **BOLD** values indicate exceedance of NY

Tabl
Malone Former MGP Site
Soil Analyses - BTEX Results

Constituent	NYSDEC TAGM	Location	SB-4	SB-4	SB-4	SB-5	SB-5	SB-6
		Sample ID	MALO-SB04-24	MALO-SB04-24RE	MALO-SB04-68	MALO-SB05-46	MALO-SB05-1214	MALO-SB-06-24
		Date/Time	07/28/2003 / 17:30	07/28/2003 / 17:30	07/28/2003 / 17:50	07/23/2003 / 08:50	07/23/2003 / 09:28	07/23/2003 / 15:50
		Depth (ft)	3	3	7	5	13	3
Benzene	60	(ug/kg)	1.3UJ	1.3UJ	1.2U	1.000U	**[500000]**	**[630]**
Toluene	1500	(ug/kg)	1.5UJ	1.5UJ	6.8	1.000U	**[270000]**	990
Ethylbenzene	5500	(ug/kg)	1.3UJ	1.3UJ	29	1.000U	**[13000]J**	94
m/p-xylene		(ug/kg)	3.7UJ	3.7UJ	36	3.000U	180000	1300
o-Xylene		(ug/kg)	1.5UJ	1.5UJ	82	1.000U	62000	570
Total BTEX		(ug/kg)	ND	ND	153.8	ND	1025000	3584

NOTE: **BOLD** values indicate exceedance of NY

Table 2
Malone Former MGP Site
Soil Analyses - BTEX Results

		Location	SB-6	SB-6	SB-7	SB-7	SB-7	SB-7
	NYSDEC	Sample ID	MALO-SB06-0810	MALO-SB06-1214	MALO-SB07-46	MALO-SB07-0810	MALO-SB07-1214	MALO-SB07-1618
Constituent	TAGM	Date/Time	07/23/2003 / 16:10	07/23/2003 / 16:40	07/21/2003 / 13:15	07/21/2003 / 13:28	07/21/2003 / 14:00	07/21/2003 / 14:25
		Depth (ft)	9	13	5	9	13	17
Benzene	60	(ug/kg)	**[120000]J**	**[120000]J**	1.000U	1.000U	1.000U	1.000U
Toluene	1500	(ug/kg)	**[53000]J**	**[71000]J**	1.000U	1.000U	1.000U	1.000U
Ethylbenzene	5500	(ug/kg)	10000.000UJ	4300J	1.000U	1.000U	1.000U	1.000U
m/p-xylene		(ug/kg)	43000J	60000J	3.000U	4.000U	4.000U	3.000U
o-Xylene		(ug/kg)	14000J	22000J	1.000U	1.000U	1.000U	1.000U
Total BTEX		(ug/kg)	230000	277300	ND	ND	ND	ND

NOTE: **BOLD** values indicate exceedance of NY

Tabl
Malone Former MGP Site
Soil Analyses - BTEX Results

		Location	SB-8	SB-8	SB-8	SB-8	SB-8
	NYSDEC	Sample ID	MALO-SB08-02	MALO-SB08-02RE	MALO-SB08-13	MALO-SB08-57	MALO-SB08-0911
Constituent	TAGM	Date/Time	07/28/2003 / 12:45	07/28/2003 / 12:45	07/28/2003 / 12:50	07/28/2003 / 14:25	07/28/2003 / 14:55
		Depth (ft)	1	1	2	6	10
Benzene	60	(ug/kg)	1.2UJ	1.2UJ	9.5	1.1U	1.2U
Toluene	1500	(ug/kg)	1.4UJ	1.4UJ	5.2J	1.2U	1.3U
Ethylbenzene	5500	(ug/kg)	1.2UJ	1.2UJ	1.2U	1.1U	1.2U
m/p-xylene		(ug/kg)	3.5UJ	3.5UJ	5.6J	3.0U	3.3U
o-Xylene		(ug/kg)	1.4UJ	1.4UJ	2.2J	1.2U	1.3U
Total BTEX		(ug/kg)	ND	ND	22.5	ND	ND

NOTE: **BOLD** values indicate exceedance of NY

Table 3
Malone Former MGP Site
Soil Analyses - SVOC Results

Constituent	NYSDEC TAGM	Location	SB-1	SB-1	SB-6	SB-6
		Sample ID	MALO-SB01-1416	MALO-SB01-1416RE	MALO-SB06-0810	MALO-SB06-0810DL2
		Date/Time	07/22/2003 / 10:10	07/22/2003 / 10:10	07/23/2003 / 16:10	07/23/2003 / 16:10
		Depth (ft)	15	15	9	9
Benzaldehyde		(ug/kg)			6600.000UJ	66000.000UJ
Phenol	30	(ug/kg)	39.000U	39.000U	**[540000]E**	**[560000]J**
Bis(2-chloroethyl)ether		(ug/kg)	34.000U	34.000U	5000.000U	50000.000U
2-Chlorophenol	800	(ug/kg)	23.000U	23.000U	3400.000U	34000.000U
o-Cresol	100	(ug/kg)	69.000U	69.000U	**[360000]**	**[390000]J**
2,2-oxybis(1-Chloropropane)		(ug/kg)	46.000U	46.000U	6800.000U	68000.000U
Acetophenone		(ug/kg)			13000.000U	130000.000U
p-Cresol	900	(ug/kg)	86.000U	86.000U	**[840000]E**	**[850000]D**
N-Nitroso-di-n-propylamine		(ug/kg)	49.000U	49.000U	7300.000U	73000.000U
Hexachloroethane		(ug/kg)	44.000U	44.000U	6600.000U	66000.000U
Nitrobenzene	200	(ug/kg)	58.000U	58.000U	8600.000U	86000.000U
Isophorone	4400	(ug/kg)	48.000U	48.000U	7100.000U	71000.000U
o-Nitrophenol	330	(ug/kg)	90.000U	90.000U	13000.000U	130000.000U
2,4-Dimethylphenol		(ug/kg)	140.000U	140.000U	370000	480000J
Bis(2-chloroethoxy)methane		(ug/kg)	51.000U	51.000U	7500.000U	75000.000U
2,4-Dichlorophenol	400	(ug/kg)	62.000U	62.000U	9200.000U	92000.000U
Naphthalene	13000	(ug/kg)	28.000U	28.000U	**[11000000]E**	**[35000000]E**
p-Chloroaniline	220	(ug/kg)	89.000U	89.000U	13000.000U	130000.000U
Hexachlorobutadiene		(ug/kg)	89.000U	89.000U	13000.000U	130000.000U
Caprolactam		(ug/kg)			13000.000U	130000.000U
p-Chloro-m-cresol	240	(ug/kg)	79.000U	79.000U	12000.000U	120000.000U
2-Methylnaphthalene	36000	(ug/kg)	49.000U	49.000U	**[3100000]E**	**[3500000]D**
Hexachlorocyclopentadiene		(ug/kg)	120.000U	120.000UJ	17000.000U	170000.000U
2,4,6-Trichlorophenol		(ug/kg)	40.000U	40.000U	5900.000U	59000.000U
2,4,5-Trichlorophenol	100	(ug/kg)	36.000U	36.000U	5300.000U	53000.000U
1,1'Biphenyl		(ug/kg)			13000.000U	130000.000U
2-Chloronaphthalene		(ug/kg)	22.000U	22.000U	3300.000U	33000.000U
o-Nitroaniline	430	(ug/kg)	16.000U	16.000U	2400.000U	24000.000U
Dimethylphthalate	2000	(ug/kg)	15.000U	15.000U	2200.000U	22000.000U
2,6-Dinitrotoluene	1000	(ug/kg)	16.000U	16.000U	2400.000U	24000.000U
Acenaphthylene	41000	(ug/kg)	17.000U	17.000U	**[3700000]E**	**[3900000]D**
m-Nitroaniline	500	(ug/kg)	94.000U	94.000U	14000.000U	140000.000U
Acenaphthene	50000	(ug/kg)	19.000U	19.000U	**[660000]E**	**[760000]D**
2,4-Dinitrophenol	200	(ug/kg)	140.000U	140.000U	21000.000U	210000.000U
p-Nitrophenol	100	(ug/kg)	160.000U	160.000U	24000.000U	240000.000U
Dibenzofuran	6200	(ug/kg)	22.000U	22.000U	**[3100000]E**	**[3700000]D**
2,4-Dinitrotoluene		(ug/kg)	33.000U	33.000U	4900.000U	49000.000U
Diethylphthalate	7100	(ug/kg)	35.000U	35.000U	5100.000U	51000.000U
Fluorene	50000	(ug/kg)	25.000U	25.000U	**[3400000]E**	**[3300000]D**
4-chlorophenyl-phenylether		(ug/kg)	26.000U	26.000U	3800.000U	38000.000U
p-Nitroaniline		(ug/kg)	64.000U	64.000U	9500.000U	95000.000U
4,6-Dinitro-o-cresol		(ug/kg)	160.000U	160.000U	23000.000U	230000.000U
N-Nitrosodiphenylamine (1)		(ug/kg)	73.000U	73.000U	11000.000U	110000.000U
Hexachlorobenzene	410	(ug/kg)	44.000U	44.000U	6600.000U	66000.000U
Atrazine		(ug/kg)			13000.000U	130000.000U
Pentachlorophenol	1000	(ug/kg)	89.000U	89.000U	13000.000U	130000.000U
Phenanthrene	50000	(ug/kg)	23.000U	23.000U	**[6800000]E**	**[18000000]E**
Anthracene	50000	(ug/kg)	23.000U	23.000U	**[2500000]E**	**[4500000]D**
Carbazole		(ug/kg)	33.000U	33.000U	2000000E	2200000D
Di-n-butyl-phthalate	8100	(ug/kg)	36.000U	36.000U	5300.000U	53000.000U
Fluoranthene	50000	(ug/kg)	72.000U	72.000U	**[5700000]E**	**[12000000]E**
Pyrene	50000	(ug/kg)	100.000U	100.000U	**[5100000]E**	**[11000000]E**
Butylbenzylphthalate	50000	(ug/kg)	79.000U	79.000U	12000.000U	120000.000U
3,3-Dichlorobenzidine		(ug/kg)	180.000U	180.000U	27000.000U	270000.000U
Benzo(a)anthracene	220	(ug/kg)	31.000U	31.000U	**[3200000]E**	**[3600000]D**
Chrysene	400	(ug/kg)	38.000U	38.000U	**[2100000]E**	**[3000000]D**
Bis(2-ethylhexyl)phthalate	50000	(ug/kg)	20.000U	47J	2900.000U	29000.000U
Di-n-octylphthalate	50000	(ug/kg)	78.000R	78.000R	12000.000U	120000.000R
Benzo(b)fluoranthene	1100	(ug/kg)	64.000R	64.000R	**[3800000]E**	**[4400000]J**
Benzo(k)fluoranthene	1100	(ug/kg)	100.000R	100.000R	**[1500000]E**	**[1700000]J**
Benzo(a)pyrene	61	(ug/kg)	22.000R	22.000R	**[3400000]E**	**[4300000]J**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	78.000R	78.000R	**[1500000]E**	**[1600000]J**
Dibenzo(a,h)anthracene	14	(ug/kg)	83.000R	83.000R	**[120000]**	**[480000]J**
Benzo(g,h,i)perylene	50000	(ug/kg)	89.000R	89.000R	**[1200000]E**	**[1400000]J**

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criterion

Table 3
Malone Former MGP Site
Soil Analyses - SVOC Results

		Location	SB-6	SB-6	SB-8	SB-8
	NYSDEC	Sample ID	MALO-SB06-0810DL3	MALO-SB06-0810DL4	MALO-SB08-02	MALO-SB08-02DL
Constituent	TAGM	Date/Time	07/23/2003 / 16:10	07/23/2003 / 16:10	07/28/2003 / 15:00	07/28/2003 / 15:00
		Depth (ft)	9	9	1	1
Benzaldehyde		(ug/kg)	160000.000UJ	1600000.00UJ	220UJ	1100UJ
Phenol	30	(ug/kg)	**[620000]J**	1400000.00U	190U	970U
Bis(2-chloroethyl)ether		(ug/kg)	130000.000U	1300000.00U	170U	840U
2-Chlorophenol	800	(ug/kg)	85000.000U	850000.000U	110U	570U
o-Cresol	100	(ug/kg)	**[420000]J**	2600000.00U	340U	1700U
2,2-oxybis(1-Chloropropane)		(ug/kg)	170000.000U	1700000.00U	230U	1100U
Acetophenone		(ug/kg)	330000.000U	3300000.00U	440U	2200U
p-Cresol	900	(ug/kg)	**[910000]J**	3200000.00U	430U	2100U
N-Nitroso-di-n-propylamine		(ug/kg)	180000.000U	1800000.00U	250U	1200U
Hexachloroethane		(ug/kg)	160000.000U	1600000.00U	220U	1100U
Nitrobenzene	200	(ug/kg)	220000.000U	2200000.00U	290U	1400U
Isophorone	4400	(ug/kg)	180000.000U	1800000.00U	240U	1200U
o-Nitrophenol	330	(ug/kg)	330000.000U	3300000.00U	450U	2200U
2,4-Dimethylphenol		(ug/kg)	580000J	5400000.00U	720U	3600U
Bis(2-chloroethoxy)methane		(ug/kg)	190000.000U	1900000.00U	250U	1300U
2,4-Dichlorophenol	400	(ug/kg)	230000.000U	2300000.00U	310U	1500U
Naphthalene	13000	(ug/kg)	**[52000000]E**	**[48000000]D**	250J	710U
p-Chloroaniline	220	(ug/kg)	330000.000U	3300000.00U	440U	2200U
Hexachlorobutadiene		(ug/kg)	330000.000U	3300000.00U	440U	2200U
Caprolactam		(ug/kg)	330000.000U	3300000.00U	440U	2200U
p-Chloro-m-cresol	240	(ug/kg)	290000.000U	2900000.00U	390U	2000U
2-Methylnaphthalene	36000	(ug/kg)	**[4200000]D**	**[4000000]J**	250U	1200U
Hexachlorocyclopentadiene		(ug/kg)	430000.000U	4300000.00U	580U	2900U
2,4,6-Trichlorophenol		(ug/kg)	150000.000U	1500000.00U	200U	980U
2,4,5-Trichlorophenol	100	(ug/kg)	130000.000U	1300000.00U	180U	890U
1,1'Biphenyl		(ug/kg)	330000.000U	3300000.00U	440U	2200U
2-Chloronaphthalene		(ug/kg)	82000.000U	820000.000U	110U	550U
o-Nitroaniline	430	(ug/kg)	60000.000U	600000.000U	80U	400U
Dimethylphthalate	2000	(ug/kg)	55000.000U	550000.000U	74U	370U
2,6-Dinitrotoluene	1000	(ug/kg)	60000.000U	600000.000U	80U	400U
Acenaphthylene	41000	(ug/kg)	**[4200000]D**	**[4600000]J**	1500J	1600J
m-Nitroaniline	500	(ug/kg)	350000.000U	3500000.00U	470U	2300U
Acenaphthene	50000	(ug/kg)	**[870000]J**	690000.000U	92U	460U
2,4-Dinitrophenol	200	(ug/kg)	520000.000U	5200000.00U	690U	3500U
p-Nitrophenol	100	(ug/kg)	600000.000U	6000000.00U	810U	4000U
Dibenzofuran	6200	(ug/kg)	**[4000000]D**	**[3700000]J**	110U	550U
2,4-Dinitrotoluene		(ug/kg)	120000.000U	1200000.00U	170U	830U
Diethylphthalate	7100	(ug/kg)	130000.000U	1300000.00U	170U	860U
Fluorene	50000	(ug/kg)	**[3700000]D**	**[3500000]J**	600J	610U
4-chlorophenyl-phenylether		(ug/kg)	96000.000U	960000.000U	130U	640U
p-Nitroaniline		(ug/kg)	240000.000U	2400000.00U	320U	1600U
4,6-Dinitro-o-cresol		(ug/kg)	580000.000U	5800000.00U	780U	3900U
N-Nitrosodiphenylamine (1)		(ug/kg)	270000.000U	2700000.00U	360U	1800U
Hexachlorobenzene	410	(ug/kg)	160000.000U	1600000.00U	220U	1100U
Atrazine		(ug/kg)	330000.000U	3300000.00U	440U	2200U
Pentachlorophenol	1000	(ug/kg)	330000.000U	3300000.00U	440U	2200U
Phenanthrene	50000	(ug/kg)	**[20000000]E**	**[18000000]D**	6300	6000J
Anthracene	50000	(ug/kg)	**[4700000]D**	**[4900000]J**	5700	5600J
Carbazole		(ug/kg)	2400000D	2600000J	650J	830U
Di-n-butyl-phthalate	8100	(ug/kg)	130000.000U	1300000.00U	180U	890U
Fluoranthene	50000	(ug/kg)	**[13000000]E**	**[13000000]J**	42000E	32000D
Pyrene	50000	(ug/kg)	**[12000000]D**	**[12000000]J**	32000E	31000D
Butylbenzylphthalate	50000	(ug/kg)	290000.000U	2900000.00U	390U	2000U
3,3-Dichlorobenzidine		(ug/kg)	680000.000U	6800000.00U	910U	4600U
Benzo(a)anthracene	220	(ug/kg)	**[4100000]D**	**[4500000]J**	**[22000]E**	**[23000]D**
Chrysene	400	(ug/kg)	**[3400000]D**	**[3800000]J**	**[16000]**	**[16000]D**
Bis(2-ethylhexyl)phthalate	50000	(ug/kg)	73000.000U	730000.000U	98U	490U
Di-n-octylphthalate	50000	(ug/kg)	290000.000U	2900000.00U	390U	1900U
Benzo(b)fluoranthene	1100	(ug/kg)	**[4700000]D**	**[4800000]J**	**[26000]E**	**[24000]D**
Benzo(k)fluoranthene	1100	(ug/kg)	**[1600000]D**	3800000.00U	**[8100]**	**[7400]J**
Benzo(a)pyrene	61	(ug/kg)	**[4500000]D**	**[4700000]J**	**[22000]E**	**[20000]D**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	**[2100000]D**	2900000.00U	**[6700]**	**[6900]J**
Dibenzo(a,h)anthracene	14	(ug/kg)	**[460000]J**	3100000.00U	**[2700]**	**[2900]J**
Benzo(g,h,i)perylene	50000	(ug/kg)	**[1900000]D**	3300000.00U	4200	4500J

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM

Table 3
Malone Former MGP Site
Soil Analyses - SVOC Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-8 MALO-SB08-13 07/28/2003 / 15:10 2	SB-8 MALO-SB08-13DL 07/28/2003 / 15:10 2	SS-01 MALO-SS01 10/02/2003 / 15:00 0.5	SS-01 MALO-SS01DL 10/02/2003 / 15:00 0.5
Benzaldehyde		(ug/kg)	220UJ	2200UJ	410U	2100U
Phenol	30	(ug/kg)	190U	1900U	410U	2100U
Bis(2-chloroethyl)ether		(ug/kg)	170U	1700U	410U	2100U
2-Chlorophenol	800	(ug/kg)	110U	1100U	410U	2100U
o-Cresol	100	(ug/kg)	340U	3400U	410U	2100U
2,2-oxybis(1-Chloropropane)		(ug/kg)	230U	2300U	410U	2100U
Acetophenone		(ug/kg)	440U	4400U	410U	2100U
p-Cresol	900	(ug/kg)	430U	4300U	410U	2100U
N-Nitroso-di-n-propylamine		(ug/kg)	250U	2500U	410U	2100U
Hexachloroethane		(ug/kg)	220U	2200U	410U	2100U
Nitrobenzene	200	(ug/kg)	290U	2900U	410U	2100U
Isophorone	4400	(ug/kg)	240U	2400U	410U	2100U
o-Nitrophenol	330	(ug/kg)	450U	4500U	410U	2100U
2,4-Dimethylphenol		(ug/kg)	720U	7200U	410U	2100U
Bis(2-chloroethoxy)methane		(ug/kg)	250U	2500U	410U	2100U
2,4-Dichlorophenol	400	(ug/kg)	310U	3100U	410U	2100U
Naphthalene	13000	(ug/kg)	500J	1400U	160J	2100U
p-Chloroaniline	220	(ug/kg)	440U	4400U	410U	2100U
Hexachlorobutadiene		(ug/kg)	440U	4400U	410U	2100U
Caprolactam		(ug/kg)	440U	4400U	410U	2100U
p-Chloro-m-cresol	240	(ug/kg)	390U	3900U	410U	2100U
2-Methylnaphthalene	36000	(ug/kg)	250U	2500U	410U	2100U
Hexachlorocyclopentadiene		(ug/kg)	580U	5800U	410U	2100U
2,4,6-Trichlorophenol		(ug/kg)	200U	2000U	410U	2100U
2,4,5-Trichlorophenol	100	(ug/kg)	180U	1800U	1000U	5200U
1,1'Biphenyl		(ug/kg)	440U	4400U	410U	2100U
2-Chloronaphthalene		(ug/kg)	110U	1100U	410U	2100U
o-Nitroaniline	430	(ug/kg)	80U	800U	1000U	5200U
Dimethylphthalate	2000	(ug/kg)	74U	740U	410U	2100U
2,6-Dinitrotoluene	1000	(ug/kg)	80U	800U	410U	2100U
Acenaphthylene	41000	(ug/kg)	2800	2700J	1200	660J
m-Nitroaniline	500	(ug/kg)	470U	4700U	1000U	5200U
Acenaphthene	50000	(ug/kg)	270J	920U	410U	2100U
2,4-Dinitrophenol	200	(ug/kg)	690U	6900U	1000U	5200U
p-Nitrophenol	100	(ug/kg)	810U	8100U	1000U	5200U
Dibenzofuran	6200	(ug/kg)	580J	1100U	84J	2100U
2,4-Dinitrotoluene		(ug/kg)	170U	1700U	410U	2100U
Diethylphthalate	7100	(ug/kg)	170U	1700U	410U	2100U
Fluorene	50000	(ug/kg)	1400J	1200U	170J	2100U
4-chlorophenyl-phenylether		(ug/kg)	130U	1300U	410U	2100U
p-Nitroaniline		(ug/kg)	320U	3200U	1000U	5200U
4,6-Dinitro-o-cresol		(ug/kg)	780U	7800U	1000U	5200U
N-Nitrosodiphenylamine (1)		(ug/kg)	360U	3600U	410U	2100U
Hexachlorobenzene	410	(ug/kg)	220U	2200U	410U	2100U
Atrazine		(ug/kg)	440U	4400U	410U	2100U
Pentachlorophenol	1000	(ug/kg)	440U	4400U	1000U	5200U
Phenanthrene	50000	(ug/kg)	16000	15000J	3500E	2100D
Anthracene	50000	(ug/kg)	14000	12000J	760	380J
Carbazole		(ug/kg)	1500J	1700U	320J	2100U
Di-n-butyl-phthalate	8100	(ug/kg)	180U	1800U	410U	2100U
Fluoranthene	50000	(ug/kg)	**[78000]E**	**[56000]D**	9900E	8800D
Pyrene	50000	(ug/kg)	**[52000]E**	**[51000]D**	7400E	8300D
Butylbenzylphthalate	50000	(ug/kg)	390U	3900U	410U	2100U
3,3-Dichlorobenzidine		(ug/kg)	910U	9100U	410U	2100U
Benzo(a)anthracene	220	(ug/kg)	**[38000]E**	**[38000]D**	**[4900]E**	**[4100]D**
Chrysene	400	(ug/kg)	**[28000]E**	**[28000]D**	**[5200]E**	**[4000]D**
Bis(2-ethylhexyl)phthalate	50000	(ug/kg)	98U	980U	160J	2100U
Di-n-octylphthalate	50000	(ug/kg)	390U	3900U	410R	2100R
Benzo(b)fluoranthene	1100	(ug/kg)	**[50000]E**	**[38000]D**	**[12000]J**	**[7700]J**
Benzo(k)fluoranthene	1100	(ug/kg)	**[12000]**	**[14000]J**	**[4200]J**	**[3100]J**
Benzo(a)pyrene	61	(ug/kg)	**[37000]E**	**[32000]D**	**[7500]J**	**[5000]J**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	**[9700]**	**[11000]J**	2000J	1700J
Dibenzo(a,h)anthracene	14	(ug/kg)	**[4000]**	**[4600]J**	**[210]J**	2100R
Benzo(g,h,i)perylene	50000	(ug/kg)	5600	6900J	540J	550J

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM

Table 3
Malone Former MGP Site
Soil Analyses - SVOC Results

Constituent	NYSDEC TAGM	Location	SS-02	SS-03	SS-04	SS-04
		Sample ID	MALO-SS02	MALO-SS03	MALO-SS04	MALO-SS04DL
		Date/Time	10/02/2003 / 15:20	10/02/2003 / 15:38	10/02/2003 / 16:05	10/02/2003 / 16:05
		Depth (ft)	0.5	0.5	0.5	0.5
Benzaldehyde		(ug/kg)	350U	410U	380U	1900U
Phenol	30	(ug/kg)	350U	410U	380U	1900U
Bis(2-chloroethyl)ether		(ug/kg)	350U	410U	380U	1900U
2-Chlorophenol	800	(ug/kg)	350U	410U	380U	1900U
o-Cresol	100	(ug/kg)	350U	410U	380U	1900U
2,2-oxybis(1-Chloropropane)		(ug/kg)	350U	410U	380U	1900U
Acetophenone		(ug/kg)	350U	410U	380U	1900U
p-Cresol	900	(ug/kg)	350U	410U	380U	1900U
N-Nitroso-di-n-propylamine		(ug/kg)	350U	410U	380U	1900U
Hexachloroethane		(ug/kg)	350U	410U	380U	1900U
Nitrobenzene	200	(ug/kg)	350U	410U	380U	1900U
Isophorone	4400	(ug/kg)	350U	410U	380U	1900U
o-Nitrophenol	330	(ug/kg)	350U	410U	380U	1900U
2,4-Dimethylphenol		(ug/kg)	350U	410U	380U	1900U
Bis(2-chloroethoxy)methane		(ug/kg)	350U	410U	380U	1900U
2,4-Dichlorophenol	400	(ug/kg)	350U	410U	380U	1900U
Naphthalene	13000	(ug/kg)	350U	410U	380U	1900U
p-Chloroaniline	220	(ug/kg)	350U	410U	380U	1900U
Hexachlorobutadiene		(ug/kg)	350U	410U	380U	1900U
Caprolactam		(ug/kg)	350U	410U	380U	1900U
p-Chloro-m-cresol	240	(ug/kg)	350U	410U	380U	1900U
2-Methylnaphthalene	36000	(ug/kg)	350U	410U	380U	1900U
Hexachlorocyclopentadiene		(ug/kg)	350U	410U	380U	1900U
2,4,6-Trichlorophenol		(ug/kg)	350U	410U	380U	1900U
2,4,5-Trichlorophenol	100	(ug/kg)	890U	1000U	960U	4800U
1,1'Biphenyl		(ug/kg)	350U	410U	380U	1900U
2-Chloronaphthalene		(ug/kg)	350U	410U	380U	1900U
o-Nitroaniline	430	(ug/kg)	890U	1000U	960U	4800U
Dimethylphthalate	2000	(ug/kg)	350U	410U	380U	1900U
2,6-Dinitrotoluene	1000	(ug/kg)	350U	410U	380U	1900U
Acenaphthylene	41000	(ug/kg)	150J	410U	130J	1900U
m-Nitroaniline	500	(ug/kg)	890U	1000U	960U	4800U
Acenaphthene	50000	(ug/kg)	350U	410U	380U	1900U
2,4-Dinitrophenol	200	(ug/kg)	890U	1000U	960U	4800U
p-Nitrophenol	100	(ug/kg)	890U	1000U	960U	4800U
Dibenzofuran	6200	(ug/kg)	350U	410U	380U	1900U
2,4-Dinitrotoluene		(ug/kg)	350U	410U	380U	1900U
Diethylphthalate	7100	(ug/kg)	350U	410U	380U	1900U
Fluorene	50000	(ug/kg)	44J	410U	92J	1900U
4-chlorophenyl-phenylether		(ug/kg)	350U	410U	380U	1900U
p-Nitroaniline		(ug/kg)	890U	1000U	960U	4800U
4,6-Dinitro-o-cresol		(ug/kg)	890U	1000U	960U	4800U
N-Nitrosodiphenylamine (1)		(ug/kg)	350U	410U	380U	1900U
Hexachlorobenzene	410	(ug/kg)	350U	410U	380U	1900U
Atrazine		(ug/kg)	350U	410U	380U	1900U
Pentachlorophenol	1000	(ug/kg)	890U	1000U	960U	4800U
Phenanthrene	50000	(ug/kg)	980	180J	1400	640J
Anthracene	50000	(ug/kg)	89J	42J	410	220J
Carbazole		(ug/kg)	95J	410U	66J	1900U
Di-n-butyl-phthalate	8100	(ug/kg)	350U	410U	380U	1900U
Fluoranthene	50000	(ug/kg)	2500	780	4200E	2100D
Pyrene	50000	(ug/kg)	1200	580	2600	1900J
Butylbenzylphthalate	50000	(ug/kg)	350U	410U	380U	1900U
3,3-Dichlorobenzidine		(ug/kg)	350U	410U	380U	1900U
Benzo(a)anthracene	220	(ug/kg)	**[700]**	**[370]J**	**[1500]**	**[1000]J**
Chrysene	400	(ug/kg)	**[880]**	370J	**[1500]**	**[900]J**
Bis(2-ethylhexyl)phthalate	50000	(ug/kg)	64J	410U	380U	1900U
Di-n-octylphthalate	50000	(ug/kg)	350U	410U	380U	1900U
Benzo(b)fluoranthene	1100	(ug/kg)	**[1100]**	350J	**[2100]**	930J
Benzo(k)fluoranthene	1100	(ug/kg)	610	320J	650	1900U
Benzo(a)pyrene	61	(ug/kg)	**[690]**	**[220]J**	**[1600]**	**[860]J**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	240J	200J	400	450J
Dibenzo(a,h)anthracene	14	(ug/kg)	350U	410U	380U	1900U
Benzo(g,h,i)perylene	50000	(ug/kg)	350U	410U	230J	1900U

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM

Table 3
Malone Former MGP Site
Soil Analyses - SVOC Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SS-04 MALO-SS14 10/02/2003 / 18:10 0.5	SS-05 MALO-SS05 10/02/2003 / 16:50 0.5	SS-06 MALO-SS06 10/02/2003 / 17:05 0.5	SS-06 MALO-SS06DL 10/02/2003 / 17:05 0.5
Benzaldehyde		(ug/kg)	380U	390U	2500U	12000U
Phenol	30	(ug/kg)	380U	390U	2500U	12000U
Bis(2-chloroethyl)ether		(ug/kg)	380U	390U	2500U	12000U
2-Chlorophenol	800	(ug/kg)	380U	390U	2500U	12000U
o-Cresol	100	(ug/kg)	380U	390U	2500U	12000U
2,2-oxybis(1-Chloropropane)		(ug/kg)	380U	390U	2500U	12000U
Acetophenone		(ug/kg)	380U	390U	2500U	12000U
p-Cresol	900	(ug/kg)	380U	390U	2500U	12000U
N-Nitroso-di-n-propylamine		(ug/kg)	380U	390U	2500U	12000U
Hexachloroethane		(ug/kg)	380U	390U	2500U	12000U
Nitrobenzene	200	(ug/kg)	380U	390U	2500U	12000U
Isophorone	4400	(ug/kg)	380U	390U	2500U	12000U
o-Nitrophenol	330	(ug/kg)	380U	390U	2500U	12000U
2,4-Dimethylphenol		(ug/kg)	380U	390U	2500U	12000U
Bis(2-chloroethoxy)methane		(ug/kg)	380U	390U	2500U	12000U
2,4-Dichlorophenol	400	(ug/kg)	380U	390U	2500U	12000U
Naphthalene	13000	(ug/kg)	380U	390U	1900J	1700J
p-Chloroaniline	220	(ug/kg)	380U	390U	2500U	12000U
Hexachlorobutadiene		(ug/kg)	380U	390U	2500U	12000U
Caprolactam		(ug/kg)	380U	390U	2500U	12000U
p-Chloro-m-cresol	240	(ug/kg)	380U	390U	2500U	12000U
2-Methylnaphthalene	36000	(ug/kg)	380U	390U	530J	12000U
Hexachlorocyclopentadiene		(ug/kg)	380U	390U	2500U	12000U
2,4,6-Trichlorophenol		(ug/kg)	380U	390U	2500U	12000U
2,4,5-Trichlorophenol	100	(ug/kg)	950U	990U	6200U	31000U
1,1'Biphenyl		(ug/kg)	380U	390U	650J	12000U
2-Chloronaphthalene		(ug/kg)	380U	390U	2500U	12000U
o-Nitroaniline	430	(ug/kg)	950U	990U	6200U	31000U
Dimethylphthalate	2000	(ug/kg)	380U	390U	2500U	12000U
2,6-Dinitrotoluene	1000	(ug/kg)	380U	390U	2500U	12000U
Acenaphthylene	41000	(ug/kg)	57J	57J	13000	8500J
m-Nitroaniline	500	(ug/kg)	950U	990U	6200U	31000U
Acenaphthene	50000	(ug/kg)	380U	390U	2500	1800J
2,4-Dinitrophenol	200	(ug/kg)	950U	990U	6200U	31000U
p-Nitrophenol	100	(ug/kg)	950U	990U	6200U	31000U
Dibenzofuran	6200	(ug/kg)	380U	390U	**[8300]**	5100J
2,4-Dinitrotoluene		(ug/kg)	380U	390U	2500U	12000U
Diethylphthalate	7100	(ug/kg)	380U	390U	2500U	12000U
Fluorene	50000	(ug/kg)	380U	390U	27000E	22000D
4-chlorophenyl-phenylether		(ug/kg)	380U	390U	2500U	12000U
p-Nitroaniline		(ug/kg)	950U	990U	6200U	31000U
4,6-Dinitro-o-cresol		(ug/kg)	950U	990U	6200U	31000U
N-Nitrosodiphenylamine (1)		(ug/kg)	380U	390U	2500U	12000U
Hexachlorobenzene	410	(ug/kg)	380U	390U	2500U	12000U
Atrazine		(ug/kg)	380U	390U	2500U	12000U
Pentachlorophenol	1000	(ug/kg)	950U	990U	6200U	31000U
Phenanthrene	50000	(ug/kg)	450	400	**[120000]E**	**[180000]E**
Anthracene	50000	(ug/kg)	120J	77J	**[51000]E**	**[85000]D**
Carbazole		(ug/kg)	380U	48J	22000E	12000D
Di-n-butyl-phthalate	8100	(ug/kg)	380U	390U	2500U	12000U
Fluoranthene	50000	(ug/kg)	2200	1500	**[170000]E**	**[280000]E**
Pyrene	50000	(ug/kg)	1600	1000	**[160000]E**	**[270000]E**
Butylbenzylphthalate	50000	(ug/kg)	380U	390U	2500U	12000U
3,3-Dichlorobenzidine		(ug/kg)	380U	390U	2500U	12000U
Benzo(a)anthracene	220	(ug/kg)	**[1100]**	**[630]**	**[210000]E**	**[140000]E**
Chrysene	400	(ug/kg)	**[980]**	**[590]**	**[15000]**	**[150000]E**
Bis(2-ethylhexyl)phthalate	50000	(ug/kg)	380U	390U	2500U	12000U
Di-n-octylphthalate	50000	(ug/kg)	380U	390U	2500U	12000R
Benzo(b)fluoranthene	1100	(ug/kg)	**[1400]**	730	**[190000]E**	**[250000]J**
Benzo(k)fluoranthene	1100	(ug/kg)	530	460	**[28000]E**	**[92000]J**
Benzo(a)pyrene	61	(ug/kg)	**[1100]**	**[600]**	**[26000]E**	**[180000]J**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	320J	250J	**[32000]E**	**[40000]J**
Dibenzo(a,h)anthracene	14	(ug/kg)	380U	390U	**[2400]J**	**[4100]J**
Benzo(g,h,i)perylene	50000	(ug/kg)	99J	130J	9200	13000J

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM

Table 3
Malone Former MGP Site
Soil Analyses - SVOC Results

Constituent	NYSDEC TAGM	Location	SS-06	SS-07	SS-07	SS-07
		Sample ID	MALO-SS06DL2	MALO-SS07	MALO-SS07DL	MALO-SS07DL2
		Date/Time	10/02/2003 / 17:05	10/02/2003 / 17:20	10/02/2003 / 17:20	10/02/2003 / 17:20
		Depth (ft)	0.5	0.5	0.5	0.5
Benzaldehyde		(ug/kg)	61000U	2700U	13000UJ	67000U
Phenol	30	(ug/kg)	61000U	**[1400]J**	13000U	67000UJ
Bis(2-chloroethyl)ether		(ug/kg)	61000U	2700U	13000UJ	67000U
2-Chlorophenol	800	(ug/kg)	61000U	2700U	13000U	67000UJ
o-Cresol	100	(ug/kg)	61000U	**[1000]J**	13000U	67000UJ
2,2-oxybis(1-Chloropropane)		(ug/kg)	61000U	2700U	13000UJ	67000U
Acetophenone		(ug/kg)	61000U	2700U	13000UJ	67000U
p-Cresol	900	(ug/kg)	61000U	**[2500]J**	13000U	67000UJ
N-Nitroso-di-n-propylamine		(ug/kg)	61000U	2700U	13000UJ	67000U
Hexachloroethane		(ug/kg)	61000U	2700U	13000UJ	67000U
Nitrobenzene	200	(ug/kg)	61000U	2700U	13000UJ	67000U
Isophorone	4400	(ug/kg)	61000U	2700U	13000UJ	67000U
o-Nitrophenol	330	(ug/kg)	61000U	2700U	13000U	67000UJ
2,4-Dimethylphenol		(ug/kg)	61000U	1200J	13000U	67000UJ
Bis(2-chloroethoxy)methane		(ug/kg)	61000U	2700U	13000UJ	67000U
2,4-Dichlorophenol	400	(ug/kg)	61000U	2700U	13000U	67000UJ
Naphthalene	13000	(ug/kg)	61000U	**[70000]E**	**[150000]J**	**[140000]D**
p-Chloroaniline	220	(ug/kg)	61000U	2700U	13000UJ	67000U
Hexachlorobutadiene		(ug/kg)	61000U	2700U	13000UJ	67000U
Caprolactam		(ug/kg)	61000U	2700U	13000UJ	67000U
p-Chloro-m-cresol	240	(ug/kg)	61000U	2700U	13000U	67000UJ
2-Methylnaphthalene	36000	(ug/kg)	61000U	26000E	24000J	15000J
Hexachlorocyclopentadiene		(ug/kg)	61000U	2700U	13000UJ	67000U
2,4,6-Trichlorophenol		(ug/kg)	61000U	2700U	13000U	67000UJ
2,4,5-Trichlorophenol	100	(ug/kg)	150000U	6700U	33000U	170000UJ
1,1'Biphenyl		(ug/kg)	61000U	7100	4700J	67000U
2-Chloronaphthalene		(ug/kg)	61000U	2700U	13000UJ	67000U
o-Nitroaniline	430	(ug/kg)	150000U	6700U	33000UJ	170000U
Dimethylphthalate	2000	(ug/kg)	61000U	2700U	13000UJ	67000U
2,6-Dinitrotoluene	1000	(ug/kg)	61000U	2700U	13000UJ	67000U
Acenaphthylene	41000	(ug/kg)	61000U	33000E	36000J	21000J
m-Nitroaniline	500	(ug/kg)	150000U	6700U	33000UJ	170000U
Acenaphthene	50000	(ug/kg)	61000U	9700	6400J	67000U
2,4-Dinitrophenol	200	(ug/kg)	150000U	6700U	33000U	170000UJ
p-Nitrophenol	100	(ug/kg)	150000U	6700U	33000U	170000UJ
Dibenzofuran	6200	(ug/kg)	61000U	**[35000]E**	**[39000]J**	**[23000]J**
2,4-Dinitrotoluene		(ug/kg)	61000U	2700U	13000UJ	67000U
Diethylphthalate	7100	(ug/kg)	61000U	2700U	13000UJ	67000U
Fluorene	50000	(ug/kg)	13000J	42000E	**[52000]J**	30000J
4-chlorophenyl-phenylether		(ug/kg)	61000U	2700U	13000UJ	67000U
p-Nitroaniline		(ug/kg)	150000U	6700U	33000UJ	170000U
4,6-Dinitro-o-cresol		(ug/kg)	150000U	6700U	33000U	170000UJ
N-Nitrosodiphenylamine (1)		(ug/kg)	61000U	2700U	13000UJ	67000U
Hexachlorobenzene	410	(ug/kg)	61000U	2700U	13000UJ	67000U
Atrazine		(ug/kg)	61000U	2700U	13000UJ	67000U
Pentachlorophenol	1000	(ug/kg)	150000U	6700U	33000U	170000UJ
Phenanthrene	50000	(ug/kg)	**[260000]D**	**[140000]E**	**[230000]J**	**[310000]D**
Anthracene	50000	(ug/kg)	**[74000]D**	38000E	**[59000]J**	38000J
Carbazole		(ug/kg)	7700J	48000E	38000J	22000J
Di-n-butyl-phthalate	8100	(ug/kg)	61000U	2700U	13000UJ	67000U
Fluoranthene	50000	(ug/kg)	**[440000]D**	**[150000]E**	**[220000]J**	**[280000]D**
Pyrene	50000	(ug/kg)	**[330000]D**	**[120000]E**	**[210000]J**	**[230000]D**
Butylbenzylphthalate	50000	(ug/kg)	61000U	2700U	13000UJ	67000U
3,3-Dichlorobenzidine		(ug/kg)	61000U	2700U	13000UJ	67000U
Benzo(a)anthracene	220	(ug/kg)	**[140000]D**	**[73000]E**	**[77000]J**	**[67000]D**
Chrysene	400	(ug/kg)	**[120000]D**	**[59000]E**	**[73000]J**	**[61000]J**
Bis(2-ethylhexyl)phthalate	50000	(ug/kg)	61000U	2700U	13000UJ	67000U
Di-n-octylphthalate	50000	(ug/kg)	61000U	2700U	13000R	67000U
Benzo(b)fluoranthene	1100	(ug/kg)	**[140000]D**	**[130000]E**	**[130000]J**	**[66000]J**
Benzo(k)fluoranthene	1100	(ug/kg)	**[53000]J**	**[29000]E**	**[60000]J**	**[25000]J**
Benzo(a)pyrene	61	(ug/kg)	**[130000]D**	**[52000]E**	**[92000]J**	**[60000]J**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	**[60000]J**	**[23000]E**	**[25000]J**	**[35000]J**
Dibenzo(a,h)anthracene	14	(ug/kg)	61000U	**[1600]J**	13000R	67000U
Benzo(g,h,i)perylene	50000	(ug/kg)	23000J	7400	9200J	16000J

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM

Table 3
Malone Former MGP Site
Soil Analyses - SVOC Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SS-08 MALO-SS08 10/02/2003 / 17:45 0.5	SS-08 MALO-SS08DL 10/02/2003 / 17:45 0.5	SS-08 MALO-SS08DL2 10/02/2003 / 17:45 0.5	SS-09 MALO-SS09 10/03/2003 / 08:45 0.5
Benzaldehyde		(ug/kg)	540U	2700U	13000U	360U
Phenol	30	(ug/kg)	540U	2700U	13000U	360U
Bis(2-chloroethyl)ether		(ug/kg)	540U	2700U	13000U	360U
2-Chlorophenol	800	(ug/kg)	540U	2700U	13000U	360U
o-Cresol	100	(ug/kg)	540U	2700U	13000U	360U
2,2-oxybis(1-Chloropropane)		(ug/kg)	540U	2700U	13000U	360U
Acetophenone		(ug/kg)	540U	2700U	13000U	360U
p-Cresol	900	(ug/kg)	140J	2700U	13000U	360U
N-Nitroso-di-n-propylamine		(ug/kg)	540U	2700U	13000U	360U
Hexachloroethane		(ug/kg)	540U	2700U	13000U	360U
Nitrobenzene	200	(ug/kg)	540U	2700U	13000U	360U
Isophorone	4400	(ug/kg)	540U	2700U	13000U	360U
o-Nitrophenol	330	(ug/kg)	540U	2700U	13000U	360U
2,4-Dimethylphenol		(ug/kg)	540U	2700U	13000U	360U
Bis(2-chloroethoxy)methane		(ug/kg)	540U	2700U	13000U	360U
2,4-Dichlorophenol	400	(ug/kg)	540U	2700U	13000U	360U
Naphthalene	13000	(ug/kg)	7400E	5500D	3800J	360U
p-Chloroaniline	220	(ug/kg)	540U	2700U	13000U	360U
Hexachlorobutadiene		(ug/kg)	540U	2700U	13000U	360U
Caprolactam		(ug/kg)	540U	2700U	13000U	360U
p-Chloro-m-cresol	240	(ug/kg)	540U	2700U	13000U	360U
2-Methylnaphthalene	36000	(ug/kg)	2000	1100J	13000U	360U
Hexachlorocyclopentadiene		(ug/kg)	540U	2700U	13000U	360U
2,4,6-Trichlorophenol		(ug/kg)	540U	2700U	13000U	360U
2,4,5-Trichlorophenol	100	(ug/kg)	1400U	6800U	34000U	910U
1,1'Biphenyl		(ug/kg)	550	2700U	13000U	360U
2-Chloronaphthalene		(ug/kg)	540U	2700U	13000U	360U
o-Nitroaniline	430	(ug/kg)	1400U	6800U	34000U	910U
Dimethylphthalate	2000	(ug/kg)	540U	2700U	13000U	360U
2,6-Dinitrotoluene	1000	(ug/kg)	540U	2700U	13000U	360U
Acenaphthylene	41000	(ug/kg)	7700E	5400D	3100J	360U
m-Nitroaniline	500	(ug/kg)	1400U	6800U	34000U	910U
Acenaphthene	50000	(ug/kg)	1100	640J	13000U	360U
2,4-Dinitrophenol	200	(ug/kg)	1400U	6800U	34000U	910U
p-Nitrophenol	100	(ug/kg)	1400U	6800U	34000U	910U
Dibenzofuran	6200	(ug/kg)	5000E	3000D	2000J	360U
2,4-Dinitrotoluene		(ug/kg)	540U	2700U	13000U	360U
Diethylphthalate	7100	(ug/kg)	540U	2700U	13000U	360U
Fluorene	50000	(ug/kg)	5900E	3600D	2200J	360U
4-chlorophenyl-phenylether		(ug/kg)	540U	2700U	13000U	360U
p-Nitroaniline		(ug/kg)	1400U	6800U	34000U	910U
4,6-Dinitro-o-cresol		(ug/kg)	1400U	6800U	34000U	910U
N-Nitrosodiphenylamine (1)		(ug/kg)	540U	2700U	13000U	360U
Hexachlorobenzene	410	(ug/kg)	540U	2700U	13000U	360U
Atrazine		(ug/kg)	540U	2700U	13000U	360U
Pentachlorophenol	1000	(ug/kg)	1400U	6800U	34000U	910U
Phenanthrene	50000	(ug/kg)	26000E	41000E	45000D	57J
Anthracene	50000	(ug/kg)	6300E	6300D	3600J	360U
Carbazole		(ug/kg)	8100E	4800D	2700J	360U
Di-n-butyl-phthalate	8100	(ug/kg)	540U	2700U	13000U	360U
Fluoranthene	50000	(ug/kg)	31000E	48000E	**[54000]D**	170J
Pyrene	50000	(ug/kg)	27000E	46000E	46000D	160J
Butylbenzylphthalate	50000	(ug/kg)	540U	2700U	13000U	360U
3,3-Dichlorobenzidine		(ug/kg)	540U	2700U	13000U	360U
Benzo(a)anthracene	220	(ug/kg)	**[29000]E**	**[16000]D**	**[13000]J**	110J
Chrysene	400	(ug/kg)	**[1600]**	**[17000]D**	**[13000]J**	130J
Bis(2-ethylhexyl)phthalate	50000	(ug/kg)	67J	2700U	13000U	43J
Di-n-octylphthalate	50000	(ug/kg)	540R	2700R	13000U	360U
Benzo(b)fluoranthene	1100	(ug/kg)	**[36000]J**	**[31000]J**	**[14000]D**	120J
Benzo(k)fluoranthene	1100	(ug/kg)	**[8300]J**	**[12000]J**	**[6400]J**	97J
Benzo(a)pyrene	61	(ug/kg)	**[4400]J**	**[21000]J**	**[13000]J**	**[120]J**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	**[7000]J**	**[6000]J**	**[8100]J**	360U
Dibenzo(a,h)anthracene	14	(ug/kg)	**[460]J**	2700R	13000U	360U
Benzo(g,h,i)perylene	50000	(ug/kg)	1800J	1700J	3000J	360U

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM

Table 3
Malone Former MGP Site
Soil Analyses - SVOC Results

Constituent	NYSDEC TAGM	Location	SS-10	SS-11	SS-12	SS-13
		Sample ID	MALO-SS10	MALO-SS11	MALO-SS12	MALO-SS13
		Date/Time	10/03/2003 / 09:05	10/03/2003 / 09:25	10/03/2003 / 10:10	10/03/2003 / 10:30
		Depth (ft)	0.5	0.5	0.5	0.5
Benzaldehyde		(ug/kg)	430U	400U	380U	400U
Phenol	30	(ug/kg)	430U	400U	380U	400U
Bis(2-chloroethyl)ether		(ug/kg)	430U	400U	380U	400U
2-Chlorophenol	800	(ug/kg)	430U	400U	380U	400U
o-Cresol	100	(ug/kg)	430U	400U	380U	400U
2,2-oxybis(1-Chloropropane)		(ug/kg)	430U	400U	380U	400U
Acetophenone		(ug/kg)	430U	400U	380U	400U
p-Cresol	900	(ug/kg)	430U	400U	380U	400U
N-Nitroso-di-n-propylamine		(ug/kg)	430U	400U	380U	400U
Hexachloroethane		(ug/kg)	430U	400U	380U	400U
Nitrobenzene	200	(ug/kg)	430U	400U	380U	400U
Isophorone	4400	(ug/kg)	430U	400U	380U	400U
o-Nitrophenol	330	(ug/kg)	430U	400U	380U	400U
2,4-Dimethylphenol		(ug/kg)	430U	400U	380U	400U
Bis(2-chloroethoxy)methane		(ug/kg)	430U	400U	380U	400U
2,4-Dichlorophenol	400	(ug/kg)	430U	400U	380U	400U
Naphthalene	13000	(ug/kg)	83J	400U	380U	400U
p-Chloroaniline	220	(ug/kg)	430U	400U	380U	400U
Hexachlorobutadiene		(ug/kg)	430U	400U	380U	400U
Caprolactam		(ug/kg)	430U	400U	380U	400U
p-Chloro-m-cresol	240	(ug/kg)	430U	400U	380U	400U
2-Methylnaphthalene	36000	(ug/kg)	430U	400U	380U	400U
Hexachlorocyclopentadiene		(ug/kg)	430U	400U	380U	400U
2,4,6-Trichlorophenol		(ug/kg)	430U	400U	380U	400U
2,4,5-Trichlorophenol	100	(ug/kg)	1100U	1000U	960U	1000U
1,1'Biphenyl		(ug/kg)	430U	400U	380U	400U
2-Chloronaphthalene		(ug/kg)	430U	400U	380U	400U
o-Nitroaniline	430	(ug/kg)	1100U	1000U	960U	1000U
Dimethylphthalate	2000	(ug/kg)	430U	400U	380U	400U
2,6-Dinitrotoluene	1000	(ug/kg)	430U	400U	380U	400U
Acenaphthylene	41000	(ug/kg)	54J	400U	200J	48J
m-Nitroaniline	500	(ug/kg)	1100U	1000U	960U	1000U
Acenaphthene	50000	(ug/kg)	430U	400U	380U	400U
2,4-Dinitrophenol	200	(ug/kg)	1100U	1000U	960U	1000U
p-Nitrophenol	100	(ug/kg)	1100U	1000U	960U	1000U
Dibenzofuran	6200	(ug/kg)	430U	400U	380U	400U
2,4-Dinitrotoluene		(ug/kg)	430U	400U	380U	400U
Diethylphthalate	7100	(ug/kg)	430U	400U	380U	400U
Fluorene	50000	(ug/kg)	430U	400U	380U	400U
4-chlorophenyl-phenylether		(ug/kg)	430U	400U	380U	400U
p-Nitroaniline		(ug/kg)	1100U	1000U	960U	1000U
4,6-Dinitro-o-cresol		(ug/kg)	1100U	1000U	960U	1000U
N-Nitrosodiphenylamine (1)		(ug/kg)	430U	400U	380U	400U
Hexachlorobenzene	410	(ug/kg)	430U	400U	380U	400U
Atrazine		(ug/kg)	430U	400U	380U	400U
Pentachlorophenol	1000	(ug/kg)	1100U	1000U	960U	1000U
Phenanthrene	50000	(ug/kg)	310J	440	400	520
Anthracene	50000	(ug/kg)	52J	42J	79J	59J
Carbazole		(ug/kg)	430U	43J	380U	48J
Di-n-butyl-phthalate	8100	(ug/kg)	430U	400U	380U	400U
Fluoranthene	50000	(ug/kg)	790	1500	2400	1400
Pyrene	50000	(ug/kg)	630	980	1600	1100
Butylbenzylphthalate	50000	(ug/kg)	430U	400U	380U	400U
3,3-Dichlorobenzidine		(ug/kg)	430U	400U	380U	400U
Benzo(a)anthracene	220	(ug/kg)	**[310]J**	**[410]**	**[1100]**	**[480]**
Chrysene	400	(ug/kg)	370J	**[570]**	**[1200]**	**[600]**
Bis(2-ethylhexyl)phthalate	50000	(ug/kg)	58J	400U	380U	71J
Di-n-octylphthalate	50000	(ug/kg)	430U	400U	380U	400U
Benzo(b)fluoranthene	1100	(ug/kg)	450	780	**[2000]**	720
Benzo(k)fluoranthene	1100	(ug/kg)	310J	280J	720	600
Benzo(a)pyrene	61	(ug/kg)	**[350]J**	**[510]**	**[1200]**	**[540]**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	180J	200J	360J	190J
Dibenzo(a,h)anthracene	14	(ug/kg)	430U	400U	380U	400U
Benzo(g,h,i)perylene	50000	(ug/kg)	430U	210J	380U	400U

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM

Table 4
Malone Former MGP Site
Soil Analyses - PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-1 MALO-SB01-46 07/22/2003 / 09:15 5	SB-1 MALO-SB01-0810 07/22/2003 / 09:35 9	SB-1 MALO-SB01-1416 07/22/2003 / 10:10 15	SB-1 MALO-SB01-1820 07/22/2003 / 10:45 19	SB-2 MALO-SB02-46 07/24/2003 / 10:30 5	SB-2 MALO-SB02-46DL 07/24/2003 / 10:30 5
Chrysene	400	(ug/kg)	59.000U	190J	65.000U	61.000U	**[1300]J**	**[620]J**
Acenaphthene	50000	(ug/kg)	44.000U	42.000UJ	48.000U	45.000U	48.000U	95.000U
Acenaphthylene	41000	(ug/kg)	44.000U	42.000UJ	48.000U	45.000U	150J	140J
Anthracene	50000	(ug/kg)	48.000U	47.000UJ	53.000U	49.000U	300J	280J
Benzo(a)anthracene	220	(ug/kg)	37.000U	210J	41.000U	38.000U	**[1400]J**	**[1600]J**
Benzo(a)pyrene	61	(ug/kg)	57J	**[270]J**	61.000U	57.000U	**[1500]J**	**[1300]J**
Benzo(b)fluoranthene	1100	(ug/kg)	47J	230J	41.000U	38.000U	**[1900]J**	**[2500]J**
Benzo(g,h,i)perylene	50000	(ug/kg)	48.000U	130J	53.000U	49.000U	260J	100.000R
Benzo(k)fluoranthene	1100	(ug/kg)	96.000U	220J	110.000U	99.000U	**[1700]J**	**[1800]J**
Dibenz(a,h)anthracene	14	(ug/kg)	56.000U	54.000U	61.000U	57.000U	60.000R	120.000R
Fluoranthene	50000	(ug/kg)	65J	390J	41.000U	38.000U	1300	1100D
Fluorene	50000	(ug/kg)	41.000U	39.000UJ	45.000U	42.000U	86J	87.000U
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	59.000U	120J	65.000U	61.000U	160J	300J
Naphthalene	13000	(ug/kg)	44.000U	42.000U	48.000U	45.000U	280J	260J
Phenanthrene	50000	(ug/kg)	37.000U	130J	41.000U	38.000U	800	660J
Pyrene	50000	(ug/kg)	58J	330J	41.000U	38.000U	9400J	6400J
Total PAHs	500,000	(ug/kg)	227	2220	ND	ND	20536	16960
Total cPAHs	10,000	(ug/kg)	104	1240	ND	ND	7960	8120

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criterion

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Malone Former MGP Site
Soil Analyses - PAH Results

Constituent	NYSDEC TAGM	Location	SB-2	SB-2	SB-2	SB-3	SB-3	SB-3
		Sample ID	MALO-SB02-0810	MALO-SB02-0810DL	MALO-SB02-1214	MALO-SB03-24	MALO-SB03-24DL	MALO-SB03-24DL2
		Date/Time	07/24/2003 / 10:50	07/24/2003 / 10:50	07/24/2003 / 11:15	07/22/2003 / 14:30	07/22/2003 / 14:30	07/22/2003 / 14:30
		Depth (ft)	9	9	13	3	3	3
Chrysene	400	(ug/kg)	**[5400]J**	**[3500]J**	64.000U	**[16000]J**	**[72000]D**	**[130000]D**
Acenaphthene	50000	(ug/kg)	120J	460.000U	48.000U	14000J	18000J	30000J
Acenaphthylene	41000	(ug/kg)	690J	660J	48.000U	**[42000]J**	**[60000]J**	**[140000]J**
Anthracene	50000	(ug/kg)	1600	1500J	52.000U	44000J	**[58000]J**	**[150000]J**
Benzo(a)anthracene	220	(ug/kg)	**[7600]J**	**[5900]D**	50J	**[190000]J**	**[78000]E**	**[140000]D**
Benzo(a)pyrene	61	(ug/kg)	**[7100]J**	**[5400]J**	60.000U	**[96000]J**	**[100000]E**	**[180000]D**
Benzo(b)fluoranthene	1100	(ug/kg)	**[9200]J**	**[8100]J**	40.000U	**[150000]J**	**[90000]E**	**[160000]D**
Benzo(g,h,i)perylene	50000	(ug/kg)	1600J	3000J	52.000U	31000J	32000D	**[81000]J**
Benzo(k)fluoranthene	1100	(ug/kg)	**[8700]J**	**[3500]J**	100.000U	**[32000]J**	**[67000]J**	**[120000]J**
Dibenz(a,h)anthracene	14	(ug/kg)	**[320]J**	570.000J	60.000U	**[11000]J**	**[14000]D**	**[28000]J**
Fluoranthene	50000	(ug/kg)	7400E	6400D	87J	**[190000]J**	**[170000]J**	**[400000]J**
Fluorene	50000	(ug/kg)	480J	490J	44.000U	45000J	**[69000]J**	**[170000]J**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	500J	1700J	64.000U	**[37000]J**	**[30000]D**	**[68000]J**
Naphthalene	13000	(ug/kg)	440J	460.000U	48.000U	**[480000]J**	**[310000]E**	**[720000]D**
Phenanthrene	50000	(ug/kg)	5700	4300D	67J	**[260000]J**	**[200000]J**	**[510000]J**
Pyrene	50000	(ug/kg)	29000J	8900J	70J	**[190000]J**	**[150000]E**	**[340000]D**
Total PAHs	500,000	(ug/kg)	85850	53350	274	1828000	1518000	3367000
Total cPAHs	10,000	(ug/kg)	38820	28100	50	532000	451000	826000

NOTE: **BOLD** values indicate exceedance of NYSDEC TAG

Table 4
Malone Former MGP Site
Soil Analyses - PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-3 MALO-SB03-0810 07/22/2003 / 15:25 9	SB-3 MALO-SB03-0810DL 07/22/2003 / 15:25 9	SB-3 MALO-SB03-1416 07/22/2003 / 15:50 15	SB-3 MALO-SB03-1921 07/22/2003 / 16:40 20	SB-4 MALO-SB04-24 07/28/2003 / 17:30 3	SB-4 MALO-SB04-24RE 07/28/2003 / 17:30 3
Chrysene	400	(ug/kg)	**[2400]**	**[2400]D**	60.000U	58.000U	70UJ	70UJ
Acenaphthene	50000	(ug/kg)	520J	480J	44.000UJ	43.000U	53U	53U
Acenaphthylene	41000	(ug/kg)	2200J	2300J	44.000UJ	43.000U	53U	53U
Anthracene	50000	(ug/kg)	2500J	2900J	49.000UJ	47.000U	57U	57U
Benzo(a)anthracene	220	(ug/kg)	**[2700]**	**[2500]D**	38.000U	36.000U	44UJ	44UJ
Benzo(a)pyrene	61	(ug/kg)	**[3300]E**	**[3200]J**	56.000U	54.000U	66UJ	66UJ
Benzo(b)fluoranthene	1100	(ug/kg)	**[3000]E**	**[3300]J**	38.000U	36.000U	44UJ	44UJ
Benzo(g,h,i)perylene	50000	(ug/kg)	1400	1200J	49.000U	47.000U	57UJ	57UJ
Benzo(k)fluoranthene	1100	(ug/kg)	**[1900]J**	**[2200]J**	97.000UJ	94.000U	110UJ	110UJ
Dibenz(a,h)anthracene	14	(ug/kg)	**[340]J**	270.000U	57.000U	55.000U	66UJ	66UJ
Fluoranthene	50000	(ug/kg)	5600J	7200J	55J	36.000U	44U	44U
Fluorene	50000	(ug/kg)	2500J	2600J	41.000UJ	40.000U	48U	48U
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	1400	760J	60.000U	58.000U	70UJ	70UJ
Naphthalene	13000	(ug/kg)	5500E	7600D	44.000U	43.000U	53UJ	53UJ
Phenanthrene	50000	(ug/kg)	7600J	11000J	65J	36.000U	44U	44U
Pyrene	50000	(ug/kg)	5200E	6600D	41J	36.000U	44UJ	44UJ
Total PAHs	500,000	(ug/kg)	48060	56240	161	ND	ND	ND
Total cPAHs	10,000	(ug/kg)	15040	14360	ND	ND	ND	ND

NOTE: **BOLD** values indicate exceedance of NYSDEC TAG

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Malone Former MGP Site
Soil Analyses - PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-4 MALO-SB04-68 07/28/2003 / 17:50 7	SB-4 MALO-SB04-68DL 07/28/2003 / 17:50 7	SB-4 MALO-SB04-68DL2 07/28/2003 / 17:50 7	SB-5 MALO-SB05-46 07/23/2003 / 08:50 5	SB-5 MALO-SB05-1214 07/23/2003 / 09:28 13	SB-5 MALO-SB05-1214DL 07/23/2003 / 09:28 13
Chrysene	400	(ug/kg)	**[5900]E**	**[5800]D**	**[5900]J**	56.000U	**[56000]J**	**[210000]E**
Acenaphthene	50000	(ug/kg)	1100	1200J	2500U	41.000U	38000J	**[55000]J**
Acenaphthylene	41000	(ug/kg)	12000E	9800D	9300J	41.000U	**[80000]J**	**[150000]J**
Anthracene	50000	(ug/kg)	12000E	10000D	9800J	45.000U	**[160000]J**	**[250000]J**
Benzo(a)anthracene	220	(ug/kg)	**[8800]E**	**[8900]D**	**[8900]J**	35.000U	**[560000]J**	**[230000]E**
Benzo(a)pyrene	61	(ug/kg)	**[7900]E**	**[7000]D**	**[3400]J**	52.000U	**[230000]J**	**[300000]J**
Benzo(b)fluoranthene	1100	(ug/kg)	**[10000]E**	**[7600]D**	**[7600]J**	35.000U	**[380000]J**	**[280000]J**
Benzo(g,h,i)perylene	50000	(ug/kg)	1400	1600J	2700U	45.000U	**[76000]J**	**[94000]J**
Benzo(k)fluoranthene	1100	(ug/kg)	**[2400]**	**[3100]J**	5400U	90.000U	**[77000]J**	**[180000]J**
Dibenz(a,h)anthracene	14	(ug/kg)	**[750]**	620U	3100U	52.000U	**[31000]J**	**[27000]J**
Fluoranthene	50000	(ug/kg)	21000E	20000D	18000J	35.000U	**[600000]J**	**[480000]J**
Fluorene	50000	(ug/kg)	11000E	8800D	8400J	38.000U	**[120000]J**	**[230000]J**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	1300	1800J	3300U	56.000U	**[94000]J**	**[70000]D**
Naphthalene	13000	(ug/kg)	**[27000]E**	**[34000]E**	**[29000]D**	41.000U	**[2900000]J**	**[1500000]E**
Phenanthrene	50000	(ug/kg)	26000E	32000D	27000D	35.000U	**[880000]J**	**[670000]J**
Pyrene	50000	(ug/kg)	15000E	16000D	15000J	35.000U	**[610000]J**	**[480000]E**
Total PAHs	500,000	(ug/kg)	163550	167600	142300	ND	6892000	5206000
Total cPAHs	10,000	(ug/kg)	37050	34200	25800	ND	1428000	1297000

NOTE: **BOLD** values indicate exceedance of NYSDEC TAC

Table 4
Malone Former MGP Site
Soil Analyses - PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-5 MALO-SB05-1214DL2 07/23/2003 / 09:28 13	SB-5 MALO-SB05-1214DL3 07/23/2003 / 09:28 13	SB-6 MALO-SB-06-24 07/23/2003 / 15:50 3	SB-6 MALO-SB-06-24DL 07/23/2003 / 15:50 3	SB-6 MALO-SB-06-24DL2 07/23/2003 / 15:50 3
Chrysene	400	(ug/kg)	**[360000]D**	**[280000]J**	**[210000]E**	**[190000]D**	**[210000]D**
Acenaphthene	50000	(ug/kg)	**[91000]J**	130000.000UJ	**[99000]J**	47000J	43000.000U
Acenaphthylene	41000	(ug/kg)	**[260000]J**	**[320000]J**	**[500000]J**	**[200000]D**	**[190000]J**
Anthracene	50000	(ug/kg)	**[480000]J**	**[440000]J**	**[190000]E**	**[250000]D**	**[250000]J**
Benzo(a)anthracene	220	(ug/kg)	**[370000]D**	**[290000]J**	**[220000]E**	**[260000]D**	**[240000]D**
Benzo(a)pyrene	61	(ug/kg)	**[470000]D**	**[390000]J**	**[720000]J**	**[260000]J**	**[230000]J**
Benzo(b)fluoranthene	1100	(ug/kg)	**[360000]D**	**[320000]J**	**[1300000]J**	**[330000]J**	**[210000]J**
Benzo(g,h,i)perylene	50000	(ug/kg)	**[180000]J**	140000.000J	**[51000]J**	**[72000]J**	**[84000]J**
Benzo(k)fluoranthene	1100	(ug/kg)	**[340000]J**	**[290000]J**	**[300000]J**	**[280000]J**	**[230000]J**
Dibenz(a,h)anthracene	14	(ug/kg)	**[63000]J**	170000.000J	**[21000]J**	27000.000U	53000.000U
Fluoranthene	50000	(ug/kg)	**[1000000]J**	**[1000000]J**	**[360000]E**	**[720000]D**	**[670000]D**
Fluorene	50000	(ug/kg)	**[490000]J**	**[410000]J**	**[590000]J**	**[190000]D**	**[190000]J**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	**[170000]J**	180000.000U	**[4400]J**	**[34000]J**	57000.000U
Naphthalene	13000	(ug/kg)	**[2700000]E**	**[3100000]D**	**[390000]E**	**[2300000]E**	**[2000000]D**
Phenanthrene	50000	(ug/kg)	**[1400000]J**	**[1700000]J**	**[330000]E**	**[1300000]D**	**[1200000]D**
Pyrene	50000	(ug/kg)	**[920000]D**	**[860000]J**	**[560000]J**	**[700000]J**	**[550000]J**
Total PAHs	500,000	(ug/kg)	9654000	9400000	5845400	7133000	6254000
Total cPAHs	10,000	(ug/kg)	2133000	1570000	2775400	1354000	1120000

NOTE: **BOLD** values indicate exceedance of NYSDEC TAG

Tabl
Malone Former MGP Site
Soil Analyses - PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-7 MALO-SB07-46 07/21/2003 / 13:15 5	SB-7 MALO-SB07-0810 07/21/2003 / 13:28 9	SB-7 MALO-SB07-1214 07/21/2003 / 14:00 13	SB-7 MALO-SB07-1618 07/21/2003 / 14:25 17	SB-8 MALO-SB08-02 07/28/2003 / 12:45 1	SB-8 MALO-SB08-02DL 07/28/2003 / 12:45 1
Chrysene	400	(ug/kg)	56.000U	65.000U	68.000U	61.000U	**[5700]E**	**[5300]D**
Acenaphthene	50000	(ug/kg)	42.000U	48.000U	50.000U	45.000U	240J	490U
Acenaphthylene	41000	(ug/kg)	42.000U	48.000U	50.000U	45.000U	1000	940J
Anthracene	50000	(ug/kg)	46.000U	53.000U	55.000U	50.000U	2100	1800J
Benzo(a)anthracene	220	(ug/kg)	35.000U	41.000U	42.000U	38.000U	**[6900]E**	**[6500]D**
Benzo(a)pyrene	61	(ug/kg)	53.000U	61.000U	63.000U	58.000U	**[9400]E**	**[7700]D**
Benzo(b)fluoranthene	1100	(ug/kg)	35.000U	41.000U	42.000U	38.000U	**[12000]E**	**[9200]D**
Benzo(g,h,i)perylene	50000	(ug/kg)	46.000U	53.000U	55.000U	50.000U	2900	3500J
Benzo(k)fluoranthene	1100	(ug/kg)	91.000U	110.000U	110.000U	100.000U	**[3400]E**	**[2900]J**
Dibenz(a,h)anthracene	14	(ug/kg)	53.000U	61.000U	64.000U	58.000U	**[960]**	610U
Fluoranthene	50000	(ug/kg)	35.000U	41.000U	42.000U	38.000U	19000E	14000D
Fluorene	50000	(ug/kg)	39.000U	45.000U	47.000U	42.000U	600	610J
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	56.000U	65.000U	68.000U	61.000U	2200	3000J
Naphthalene	13000	(ug/kg)	42.000U	48.000U	50.000U	45.000U	230J	490U
Phenanthrene	50000	(ug/kg)	35.000U	41.000U	42.000U	38.000U	9200E	7000D
Pyrene	50000	(ug/kg)	35.000U	41.000U	42.000U	38.000U	14000E	13000D
Total PAHs	500,000	(ug/kg)	ND	ND	ND	ND	89830	75450
Total cPAHs	10,000	(ug/kg)	ND	ND	ND	ND	40560	34600

NOTE: **BOLD** values indicate exceedance of NYSDEC TAG

Table 4
Malone Former MGP Site
Soil Analyses - PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-8 MALO-SB08-13 07/28/2003 / 12:50 2	SB-8 MALO-SB08-13DL 07/28/2003 / 12:50 2	SB-8 MALO-SB08-57 07/28/2003 / 14:25 6	SB-8 MALO-SB08-57RE 07/28/2003 / 14:25 6	SB-8 MALO-SB08-0911 07/28/2003 / 14:55 10
Chrysene	400	(ug/kg)	**[4400]E**	**[4200]D**	57UJ	57U	62U
Acenaphthene	50000	(ug/kg)	560	520J	43U	43U	47U
Acenaphthylene	41000	(ug/kg)	580	530J	43U	43U	47U
Anthracene	50000	(ug/kg)	2100	1800J	47U	47U	50U
Benzo(a)anthracene	220	(ug/kg)	**[5200]E**	**[4300]D**	36UJ	44J	39U
Benzo(a)pyrene	61	(ug/kg)	**[6900]E**	**[5600]D**	54UJ	54UJ	58U
Benzo(b)fluoranthene	1100	(ug/kg)	**[7900]E**	**[6600]D**	48J	38J	39U
Benzo(g,h,i)perylene	50000	(ug/kg)	2000	2600J	47UJ	47UJ	50U
Benzo(k)fluoranthene	1100	(ug/kg)	**[2700]**	**[2500]J**	93UJ	93UJ	100U
Dibenz(a,h)anthracene	14	(ug/kg)	**[770]**	600U	54UJ	54UJ	58U
Fluoranthene	50000	(ug/kg)	13000E	9000D	63J	65J	39U
Fluorene	50000	(ug/kg)	800	700J	39U	39U	43U
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	1500	2100J	57UJ	57UJ	62U
Naphthalene	13000	(ug/kg)	220J	480U	43U	43U	47U
Phenanthrene	50000	(ug/kg)	7800E	6000D	36U	36U	39U
Pyrene	50000	(ug/kg)	10000E	9700D	65J	67J	39U
Total PAHs	500,000	(ug/kg)	66430	56150	176	214	ND
Total cPAHs	10,000	(ug/kg)	29370	25300	48	82	ND

NOTE: **BOLD** values indicate exceedance of NYSDEC TAG

Tabl
Malone Former MGP Site
Soil Analyses - Carcinogenic PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth	SB-1 MALO-SB01-46 07/22/2003 / 09:15 5	SB-1 MALO-SB01-0810 07/22/2003 / 09:35 9	SB-1 MALO-SB01-1416 07/22/2003 / 10:10 15	SB-1 MALO-SB01-1416RE 07/22/2003 / 10:10 15	SB-1 MALO-SB01-1820 07/22/2003 / 10:45 19	SB-2 MALO-SB02-46 07/24/2003 / 10:30 5
Benzo(a)anthracene	220	(ug/kg)	37.000U	210J	41.000U	31.000U	38.000U	**[1400]J**
Benzo(a)pyrene	61	(ug/kg)	57J	**[270]J**	61.000U	22.000R	57.000U	**[1500]J**
Benzo(b)fluoranthene	1100	(ug/kg)	47J	230J	64.000R	64.000R	38.000U	**[1900]J**
Benzo(k)fluoranthene	1100	(ug/kg)	96.000U	220J	110.000U	100.000R	99.000U	**[1700]J**
Dibenzo(a,h)anthracene	14	(ug/kg)	56.000U	54.000U	83.000R	83.000R	57.000U	60.000R
Chrysene	400	(ug/kg)	59.000U	190J	65.000U	38.000U	61.000U	**[1300]J**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	59.000U	120J	78.000R	78.000R	61.000U	160J
Total cPAHs	10000	(ug/kg)	104	1240	ND	ND	ND	7960
Total cPAHs	10	**mg/Kg**	0.1	1.2	ND	ND	ND	8.0

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criterion

Table 5
Malone Former MGP Site
Soil Analyses - Carcinogenic PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth	SB-2 MALO-SB02-46DL 07/24/2003 / 10:30 5	SB-2 MALO-SB02-0810 07/24/2003 / 10:50 9	SB-2 MALO-SB02-0810DL 07/24/2003 / 10:50 9	SB-2 MALO-SB02-1214 07/24/2003 / 11:15 13	SB-3 MALO-SB03-24 07/22/2003 / 14:30 3	SB-3 MALO-SB03-24DL 07/22/2003 / 14:30 3
Benzo(a)anthracene	220	(ug/kg)	**[1600]J**	**[7600]J**	**[5900]D**	50J	**[190000]J**	**[78000]E**
Benzo(a)pyrene	61	(ug/kg)	**[1300]J**	**[7100]J**	**[6400]J**	60.000U	**[96000]J**	**[100000]E**
Benzo(b)fluoranthene	1100	(ug/kg)	**[2500]J**	**[9200]J**	**[8100]J**	40.000U	**[150000]J**	**[90000]E**
Benzo(k)fluoranthene	1100	(ug/kg)	**[1800]J**	**[8700]J**	**[3500]J**	100.000U	**[32000]J**	**[67000]J**
Dibenzo(a,h)anthracene	14	(ug/kg)	120.000R	**[320]J**	570.000J	60.000U	**[11000]J**	**[14000]D**
Chrysene	400	(ug/kg)	**[620]J**	**[5400]J**	**[3500]J**	64.000U	**[16000]J**	**[72000]D**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	300J	500J	1700J	64.000U	**[37000]J**	**[30000]D**
Total cPAHs	10000	(ug/kg)	8120	**38820**	**28100**	50	**532000**	**451000**
Total cPAHs	10	**mg/Kg**	8.1	**38.8**	**28.1**	0.1	**532.0**	**451.0**

NOTE: **BOLD** values indicate exceedance of NYSDEC T

Tabl
Malone Former MGP Site
Soil Analyses - Carcinogenic PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth	SB-3 MALO-SB03-24DL2 07/22/2003 / 14:30 3	SB-3 MALO-SB03-0810 07/22/2003 / 15:25 9	SB-3 MALO-SB03-0810DL 07/22/2003 / 15:25 9	SB-3 MALO-SB03-1416 07/22/2003 / 15:50 15	SB-3 MALO-SB03-1921 07/22/2003 / 16:40 20	SB-4 MALO-SB04-24 07/28/2003 / 17:30 3
Benzo(a)anthracene	220	(ug/kg)	**[140000]D**	**[2700]**	**[2500]D**	38.000U	36.000U	44UJ
Benzo(a)pyrene	61	(ug/kg)	**[180000]D**	**[3300]E**	**[3200]J**	56.000U	54.000U	66UJ
Benzo(b)fluoranthene	1100	(ug/kg)	**[160000]D**	**[3000]E**	**[3300]J**	38.000U	36.000U	44UJ
Benzo(k)fluoranthene	1100	(ug/kg)	**[120000]J**	**[1900]J**	**[2200]J**	97.000UJ	94.000U	110UJ
Dibenzo(a,h)anthracene	14	(ug/kg)	**[28000]J**	**[340]J**	270.000U	57.000U	55.000U	66UJ
Chrysene	400	(ug/kg)	**[130000]D**	**[2400]**	**[2400]D**	60.000U	58.000U	70UJ
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	**[68000]J**	1400	760J	60.000U	58.000U	70UJ
Total cPAHs	10000	(ug/kg)	**826000**	**15040**	**14360**	ND	ND	ND
Total cPAHs	10	**mg/Kg**	**826.0**	**15.0**	**14.4**	ND	ND	ND

NOTE: **BOLD** values indicate exceedance of NYSDEC T

Table 5
Malone Former MGP Site
Soil Analyses - Carcinogenic PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth	SB-4 MALO-SB04-24RE 07/28/2003 / 17:30 3	SB-4 MALO-SB04-68 07/28/2003 / 17:50 7	SB-4 MALO-SB04-68DL 07/28/2003 / 17:50 7	SB-4 MALO-SB04-68DL2 07/28/2003 / 17:50 7	SB-5 MALO-SB05-46 07/23/2003 / 08:50 5	SB-5 MALO-SB05-1214 07/23/2003 / 09:28 13
Benzo(a)anthracene	220	(ug/kg)	44UJ	**[8800]E**	**[8900]D**	**[8900]J**	35.000U	**[560000]J**
Benzo(a)pyrene	61	(ug/kg)	66UJ	**[7900]E**	**[7000]D**	**[3400]J**	52.000U	**[230000]J**
Benzo(b)fluoranthene	1100	(ug/kg)	44UJ	**[10000]E**	**[7600]D**	**[7600]J**	35.000U	**[380000]J**
Benzo(k)fluoranthene	1100	(ug/kg)	110UJ	**[2400]**	**[3100]J**	5400U	90.000U	**[77000]J**
Dibenzo(a,h)anthracene	14	(ug/kg)	66UJ	**[750]**	620U	3100U	52.000U	**[31000]J**
Chrysene	400	(ug/kg)	70UJ	**[5900]E**	**[5800]D**	**[5900]J**	56.000U	**[56000]J**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	70UJ	1300	1800J	3300U	56.000U	**[94000]J**
Total cPAHs	10000	(ug/kg)	ND	**37050**	**34200**	**25800**	ND	**1428000**
Total cPAHs	10	**mg/Kg**	ND	**37.1**	**34.2**	**25.8**	ND	**1428.0**

NOTE: **BOLD** values indicate exceedance of NYSDEC T/

Tabl
Malone Former MGP Site
Soil Analyses - Carcinogenic PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth	SB-5 MALO-SB05-1214DL 07/23/2003 / 09:28 13	SB-5 MALO-SB05-1214DL2 07/23/2003 / 09:28 13	SB-5 MALO-SB05-1214DL3 07/23/2003 / 09:28 13	SB-6 MALO-SB-06-24 07/23/2003 / 15:50 3	SB-6 MALO-SB-06-24DL 07/23/2003 / 15:50 3
Benzo(a)anthracene	220	(ug/kg)	**[230000]E**	**[370000]D**	**[290000]J**	**[220000]E**	**[260000]D**
Benzo(a)pyrene	61	(ug/kg)	**[300000]J**	**[470000]D**	**[390000]J**	**[720000]J**	**[260000]J**
Benzo(b)fluoranthene	1100	(ug/kg)	**[280000]J**	**[360000]D**	**[320000]J**	**[1300000]J**	**[330000]J**
Benzo(k)fluoranthene	1100	(ug/kg)	**[180000]J**	**[340000]J**	**[290000]J**	**[300000]J**	**[280000]J**
Dibenzo(a,h)anthracene	14	(ug/kg)	**[27000]J**	**[63000]J**	170000.000J	**[21000]J**	27000.000U
Chrysene	400	(ug/kg)	**[210000]E**	**[360000]D**	**[280000]J**	**[210000]E**	**[190000]D**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	**[70000]D**	**[170000]J**	180000.000U	**[4400]J**	**[34000]J**
Total cPAHs	10000	(ug/kg)	**1297000**	**2133000**	**1570000**	**2775400**	**1354000**
Total cPAHs	10	**mg/Kg**	**1297.0**	**2133.0**	**1570.0**	**2775.4**	**1354.0**

NOTE: **BOLD** values indicate exceedance of NYSDEC T

Table 5
Malone Former MGP Site
Soil Analyses - Carcinogenic PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth	SB-6 MALO-SB-06-24DL2 07/23/2003 / 15:50 3	SB-6 MALO-SB06-0810 07/23/2003 / 16:10 9	SB-6 MALO-SB06-0810DL 07/23/2003 / 16:10 9	SB-6 MALO-SB06-0810DL2 07/23/2003 / 16:10 9	SB-6 MALO-SB06-0810DL3 07/23/2003 / 16:10 9
Benzo(a)anthracene	220	(ug/kg)	**[240000]D**	**[3200000]E**	**[77000]D**	**[3600000]D**	**[4100000]D**
Benzo(a)pyrene	61	(ug/kg)	**[230000]J**	**[3400000]E**	**[100000]J**	**[4300000]J**	**[4500000]D**
Benzo(b)fluoranthene	1100	(ug/kg)	**[210000]J**	**[3800000]E**	**[88000]J**	**[4400000]J**	**[4700000]D**
Benzo(k)fluoranthene	1100	(ug/kg)	**[230000]J**	**[1500000]E**	**[55000]J**	**[1700000]J**	**[1600000]D**
Dibenzo(a,h)anthracene	14	(ug/kg)	53000.000U	**[120000]**	**[29000]J**	**[480000]J**	**[460000]J**
Chrysene	400	(ug/kg)	**[210000]D**	**[2100000]E**	**[70000]D**	**[3000000]D**	**[3400000]D**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	57000.000U	**[1500000]E**	**[38000]J**	**[1600000]J**	**[2100000]D**
Total cPAHs	10000	(ug/kg)	**1120000**	**15620000**	**457000**	**19080000**	**20860000**
Total cPAHs	10	**mg/Kg**	**1120.0**	**15620.0**	**457.0**	**19080.0**	**20860.0**

NOTE: **BOLD** values indicate exceedance of NYSDEC T

Tabl

Malone Former MGP Site

Soil Analyses - Carcinogenic PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth	SB-6 MALO-SB06-0810DL4 07/23/2003 / 16:10 9	SB-6 MALO-SB06-1214 07/23/2003 / 16:40 13	SB-6 MALO-SB06-1214DL 07/23/2003 / 16:40 13	SB-7 MALO-SB07-46 07/21/2003 / 13:15 5	SB-7 MALO-SB07-0810 07/21/2003 / 13:28 9	SB-7 MALO-SB07-1214 07/21/2003 / 14:00 13
Benzo(a)anthracene	220	(ug/kg)	**[4500000]J**	**[16000]E**	**[21000]D**	35.000U	41.000U	42.000U
Benzo(a)pyrene	61	(ug/kg)	**[4700000]J**	**[23000]J**	**[27000]D**	53.000U	61.000U	63.000U
Benzo(b)fluoranthene	1100	(ug/kg)	**[4800000]J**	**[19000]J**	**[17000]J**	35.000U	41.000U	42.000U
Benzo(k)fluoranthene	1100	(ug/kg)	3800000.00U	**[12000]J**	**[21000]J**	91.000U	110.000U	110.000U
Dibenzo(a,h)anthracene	14	(ug/kg)	3100000.00U	**[5800]J**	2900.000U	53.000U	61.000U	64.000U
Chrysene	400	(ug/kg)	**[3800000]J**	**[14000]**	**[18000]J**	56.000U	65.000U	68.000U
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	2900000.00U	**[6900]J**	**[9900]J**	56.000U	65.000U	68.000U
Total cPAHs	10000	(ug/kg)	**17800000**	**96700**	**113900**	ND	ND	ND
Total cPAHs	10	**mg/Kg**	**17800.0**	**96.7**	**113.9**	ND	ND	ND

NOTE: **BOLD** values indicate exceedance of NYSDEC T

Table 5
Malone Former MGP Site
Soil Analyses - Carcinogenic PAH Results

Constituent	**NYSDEC TAGM**	**Location Sample ID Date/Time Depth**	**SB-7 MALO-SB07-1618 07/21/2003 / 14:25 17**	**SB-8 MALO-SB08-02 07/28/2003 / 12:45 1**	**SB-8 MALO-SB08-02DL 07/28/2003 / 12:45 1**	**SB-8 MALO-SB08-13 07/28/2003 / 12:50 2**	**SB-8 MALO-SB08-13DL 07/28/2003 / 12:50 2**	**SB-8 MALO-SB08-57 07/28/2003 / 14:25 6**
Benzo(a)anthracene	220	(ug/kg)	38.000U	**[6900]E**	**[6500]D**	**[5200]E**	**[4300]D**	36UJ
Benzo(a)pyrene	61	(ug/kg)	58.000U	**[9400]E**	**[7700]D**	**[6900]E**	**[5600]D**	54UJ
Benzo(b)fluoranthene	1100	(ug/kg)	38.000U	**[12000]E**	**[9200]D**	**[7900]E**	**[6600]D**	48J
Benzo(k)fluoranthene	1100	(ug/kg)	100.000U	**[3400]E**	**[2900]J**	**[2700]**	**[2500]J**	93UJ
Dibenzo(a,h)anthracene	14	(ug/kg)	58.000U	**[960]**	610U	**[770]**	600U	54UJ
Chrysene	400	(ug/kg)	61.000U	**[5700]E**	**[5300]D**	**[4400]E**	**[4200]D**	57UJ
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	61.000U	2200	3000J	1500	2100J	57UJ
Total cPAHs	10000	(ug/kg)	ND	**40560**	**34600**	**29370**	**25300**	48
Total cPAHs	10	**mg/Kg**	ND	**40.6**	**34.6**	**29.4**	**25.3**	0.0

NOTE: **BOLD** values indicate exceedance of NYSDEC T

Tabl

Malone Former MGP Site

Soil Analyses - Carcinogenic PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth	SB-8 MALO-SB08-57RE 07/28/2003 / 14:25 6	SB-8 MALO-SB08-0911 07/28/2003 / 14:55 10	SB-8 MALO-SB08-02 07/28/2003 / 15:00 1	SB-8 MALO-SB08-02DL 07/28/2003 / 15:00 1	SB-8 MALO-SB08-13 07/28/2003 / 15:10 2	SB-8 MALO-SB08-13DL 07/28/2003 / 15:10 2
Benzo(a)anthracene	220	(ug/kg)	44J	39U	**[22000]E**	**[23000]D**	**[38000]E**	**[38000]D**
Benzo(a)pyrene	61	(ug/kg)	54UJ	58U	**[22000]E**	**[20000]D**	**[37000]E**	**[32000]D**
Benzo(b)fluoranthene	1100	(ug/kg)	38J	39U	**[26000]E**	**[24000]D**	**[50000]E**	**[38000]D**
Benzo(k)fluoranthene	1100	(ug/kg)	93UJ	100U	**[8100]**	**[7400]J**	**[12000]**	**[14000]J**
Dibenzo(a,h)anthracene	14	(ug/kg)	54UJ	58U	**[2700]**	**[2900]J**	**[4000]**	**[4600]J**
Chrysene	400	(ug/kg)	57U	62U	**[16000]**	**[16000]D**	**[28000]E**	**[28000]D**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	57UJ	62U	**[6700]**	**[6900]J**	**[9700]**	**[11000]J**
Total cPAHs	10000	(ug/kg)	82	ND	**103500**	**100200**	**178700**	**165600**
Total cPAHs	10	**mg/Kg**	0.1	ND	**103.5**	**100.2**	**178.7**	**165.6**

NOTE: **BOLD** values indicate exceedance of NYSDEC T

Table 5
Malone Former MGP Site
Soil Analyses - Carcinogenic PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth	SS-01 MALO-SS01 10/02/2003 / 15:00 0.5	SS-01 MALO-SS01DL 10/02/2003 / 15:00 0.5	SS-02 MALO-SS02 10/02/2003 / 15:20 0.5	SS-03 MALO-SS03 10/02/2003 / 15:38 0.5	SS-04 MALO-SS04 10/02/2003 / 16:05 0.5	SS-04 MALO-SS04DL 10/02/2003 / 16:05 0.5
Benzo(a)anthracene	220	(ug/kg)	**[4900]E**	**[4100]D**	**[700]**	**[370]J**	**[1500]**	**[1000]J**
Benzo(a)pyrene	61	(ug/kg)	**[7500]J**	**[5000]J**	**[690]**	**[220]J**	**[1600]**	**[860]J**
Benzo(b)fluoranthene	1100	(ug/kg)	**[12000]J**	**[7700]J**	**[1100]**	350J	**[2100]**	930J
Benzo(k)fluoranthene	1100	(ug/kg)	**[4200]J**	**[3100]J**	610	320J	650	1900U
Dibenzo(a,h)anthracene	14	(ug/kg)	**[210]J**	2100R	350U	410U	380U	1900U
Chrysene	400	(ug/kg)	**[5200]E**	**[4000]D**	**[880]**	370J	**[1500]**	**[900]J**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	2000J	1700J	240J	200J	400	450J
Total cPAHs	10000	(ug/kg)	**36010**	**25600**	4220	1830	7750	4140
Total cPAHs	10	**mg/Kg**	**36.0**	**25.6**	4.2	1.8	7.8	4.1

NOTE: **BOLD** values indicate exceedance of NYSDEC T

Tabl
Malone Former MGP Site
Soil Analyses - Carcinogenic PAH Results

Constituent	**NYSDEC TAGM**	**Location Sample ID Date/Time Depth**	**SS-04 MALO-SS14 10/02/2003 / 16:10 0.5**	**SS-05 MALO-SS05 10/02/2003 / 16:50 0.5**	**SS-06 MALO-SS06 10/02/2003 / 17:05 0.5**	**SS-06 MALO-SS06DL 10/02/2003 / 17:05 0.5**	**SS-06 MALO-SS06DL2 10/02/2003 / 17:05 0.5**	**SS-07 MALO-SS07 10/02/2003 / 17:20 0.5**
Benzo(a)anthracene	220	(ug/kg)	**[1100]**	**[630]**	**[210000]**E	**[140000]**E	**[140000]**D	**[73000]**E
Benzo(a)pyrene	61	(ug/kg)	**[1100]**	**[600]**	**[26000]**E	**[180000]**J	**[130000]**D	**[52000]**E
Benzo(b)fluoranthene	1100	(ug/kg)	**[1400]**	730	**[190000]**E	**[250000]**J	**[140000]**D	**[130000]**E
Benzo(k)fluoranthene	1100	(ug/kg)	530	460	**[28000]**E	**[92000]**J	**[53000]**J	**[29000]**E
Dibenzo(a,h)anthracene	14	(ug/kg)	380U	390U	**[2400]**J	**[4100]**J	61000U	**[1600]**J
Chrysene	400	(ug/kg)	**[980]**	**[590]**	**[15000]**	**[150000]**E	**[120000]**D	**[59000]**E
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	320J	250J	**[32000]**E	**[40000]**J	**[60000]**J	**[23000]**E
Total cPAHs	10000	(ug/kg)	5430	3260	**503400**	**856100**	**643000**	**367600**
Total cPAHs	10	**mg/Kg**	5.4	3.3	**503.4**	**856.1**	**643.0**	**367.6**

NOTE: **BOLD** values indicate exceedance of NYSDEC T/

Table 5
Malone Former MGP Site
Soil Analyses - Carcinogenic PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth	SS-07 MALO-SS07DL 10/02/2003 / 17:20 0.5	SS-07 MALO-SS07DL2 10/02/2003 / 17:20 0.5	SS-08 MALO-SS08 10/02/2003 / 17:45 0.5	SS-08 MALO-SS08DL 10/02/2003 / 17:45 0.5	SS-08 MALO-SS08DL2 10/02/2003 / 17:45 0.5	SS-09 MALO-SS09 10/03/2003 / 08:45 0.5
Benzo(a)anthracene	220	(ug/kg)	**[77000]J**	**[67000]D**	**[29000]E**	**[16000]D**	**[13000]J**	110J
Benzo(a)pyrene	61	(ug/kg)	**[92000]J**	**[60000]J**	**[4400]J**	**[21000]J**	**[13000]J**	**[120]J**
Benzo(b)fluoranthene	1100	(ug/kg)	**[130000]J**	**[66000]J**	**[36000]J**	**[31000]J**	**[14000]D**	120J
Benzo(k)fluoranthene	1100	(ug/kg)	**[60000]J**	**[25000]J**	**[8300]J**	**[12000]J**	**[6400]J**	97J
Dibenzo(a,h)anthracene	14	(ug/kg)	13000R	67000U	**[460]J**	2700R	13000U	360U
Chrysene	400	(ug/kg)	**[73000]J**	**[61000]J**	**[1600]**	**[17000]D**	**[13000]J**	130J
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	**[25000]J**	**[35000]J**	**[7000]J**	**[6000]J**	**[8100]J**	360U
Total cPAHs	10000	(ug/kg)	**457000**	**314000**	**86760**	**103000**	**67500**	577
Total cPAHs	10	**mg/Kg**	**457.0**	**314.0**	**86.8**	**103.0**	**67.5**	0.6

NOTE: **BOLD** values indicate exceedance of NYSDEC T

Tabl
Malone Former MGP Site
Soil Analyses - Carcinogenic PAH Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth	SS-10 MALO-SS10 10/03/2003 / 09:05 0.5	SS-11 MALO-SS11 10/03/2003 / 09:25 0.5	SS-12 MALO-SS12 10/03/2003 / 10:10 0.5	SS-13 MALO-SS13 10/03/2003 / 10:30 0.5
Benzo(a)anthracene	220	(ug/kg)	**[310]J**	**[410]**	**[1100]**	**[480]**
Benzo(a)pyrene	61	(ug/kg)	**[350]J**	**[510]**	**[1200]**	**[540]**
Benzo(b)fluoranthene	1100	(ug/kg)	450	780	**[2000]**	720
Benzo(k)fluoranthene	1100	(ug/kg)	310J	280J	720	600
Dibenzo(a,h)anthracene	14	(ug/kg)	430U	400U	380U	400U
Chrysene	400	(ug/kg)	370J	**[570]**	**[1200]**	**[600]**
Indeno(1,2,3-cd)pyrene	3200	(ug/kg)	180J	200J	360J	190J
Total cPAHs	10000	(ug/kg)	1970	2750	6580	3130
Total cPAHs	10	**mg/Kg**	2.0	2.8	6.6	3.1

NOTE: **BOLD** values indicate exceedance of NYSDEC T/

Table 6
Malone Former MGP Site
Soil Analyses - Inorganics Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-1 MALO-SB01-46 07/22/2003 / 09:15 5	SB-1 MALO-SB01-0810 07/22/2003 / 09:35 9	SB-1 MALO-SB01-1416 07/22/2003 / 10:10 15	SB-1 MALO-SB01-1820 07/22/2003 / 10:45 19	SB-2 MALO-SB02-46 07/24/2003 / 10:30 5
Aluminum		(mg/kg)	NA	NA	3780	NA	NA
Antimony		(mg/kg)	NA	NA	1.000U	NA	NA
Arsenic	7.5	(mg/kg)	NA	NA	2.7N	NA	NA
Barium	300	(mg/kg)	NA	NA	21.0J	NA	NA
Beryllium	0.16	(mg/kg)	NA	NA	**[0.17]J**	NA	NA
Cadmium	1	(mg/kg)	NA	NA	0.250U	NA	NA
Calcium		(mg/kg)	NA	NA	2140	NA	NA
Chromium	10	(mg/kg)	NA	NA	6	NA	NA
Cobalt	30	(mg/kg)	NA	NA	3.6J	NA	NA
Copper	25	(mg/kg)	NA	NA	8.1	NA	NA
Iron	2000	(mg/kg)	NA	NA	**[7710]**	NA	NA
Lead		(mg/kg)	NA	NA	3.4	NA	NA
Magnesium		(mg/kg)	NA	NA	1210J	NA	NA
Manganese		(mg/kg)	NA	NA	261N	NA	NA
Mercury	0.1	(mg/kg)	NA	NA	0.120N	NA	NA
Nickel	13	(mg/kg)	NA	NA	7.0J	NA	NA
Potassium		(mg/kg)	NA	NA	380J	NA	NA
Selenium	2	(mg/kg)	NA	NA	0.640U	NA	NA
Silver		(mg/kg)	NA	NA	0.420N	NA	NA
Sodium		(mg/kg)	NA	NA	99.3J	NA	NA
Thallium		(mg/kg)	NA	NA	1.100U	NA	NA
Vanadium	150	(mg/kg)	NA	NA	9.5J	NA	NA
Zinc	20	(mg/kg)	NA	NA	**[20.5]**	NA	NA
Cyanide		(mg/kg)	0.562U	0.546U	0.619U	0.572U	0.600U

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criterion

Tabl
Malone Former MGP Site
Soil Analyses - Inorganics Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-2 MALO-SB02-0810 07/24/2003 / 10:50 9	SB-2 MALO-SB02-1214 07/24/2003 / 11:15 13	SB-3 MALO-SB03-24 07/22/2003 / 14:30 3	SB-3 MALO-SB03-0810 07/22/2003 / 15:25 9	SB-3 MALO-SB03-1416 07/22/2003 / 15:50 15
Aluminum		(mg/kg)	NA	NA	NA	NA	NA
Antimony		(mg/kg)	NA	NA	NA	NA	NA
Arsenic	7.5	(mg/kg)	NA	NA	NA	NA	NA
Barium	300	(mg/kg)	NA	NA	NA	NA	NA
Beryllium	0.16	(mg/kg)	NA	NA	NA	NA	NA
Cadmium	1	(mg/kg)	NA	NA	NA	NA	NA
Calcium		(mg/kg)	NA	NA	NA	NA	NA
Chromium	10	(mg/kg)	NA	NA	NA	NA	NA
Cobalt	30	(mg/kg)	NA	NA	NA	NA	NA
Copper	25	(mg/kg)	NA	NA	NA	NA	NA
Iron	2000	(mg/kg)	NA	NA	NA	NA	NA
Lead		(mg/kg)	NA	NA	NA	NA	NA
Magnesium		(mg/kg)	NA	NA	NA	NA	NA
Manganese		(mg/kg)	NA	NA	NA	NA	NA
Mercury	0.1	(mg/kg)	NA	NA	NA	NA	NA
Nickel	13	(mg/kg)	NA	NA	NA	NA	NA
Potassium		(mg/kg)	NA	NA	NA	NA	NA
Selenium	2	(mg/kg)	NA	NA	NA	NA	NA
Silver		(mg/kg)	NA	NA	NA	NA	NA
Sodium		(mg/kg)	NA	NA	NA	NA	NA
Thallium		(mg/kg)	NA	NA	NA	NA	NA
Vanadium	150	(mg/kg)	NA	NA	NA	NA	NA
Zinc	20	(mg/kg)	NA	NA	NA	NA	NA
Cyanide		(mg/kg)	0.572U	0.600U	0.546U	0.543U	0.569U

NOTE: **BOLD** values indicate exceedance of NYSDE

Table 6
Malone Former MGP Site
Soil Analyses - Inorganics Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-3 MALO-SB03-1921 07/22/2003 / 16:40 20	SB-4 MALO-SB04-24 07/28/2003 / 17:30 3	SB-4 MALO-SB04-68 07/28/2003 / 17:50 7	SB-5 MALO-SB05-46 07/23/2003 / 08:50 5	SB-5 MALO-SB05-1214 07/23/2003 / 09:28 13
Aluminum		(mg/kg)	NA	NA	NA	NA	NA
Antimony		(mg/kg)	NA	NA	NA	NA	NA
Arsenic	7.5	(mg/kg)	NA	NA	NA	NA	NA
Barium	300	(mg/kg)	NA	NA	NA	NA	NA
Beryllium	0.16	(mg/kg)	NA	NA	NA	NA	NA
Cadmium	1	(mg/kg)	NA	NA	NA	NA	NA
Calcium		(mg/kg)	NA	NA	NA	NA	NA
Chromium	10	(mg/kg)	NA	NA	NA	NA	NA
Cobalt	30	(mg/kg)	NA	NA	NA	NA	NA
Copper	25	(mg/kg)	NA	NA	NA	NA	NA
Iron	2000	(mg/kg)	NA	NA	NA	NA	NA
Lead		(mg/kg)	NA	NA	NA	NA	NA
Magnesium		(mg/kg)	NA	NA	NA	NA	NA
Manganese		(mg/kg)	NA	NA	NA	NA	NA
Mercury	0.1	(mg/kg)	NA	NA	NA	NA	NA
Nickel	13	(mg/kg)	NA	NA	NA	NA	NA
Potassium		(mg/kg)	NA	NA	NA	NA	NA
Selenium	2	(mg/kg)	NA	NA	NA	NA	NA
Silver		(mg/kg)	NA	NA	NA	NA	NA
Sodium		(mg/kg)	NA	NA	NA	NA	NA
Thallium		(mg/kg)	NA	NA	NA	NA	NA
Vanadium	150	(mg/kg)	NA	NA	NA	NA	NA
Zinc	20	(mg/kg)	NA	NA	NA	NA	NA
Cyanide		(mg/kg)	0.547U	0.021	0.0069	0.529U	0.666U

NOTE: **BOLD** values indicate exceedance of NYSDE

Tabl
Malone Former MGP Site
Soil Analyses - Inorganics Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-6 MALO-SB-06-24 07/23/2003 / 15:50 3	SB-6 MALO-SB06-0810 07/23/2003 / 16:10 9	SB-6 MALO-SB06-1214 07/23/2003 / 16:40 13	SB-7 MALO-SB07-46 07/21/2003 / 13:15 6	SB-7 MALO-SB07-0810 07/21/2003 / 13:28 9
Aluminum		(mg/kg)	NA	595	NA	NA	NA
Antimony		(mg/kg)	NA	1.000U	NA	NA	NA
Arsenic	7.5	(mg/kg)	NA	1.1J	NA	NA	NA
Barium	300	(mg/kg)	NA	4.6J	NA	NA	NA
Beryllium	0.16	(mg/kg)	NA	**[0.35]J**	NA	NA	NA
Cadmium	1	(mg/kg)	NA	0.000U	NA	NA	NA
Calcium		(mg/kg)	NA	8710	NA	NA	NA
Chromium	10	(mg/kg)	NA	1.6J	NA	NA	NA
Cobalt	30	(mg/kg)	NA	0.39J	NA	NA	NA
Copper	25	(mg/kg)	NA	2.9J	NA	NA	NA
Iron	2000	(mg/kg)	NA	1250	NA	NA	NA
Lead		(mg/kg)	NA	4.3	NA	NA	NA
Magnesium		(mg/kg)	NA	1780	NA	NA	NA
Manganese		(mg/kg)	NA	82.5	NA	NA	NA
Mercury	0.1	(mg/kg)	NA	**[0.30]N**	NA	NA	NA
Nickel	13	(mg/kg)	NA	1.4J	NA	NA	NA
Potassium		(mg/kg)	NA	65.8J	NA	NA	NA
Selenium	2	(mg/kg)	NA	1.000U	NA	NA	NA
Silver		(mg/kg)	NA	0.000N	NA	NA	NA
Sodium		(mg/kg)	NA	61.9J	NA	NA	NA
Thallium		(mg/kg)	NA	1.000U	NA	NA	NA
Vanadium	150	(mg/kg)	NA	1.2J	NA	NA	NA
Zinc	20	(mg/kg)	NA	8.6	NA	NA	NA
Cyanide		(mg/kg)	0.540U	0.677U	0.582U	0.532U	0.617U

NOTE: **BOLD** values indicate exceedance of NYSDE

Table 6
Malone Former MGP Site
Soil Analyses - Inorganics Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-7 MALO-SB07-1214 07/21/2003 / 14:00 13	SB-7 MALO-SB07-1618 07/21/2003 / 14:25 13	SB-8 MALO-SB08-02 07/28/2003 / 12:45 1	SB-8 MALO-SB08-13 07/28/2003 / 12:50 2	SB-8 MALO-SB08-57 07/28/2003 / 14:25 6
Aluminum		(mg/kg)	NA	NA	NA	NA	NA
Antimony		(mg/kg)	NA	NA	NA	NA	NA
Arsenic	7.5	(mg/kg)	NA	NA	NA	NA	NA
Barium	300	(mg/kg)	NA	NA	NA	NA	NA
Beryllium	0.16	(mg/kg)	NA	NA	NA	NA	NA
Cadmium	1	(mg/kg)	NA	NA	NA	NA	NA
Calcium		(mg/kg)	NA	NA	NA	NA	NA
Chromium	10	(mg/kg)	NA	NA	NA	NA	NA
Cobalt	30	(mg/kg)	NA	NA	NA	NA	NA
Copper	25	(mg/kg)	NA	NA	NA	NA	NA
Iron	2000	(mg/kg)	NA	NA	NA	NA	NA
Lead		(mg/kg)	NA	NA	NA	NA	NA
Magnesium		(mg/kg)	NA	NA	NA	NA	NA
Manganese		(mg/kg)	NA	NA	NA	NA	NA
Mercury	0.1	(mg/kg)	NA	NA	NA	NA	NA
Nickel	13	(mg/kg)	NA	NA	NA	NA	NA
Potassium		(mg/kg)	NA	NA	NA	NA	NA
Selenium	2	(mg/kg)	NA	NA	NA	NA	NA
Silver		(mg/kg)	NA	NA	NA	NA	NA
Sodium		(mg/kg)	NA	NA	NA	NA	NA
Thallium		(mg/kg)	NA	NA	NA	NA	NA
Vanadium	150	(mg/kg)	NA	NA	NA	NA	NA
Zinc	20	(mg/kg)	NA	NA	NA	NA	NA
Cyanide		(mg/kg)	0.644U	0.579U	0.014	0.000012U	0.026

NOTE: **BOLD** values Indicate exceedance of NYSDE

Tabl
Malone Former MGP Site
Soil Analyses - Inorganics Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-8 MALO-SB08-0911 07/28/2003 / 14:55 10	SB-8 MALO-SB08-02 07/28/2003 / 15:00 1	SB-8 MALO-SB08-13 07/28/2003 / 15:10 2	SS-01 MALO-SS01 10/02/2003 / 15:00 0.5	SS-02 MALO-SS02 10/02/2003 / 15:20 0.5
Aluminum		(mg/kg)	NA	6680	7240	3210	1260
Antimony		(mg/kg)	NA	1.0U	1.0U	1.0U	0.89U
Arsenic	7.5	(mg/kg)	NA	2.4J	3.2J	5.1	1.5J
Barium	300	(mg/kg)	NA	37.0J	36.6J	58	25.1J
Beryllium	0.16	(mg/kg)	NA	**[0.26]J**	**[0.27]J**	0.14J	0.14J
Cadmium	1	(mg/kg)	NA	0.25U	0.25U	**[1.4]**	0.21U
Calcium		(mg/kg)	NA	3490	3290	11800	3330
Chromium	10	(mg/kg)	NA	6.3	6.9	6.2	2.2
Cobalt	30	(mg/kg)	NA	2.8J	2.9J	2.8J	3.6J
Copper	25	(mg/kg)	NA	12.7EJ	15.9EJ	16	7.5
Iron	2000	(mg/kg)	NA	**[8090]**	**[8310]**	**[6570]**	**[3940]**
Lead		(mg/kg)	NA	37.3	31.4	107	111
Magnesium		(mg/kg)	NA	932J	1010J	6000	1190
Manganese		(mg/kg)	NA	136	155	150	74.6
Mercury	0.1	(mg/kg)	NA	0.12NUJ	**[0.20]NJ**	0.12U	0.10U
Nickel	13	(mg/kg)	NA	4.5J	8.5J	5.9J	4.4J
Potassium		(mg/kg)	NA	192J	207J	301J	188J
Selenium	2	(mg/kg)	NA	0.64U	0.83J	0.64U	0.73J
Silver		(mg/kg)	NA	0.42NUJ	0.45NJ	0.42U	0.36U
Sodium		(mg/kg)	NA	47.3U	120J	91.7J	40.5U
Thallium		(mg/kg)	NA	1.1U	1.1U	1.1U	0.93U
Vanadium	150	(mg/kg)	NA	12.0J	12.7	10.3J	4.4J
Zinc	20	(mg/kg)	NA	**[43.2]**	**[60.5]**	**[215]**	**[86.9]**
Cyanide		(mg/kg)	0.0018	NA	NA	NA	NA

NOTE: **BOLD** values indicate exceedance of NYSDE

Table 6
Malone Former MGP Site
Soil Analyses - Inorganics Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SS-03 MALO-SS03 10/02/2003 / 15:38 0.5	SS-04 MALO-SS04 10/02/2003 / 16:05 0.5	SS-04 MALO-SS14 10/02/2003 / 16:10 0.5	SS-05 MALO-SS05 10/02/2003 / 16:50 0.5	SS-06 MALO-SS06 10/02/2003 / 17:05 0.5
Aluminum		(mg/kg)	3540	3190	2940	3540	2370
Antimony		(mg/kg)	1.1U	0.97U	0.94U	0.97U	1.6J
Arsenic	7.5	(mg/kg)	3	4.1	3.4	2.9	**[14.2]**
Barium	300	(mg/kg)	41.9J	47.9	49.2	70.9	96.9
Beryllium	0.16	(mg/kg)	**[0.18]J**	0.13J	0.13J	**[0.17]J**	**[0.16]J**
Cadmium	1	(mg/kg)	0.26J	0.23U	0.22U	0.26J	0.30U
Calcium		(mg/kg)	4940	3530	3470	5940	4440
Chromium	10	(mg/kg)	8.4	3.8	4.6	5.4	5.8
Cobalt	30	(mg/kg)	3.1J	2.4J	2.2J	2.8J	2.3J
Copper	25	(mg/kg)	10.3	7.5	8	16	**[26.5]**
Iron	2000	(mg/kg)	**[7540]**	**[5510]**	**[4870]**	**[6340]**	**[16800]**
Lead		(mg/kg)	39	51.6	64	120	219
Magnesium		(mg/kg)	2150	1760	1650	2220	943J
Manganese		(mg/kg)	271	284	288	234	142
Mercury	0.1	(mg/kg)	0.12U	0.12U	0.11U	**[0.27]**	**[1.0]**
Nickel	13	(mg/kg)	8.0J	4.4J	4.2J	5.4J	5.1J
Potassium		(mg/kg)	292J	223J	211J	312J	394J
Selenium	2	(mg/kg)	1.3	0.60U	0.58U	0.74J	**[3.4]**
Silver		(mg/kg)	0.43U	0.39U	0.38U	0.39U	0.51U
Sodium		(mg/kg)	50.9J	60.2J	42.9U	59.5J	57.0U
Thallium		(mg/kg)	1.5J	1.0U	0.99U	1.0U	1.3U
Vanadium	150	(mg/kg)	11.1J	6.5J	6.0J	8.5J	13.3J
Zinc	20	(mg/kg)	**[54.9]**	**[59.3]**	**[58.4]**	**[132]**	**[161]**
Cyanide		(mg/kg)	NA	NA	NA	NA	NA

NOTE: **BOLD** values indicate exceedance of NYSDE

Tabl

Malone Former MGP Site

Soil Analyses - Inorganics Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SS-07 MALO-SS07 10/02/2003 / 17:20 0.5	SS-08 MALO-SS08 10/02/2003 / 17:45 0.5	SS-09 MALO-SS09 10/03/2003 / 08:45 0.5	SS-10 MALO-SS10 10/03/2003 / 09:05 0.5	SS-11 MALO-SS11 10/03/2003 / 09:25 0.5
Aluminum		(mg/kg)	3900	2340	2200	4100	4100
Antimony		(mg/kg)	3.2J	3.2J	0.93U	1.1U	1.0U
Arsenic	7.5	(mg/kg)	**[15.2]**	**[9.2]**	1.6J	3.8	2.8
Barium	300	(mg/kg)	74.4	63.2J	18.5J	58.1	39.3J
Beryllium	0.16	(mg/kg)	**[0.23]J**	0.14J	0.14J	**[0.19]J**	**[0.19]J**
Cadmium	1	(mg/kg)	0.33U	0.44J	0.22U	0.26U	0.24U
Calcium		(mg/kg)	7520	5580	2380	4260	4410
Chromium	10	(mg/kg)	8.5	4.4	3.1	6.4	7
Cobalt	30	(mg/kg)	5.5J	2.4J	2.1J	3.3J	3.4J
Copper	25	(mg/kg)	**[34.1]**	**[50.6]**	6.1	13.7	10
Iron	2000	(mg/kg)	**[31400]**	**[11200]**	**[5020]**	**[8750]**	**[6820]**
Lead		(mg/kg)	161	121	29.9	104	41
Magnesium		(mg/kg)	2250	1090J	1220	1520	2100
Manganese		(mg/kg)	256	161	204	246	290
Mercury	0.1	(mg/kg)	**[0.24]**	0.16U	0.11U	0.12U	0.12U
Nickel	13	(mg/kg)	10.5J	4.6J	3.5J	6.0J	5.7J
Potassium		(mg/kg)	384J	460J	185J	280J	243J
Selenium	2	(mg/kg)	**[3.6]**	**[2.9]**	0.57U	0.67U	1.2J
Silver		(mg/kg)	2.2J	1.6J	0.38U	0.99J	0.41U
Sodium		(mg/kg)	139J	141J	91.2J	48.9U	139J
Thallium		(mg/kg)	1.4U	1.4U	0.97U	1.1U	1.1U
Vanadium	150	(mg/kg)	12.0J	11.8J	5.1J	10.6J	8.8J
Zinc	20	(mg/kg)	**[262]**	**[152]**	**[36.9]**	**[73.4]**	**[57.5]**
Cyanide		(mg/kg)	NA	NA	NA	NA	NA

NOTE: **BOLD** values indicate exceedance of NYSDE

Table 6
Malone Former MGP Site
Soil Analyses - Inorganics Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SS-12 MALO-SS12 10/03/2003 / 10:10 0.5	SS-13 MALO-SS13 10/03/2003 / 10:30 0.5
Aluminum		(mg/kg)	2840	3060
Antimony		(mg/kg)	0.98U	1.0U
Arsenic	7.5	(mg/kg)	2.9	4.3
Barium	300	(mg/kg)	37.9J	42.0J
Beryllium	0.16	(mg/kg)	**[0.16]J**	0.15J
Cadmium	1	(mg/kg)	0.62J	0.24U
Calcium		(mg/kg)	2790	3680
Chromium	10	(mg/kg)	4.4	6.7
Cobalt	30	(mg/kg)	2.9J	2.5J
Copper	25	(mg/kg)	8.2	12
Iron	2000	(mg/kg)	**[6160]**	**[4890]**
Lead		(mg/kg)	71.8	125
Magnesium		(mg/kg)	1220	1210J
Manganese		(mg/kg)	318	211
Mercury	0.1	(mg/kg)	0.12U	0.12U
Nickel	13	(mg/kg)	4.7J	3.9J
Potassium		(mg/kg)	241J	182J
Selenium	2	(mg/kg)	0.90J	1.3
Silver		(mg/kg)	0.40U	0.41U
Sodium		(mg/kg)	80.7J	79.5J
Thallium		(mg/kg)	1.0U	1.1U
Vanadium	150	(mg/kg)	8.6J	6.9J
Zinc	20	(mg/kg)	**[63.8]**	**[67.7]**
Cyanide		(mg/kg)	NA	NA

NOTE: **BOLD** values indicate exceedance of NYSDE

Table 7
Malone Former MGP Site
Soil Analyses - PCB Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time Depth (ft)	SB-2 MALO-SB02-46 07/24/2003 / 10:30 5	SB-2 MALO-SB02-57 07/24/2003 / 10:45 6	SB-2 MALO-SB02-1214 07/24/2003 / 11:15 13
Aroclor 1016		(ug/kg)	6.000U	6.000U	6.000U
Aroclor 1221		(ug/kg)	2.000U	2.000U	2.000U
Aroclor 1232		(ug/kg)	10.000U	10.000U	10.000U
Aroclor 1242		(ug/kg)	3.000U	3.000U	3.000U
Aroclor 1248		(ug/kg)	7.000U	7.000U	7.000U
Aroclor 1254		(ug/kg)	13.000U	13.000U	13.000U
Aroclor 1260		(ug/kg)	2.000U	2.000U	2.000U
Total PCBs	10,000		ND	ND	ND

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criterion

Table 8
Malone Former MGP Site
Soil Analyses - Total Organic Carbon Results

		Location	SB-1	SB-2	SB-3	SB-5	SB-7	SB-8	SS-01
	NYSDEC	Sample ID	MALO-SB01-0810	MALO-SB02-46	MALO-SB03-1416	MALO-SB06-1214	MALO-SB07-1618	MALO-SB08-02	MALO-SS01
Constituent	TAGM	Date/Time	07/22/2003 / 09:35	07/24/2003 / 10:30	07/22/2003 / 15:50	07/23/2003 / 09:28	07/21/2003 / 14:25	07/28/2003 / 12:45	10/02/2003 / 15:00
		Depth (feet)	9	5	15	13	17	1	0.5
TOC		(mg/kg)	4700	5700	2500	4100	4000	4500	4200

Tabl
Malone Former MGP Site
Soil Analyses - Total Organic Carbon Results

		Location	SS-02	SS-03	SS-04	SS-04	SS-05	SS-06	SS-07
	NYSDEC	Sample ID	MALO-SS02	MALO-SS03	MALO-SS04	MALO-SS14	MALO-SS05	MALO-SS06	MALO-SS07
Constituent	TAGM	Date/Time	10/02/2003 / 15:20	10/02/2003 / 15:38	10/02/2003 / 16:05	10/02/2003 / 16:10	10/02/2003 / 16:50	10/02/2003 / 17:05	10/02/2003 / 17:20
		Depth (feet)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
TOC		(mg/kg)	3100	3200	4700	4800	6700	7300	5300

Table 8
Malone Former MGP Site
Soil Analyses - Total Organic Carbon Results

		Location	SS-08	SS-09	SS-10	SS-11	SS-12	SS-13
	NYSDEC	Sample ID	MALO-SS08	MALO-SS09	MALO-SS10	MALO-SS11	MALO-SS12	MALO-SS13
Constituent	TAGM	Date/Time	10/02/2003 / 17:45	10/03/2003 / 08:45	10/03/2003 / 09:05	10/03/2003 / 09:25	10/03/2003 / 10:10	10/03/2003 / 10:30
		Depth (feet)	0.5	0.5	0.5	0.5	0.5	0.5
TOC		(mg/kg)	4100	2300	4200	3000	5200	4700

Table 9
Malone Former MGP Site
Groundwater Analyses - VOC Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time	MW-3 MW-3 08/29/2003 / 08:00	MW-4 MW-4 08/29/2003 / 09:15	MW-4 MW-4DL 08/29/2003 / 09:15	MW-4 (DUP) MW-5 08/29/2003 / 10:30
Dichlorodifluoromethane		(ug/l)	0.50U	0.50U	2.5U	0.50U
Methyl chloride		(ug/l)	0.50U	0.50U	2.5U	0.50U
Vinyl chloride	2	(ug/l)	0.50U	0.50U	2.5U	0.50U
Methyl bromide		(ug/l)	0.50U	0.50U	2.5U	0.50U
Chloroethane	50	(ug/l)	0.50U	0.50U	2.5U	0.50U
Trichlorofluoromethane		(ug/l)	0.50U	0.50U	2.5U	0.50U
1,1-Dichloroethylene	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
Freon 113	5	(ug/l)	0.50U			
Acetone	50	(ug/l)	0.50U	0.50U	2.5U	0.50U
Carbon disulfide	50	(ug/l)	0.50U	0.50U	2.5U	0.50U
Methyl Acetate		(ug/l)	0.50UJ	0.50UJ	2.5UJ	0.50UJ
Methylene chloride	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
Ethene, 1,2-dichloro-, (E)-	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
Methyl tert-butyl ether		(ug/l)	6.8J	310E	270D	320E
1,1-Dichloroethane	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
cis-1,2-Dichloroethylene		(ug/l)	0.50U	0.50U	2.5U	0.50U
Methyl ethyl ketone	50	(ug/l)	0.50U	0.50U	2.5U	0.50U
Chloroform	7	(ug/l)	0.50U	0.50U	2.5U	0.50U
1,1,1-trichloroethane	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
Cyclohexane		(ug/l)	2.7J	0.50U	2.5U	0.50U
Carbon tetrachloride	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
Benzene	0.7	(ug/l)	**[73]J**	**[4.3]J**	2.5U	**[2.9]J**
1,2-Dichloroethane	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
Trichloroethene	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
Methylcyclohexane		(ug/l)	1.4J	0.50U	2.5U	0.50U
1,2-Dichloropropane		(ug/l)	0.50U	0.50U	2.5U	0.50U
Bromodichloromethane		(ug/l)	0.50U	0.50U	2.5U	0.50U
cis-1,3-Dichloropropene		(ug/l)	0.50U	0.50U	2.5U	0.50U
Methyl isobutyl ketone (MIBK)	50	(ug/l)	0.50U	0.50U	2.5U	0.50U
Toluene	5	(ug/l)	**[120]J**	**[15]**	**[12]J**	**[11]**
Trans-1,3-Dichloropropene		(ug/l)	0.50U	0.50U	2.5U	0.50U
1,1,2-Trichloroethane		(ug/l)	0.50U	0.50U	2.5U	0.50U
Tetrachloroethylene	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
2-Hexanone		(ug/l)	0.50U	0.50U	2.5U	0.50U
Dibromochloromethane	50	(ug/l)	0.50U	0.50U	2.5U	0.50U
EDB		(ug/l)	0.50U	0.50U	2.5U	0.50U
Chlorobenzene	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
Ethylbenzene	5	(ug/l)	**[17]**	**[5.5]J**	4.8J	4.8J
Styrene		(ug/l)	13	1.6J	2.5U	1.4J
Bromoform		(ug/l)	0.50U	0.50U	2.5U	0.50U
Benzene, 1-methylethyl-		(ug/l)	1.5J	0.50U	2.5U	0.50U
1,1,2,2-Tetrachloroethane	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
m-Dichlorobenzene	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
p-Dichlorobenzene	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
o-Dichlorobenzene	4.7	(ug/l)	0.50U	0.50U	2.5U	0.50U
DBCP		(ug/l)	0.50U	0.50U	2.5U	0.50U
1,2,4-Trichlorobenzene	5	(ug/l)	0.50U	0.50U	2.5U	0.50U
m/p-xylene		(ug/l)	180	23	20J	21
o-Xylene		(ug/l)	94	10J	20J	9.0J
4-Bromofluorobenzene		(ug/l)	1.9UJ	2.0U		1.9U

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criterion

Table 9
Malone Former MGP Site
Groundwater Analyses - VOC Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time	MW-4(DUP) MW-5DL 08/29/2003 / 10:30	SEEP SEEP-1 08/29/2003 / 10:00
Dichlorodifluoromethane		(ug/l)	2.5U	0.50U
Methyl chloride		(ug/l)	2.5U	0.50U
Vinyl chloride	2	(ug/l)	2.5U	0.50U
Methyl bromide		(ug/l)	2.5U	0.50U
Chloroethane	50	(ug/l)	2.5U	0.50U
Trichlorofluoromethane		(ug/l)	2.5U	0.50U
1,1-Dichloroethylene	5	(ug/l)	2.5U	0.50U
Freon 113	5	(ug/l)		
Acetone	50	(ug/l)	2.5U	0.50U
Carbon disulfide	50	(ug/l)	2.5U	0.50U
Methyl Acetate		(ug/l)	2.5UJ	0.50UJ
Methylene chloride	5	(ug/l)	**[17]J**	0.50U
Ethene, 1,2-dichloro-, (E)-	5	(ug/l)	2.5U	0.50U
Methyl tert-butyl ether		(ug/l)	310D	0.50U
1,1-Dichloroethane	5	(ug/l)	2.5U	0.50U
cis-1,2-Dichloroethylene		(ug/l)	2.5U	0.50U
Methyl ethyl ketone	50	(ug/l)	2.5U	0.50U
Chloroform	7	(ug/l)	2.5U	0.50U
1,1,1-trichloroethane	5	(ug/l)	2.5U	0.50U
Cyclohexane		(ug/l)	2.5U	0.50U
Carbon tetrachloride	5	(ug/l)	2.5U	0.50U
Benzene	0.7	(ug/l)	2.5U	0.50U
1,2-Dichloroethane	5	(ug/l)	2.5U	0.50U
Trichloroethene	5	(ug/l)	2.5U	0.50U
Methylcyclohexane		(ug/l)	2.5U	0.50U
1,2-Dichloropropane		(ug/l)	2.5U	0.50U
Bromodichloromethane		(ug/l)	2.5U	0.50U
cis-1,3-Dichloropropene		(ug/l)	2.5U	0.50U
Methyl isobutyl ketone (MIBK)	50	(ug/l)	2.5U	0.50U
Toluene	5	(ug/l)	**[9.0]J**	0.50U
Trans-1,3-Dichloropropene		(ug/l)	2.5U	0.50U
1,1,2-Trichloroethane		(ug/l)	2.5U	0.50U
Tetrachloroethylene	5	(ug/l)	2.5U	0.50U
2-Hexanone		(ug/l)	2.5U	0.50U
Dibromochloromethane	50	(ug/l)	2.5U	0.50U
EDB		(ug/l)	2.5U	0.50U
Chlorobenzene	5	(ug/l)	2.5U	0.50U
Ethylbenzene	5	(ug/l)	3.8J	0.50U
Styrene		(ug/l)	2.5U	0.50U
Bromoform		(ug/l)	2.5U	0.50U
Benzene, 1-methylethyl-		(ug/l)	2.5U	0.50U
1,1,2,2-Tetrachloroethane	5	(ug/l)	2.5U	0.50U
m-Dichlorobenzene	5	(ug/l)	2.5U	0.50U
p-Dichlorobenzene	5	(ug/l)	2.5U	0.50U
o-Dichlorobenzene	4.7	(ug/l)	2.5U	0.50U
DBCP		(ug/l)	2.5U	0.50U
1,2,4-Trichlorobenzene	5	(ug/l)	2.5U	0.50U
m/p-xylene		(ug/l)	16J	0.50U
o-Xylene		(ug/l)	16J	0.50U
4-Bromofluorobenzene		(ug/l)		1.9U

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM

Table 10
Malone Former MGP Site
Groundwater Analyses - SVOC Results

Constituent	NYSDEC TAGM	Location	MW-3	MW-3	MW-4	MW-4	SEEP
		Sample ID	MW-3	MW-3DL	MW-4	MW-5	SEEP-1
		Date/Time	08/29/2003 / 08:00	08/29/2003 / 08:00	08/29/2003 / 09:15	08/29/2003 / 10:30	08/29/2003 / 10:00
Benzaldehyde		(ug/l)	0.660UJ	3.3UJ	0.670U	0.660U	0.660U
Phenol	1	(ug/l)	3.2UJ	16UJ	3.2UJ	3.2UJ	3.1U
Bis(2-chloroethyl)ether		(ug/l)	1.5UJ	7.7UJ	1.5U	1.5U	1.5U
2-Chlorophenol	50	(ug/l)	3.7UJ	18UJ	3.7UJ	3.7UJ	3.6U
o-Cresol	5	(ug/l)	**[5.0]J**	15UJ	3.1UJ	3.1UJ	3.0U
2,2-oxybis(1-Chloropropane)		(ug/l)	1.600UJ	8.200UJ	1.600U	1.600U	1.600U
Acetophenone		(ug/l)	1.3J	3.3UJ	1.7J	0.660U	0.660U
p-Cresol	50	(ug/l)	10J	15UJ	3.1U	3.1UJ	3.0U
N-Nitroso-di-n-propylamine		(ug/l)	1.4UJ	7.1UJ	1.4U	1.4U	1.4U
Hexachloroethane		(ug/l)	1.9UJ	9.7UJ	2.0U	1.9U	1.9U
Nitrobenzene	5	(ug/l)	1.6UJ	8.2UJ	1.6UJ	1.6U	1.6UJ
Isophorone	50	(ug/l)	1.2UJ	6.1UJ	1.2U	1.2U	1.2U
o-Nitrophenol	5	(ug/l)	3.1UJ	15UJ	3.1UJ	3.1UJ	3.0U
2,4-Dimethylphenol		(ug/l)	21J	15J	3.4J	2.2UJ	2.2U
Bis(2-chloroethoxy)methane		(ug/l)	1.3UJ	6.6UJ	1.3U	1.3U	1.3U
2,4-Dichlorophenol	1	(ug/l)	2.7UJ	13UJ	2.7UJ	2.7UJ	2.6U
Naphthalene	10	(ug/l)	**[140]J**	**[94]J**	1.9U	1.8U	1.8U
p-Chloroaniline	5	(ug/l)	0.660UJ	3.3UJ	0.670U	0.660U	0.660U
Hexachlorobutadiene		(ug/l)	0.660UJ	3.3UJ	0.670U	0.660U	0.660U
Caprolactam		(ug/l)	0.660UJ	3.3UJ	0.670U	0.660U	0.660U
p-Chloro-m-cresol	5	(ug/l)	1.7UJ	8.7UJ	1.8UJ	1.7UJ	1.7U
2-Methylnaphthalene	50	(ug/l)	29J	22J	1.4UJ	1.4UJ	1.4UJ
Hexachlorocyclopentadiene		(ug/l)	1.5UJ	7.7UJ	1.5UJ	1.5U	1.5UJ
2,4,6-Trichlorophenol		(ug/l)	2.1UJ	11UJ	2.2UJ	2.1UJ	2.1U
2,4,5-Trichlorophenol	1	(ug/l)	2.4UJ	12UJ	2.5UJ	2.4UJ	2.4U
1,1'Biphenyl		(ug/l)	0.660UJ	3.3UJ	0.670U	0.660U	0.660U
2-Chloronaphthalene		(ug/l)	1.8UJ	9.2UJ	1.9U	1.8U	1.8U
o-Nitroaniline	5	(ug/l)	1.2UJ	6.1UJ	1.2U	1.2U	1.2U
Dimethylphthalate	50	(ug/l)	6.1UJ	31UJ	6.2U	6.1U	6.1U
2,6-Dinitrotoluene	5	(ug/l)	1.0UJ	5.1UJ	1.0U	1.0U	1.0U
Acenaphthylene	20	(ug/l)	19J	15J	2.3J	1.1U	1.1U
m-Nitroaniline	5	(ug/l)	1.5UJ	7.7UJ	1.5U	1.5U	1.5U
Acenaphthene	20	(ug/l)	4.1J	5.6UJ	1.1U	1.1U	1.1U
2,4-Dinitrophenol	5	(ug/l)	3.4UJ	17UJ	3.4UJ	3.4UJ	3.3U
p-Nitrophenol	5	(ug/l)	3.6UJ	18UJ	3.6UJ	3.6UJ	3.5U
Dibenzofuran	5	(ug/l)	**[14]J**	**[11]J**	2.8J	1.0U	1.0U
2,4-Dinitrotoluene		(ug/l)	1.0UJ	5.1UJ	1.0U	1.0U	1.0U
Diethylphthalate	50	(ug/l)	8.2UJ	41UJ	8.2U	8.2U	8.1U
Fluorene	50	(ug/l)	18J	12J	1.9J	1.1U	1.1U
4-chlorophenyl-phenylether		(ug/l)	1.0UJ	5.1UJ	1.0U	1.0U	1.0U
p-Nitroaniline		(ug/l)	1.3UJ	6.6UJ	1.3U	1.3U	1.3U
4,6-Dinitro-o-cresol		(ug/l)	3.1UJ	15UJ	3.1UJ	3.1UJ	3.0U
N-Nitrosodiphenylamine (1)		(ug/l)	1.4UJ	7.1UJ	1.4U	1.4U	1.4U
Hexachlorobenzene	0.35	(ug/l)	1.9UJ	9.7UJ	2.0U	1.9U	1.9U
Atrazine		(ug/l)	0.660UJ	3.3UJ	0.670U	0.660U	0.660U
Pentachlorophenol	1	(ug/l)	2.7UJ	13UJ	2.7UJ	2.7UJ	2.6U
Phenanthrene	50	(ug/l)	14J	8.6J	5.7J	2.8J	0.860U
Anthracene	50	(ug/l)	3.9J	4.7UJ	4.3J	2.4J	0.930U
Carbazole		(ug/l)	15J	11J	0.860U	0.850U	0.840U
Di-n-butyl-phthalate	50	(ug/l)	7.7UJ	38UJ	7.7U	7.7U	7.6U
Fluoranthene	50	(ug/l)	1.9J	4.8UJ	8.1J	3.4J	0.960U
Pyrene	50	(ug/l)	2.7UJ	13UJ	7.6J	3.4J	2.6U
Butylbenzylphthalate	50	(ug/l)	0.380UJ	1.9UJ	0.380U	0.380U	0.370U
3,3-Dichlorobenzidine		(ug/l)	4.3UJ	21UJ	4.3U	4.3U	4.2U
Benzo(a)anthracene	0.002	(ug/l)	1.2UJ	6.1UJ	**[4.6]J**	**[2.3]J**	1.2U
Chrysene	0.002	(ug/l)	1.2UJ	6.1UJ	**[4.2]J**	**[2.2]J**	1.2U
Bis(2-ethylhexyl)phthalate	50	(ug/l)	2.3UJ	12UJ	2.4U	2.3U	2.3U
Di-n-octylphthalate	50	(ug/l)	2.0UJ	10UJ	2.1U	2.0U	2.0U
Benzo(b)fluoranthene	0.002	(ug/l)	1.5UJ	7.7UJ	**[3.3]J**	1.5U	1.5U
Benzo(k)fluoranthene	0.002	(ug/l)	1.6UJ	8.2UJ	1.6U	1.6U	1.6U
Benzo(a)pyrene	0.002	(ug/l)	1.0UJ	5.1UJ	**[3.4]J**	**[1.6]J**	1.0U
Indeno(1,2,3-cd)pyrene	0.002	(ug/l)	0.890UJ	4.4UJ	**[1.5]J**	0.890U	0.880U
Dibenzo(a,h)anthracene	50	(ug/l)	1.3UJ	6.6UJ	1.3U	1.3U	1.3U
Benzo(g,h,i)perylene	5	(ug/l)	0.660UJ	3.3UJ	1.5J	0.660U	0.660U

NOTE: **BOLD** values indicate exceedance of NYSDEC TAGM criterion

Table 11
Malone Former MGP Site
Groundwater Analyses - Inorganic Results

Constituent	NYSDEC TAGM	Location Sample ID Date/Time	MW-3 MW-3 08/29/2003 / 08:00	MW-4 MW-4 08/29/2003 / 09:15	MW-4 MW-6 08/29/2003 / 10:30	SEEP SEEP-1 08/29/2003 / 10:00
Aluminum	NE	(ug/l)	51.8J	141J	105J	13.7J
Antimony	NE	(ug/l)	4.7U	4.7U	4.7U	4.7U
Arsenic	NE	(ug/l)	2.8U	2.8U	2.8U	2.8U
Barium	NE	(ug/l)	128J	129J	133J	170J
Beryllium	NE	(ug/l)	0.10U	0.10U	0.10U	0.10U
Cadmium	NE	(ug/l)	0.40U	0.40U	0.40U	0.40U
Calcium	NE	(ug/l)	142000	127000	131000	158000
Chromium	NE	(ug/l)	0.60U	0.60U	0.60U	0.60U
Cobalt	NE	(ug/l)	4.5J	0.81J	1.8J	0.81J
Copper	NE	(ug/l)	3.0J	6.6J	5.1J	2.6J
Iron	NE	(ug/l)	1610	179	161	17.3U
Lead	NE	(ug/l)	2.1U	2.1U	2.1U	2.1U
Magnesium	NE	(ug/l)	30400	28000	29000	32400
Manganese	NE	(ug/l)	503	204	207	8.1J
Mercury	NE	(ug/l)	0.20U	0.20U	0.20U	0.20U
Nickel	NE	(ug/l)	3.1J	2.6J	1.8U	1.8U
Potassium	NE	(ug/l)	7410EJ	9100EJ	9480EJ	10300EJ
Selenium	NE	(ug/l)	3.6J	3.0U	3.7J	3.3J
Silver	NE	(ug/l)	1.0NUJ	1.1NJ	1.2NJ	1.0NUJ
Sodium	NE	(ug/l)	152000EJ	134000EJ	139000EJ	168000EJ
Thallium	NE	(ug/l)	5.4U	5.4U	5.4U	5.4U
Vanadium	NE	(ug/l)	0.70U	0.70U	0.85J	0.70U
Zinc	NE	(ug/l)	26.9	28.2	22.6	23.6

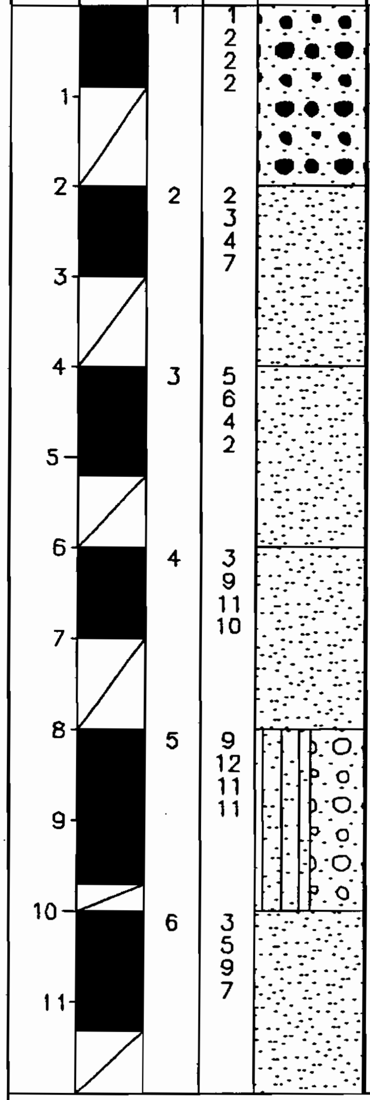
NE = TAGM not established

ATTACHMENT 1
GEOLOGIC LOGS

TRC
5 Waterside Crossing
Windsor, CT 06095
(860) 298-9692
FAX (860) 298-6399

Site Id: SB-1
Date(s): 07/22/03 - 07/22/03

Project Name: Malone	Total Depth: 22.00'
Project Number:	Borehole Dia.: 6.25in
Location:	Screens: type: size: dia: fm: to:
Logged By: S. Fischer	Blank Casing: type: dia: 0.00in fm: 0.0' to: 22.00'
Contractor: Lyon Drilling	
Drilling Method: Hollow Stem Auger	Annular Fill: type: Grout fm: 0.00' to: 22.00' type: fm: to: type: fm: to:
Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector	Measuring Point: 0.00'
Ground Elevation: 704.00'	Static Water Level:



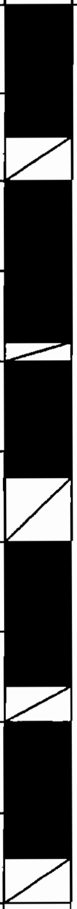
Depth (ft)	Sample No.	Blow Count	Material Description	Field Screening (ppm)	Well Construction
0	1	1 2 2 2	Brown, F-C SAND & find GRAVEL, some SILT, traces clay, roots, organics. No stains, no odor, slightly moist. (Fill/GP)	0 ppm	
2	2	2 3 4 7	Tan, fine SAND, trace fine round GRAVEL, orange fine SAND seam 2.3'-2.4', no stain or odor, slightly moist. (Fill/SP)	0 ppm	
4	3	5 6 4 2	Medium brown fine SAND, trace SILT & f-m round GRAVEL, no stain or odor, slightly moist. Red brown SAND as above 4.9'-5.2' Sample MALO-SB01-46 collected.	0 ppm	
6	4	3 9 11 10	Dark brown, 6'-6.3', silty fine SAND, trace f-m and GRAVEL & organics 6.3'-6.9'. Tan/orange fine sand, no stains, no odors, slightly moist. (Fill/SP)	0 ppm	
8	5	9 12 11 11	Dark brown silty fine sand, trace brick & f-c round GRAVEL from 8'-8.5. 8.5-9.7, tan/orange fine SAND & f-m round GRAVEL, trace SILT, no stain, no odor, moist (Fill/SM). Sample MALO-SB01-0810 collected.	0 ppm	
10	6	3 5 9 7	Tan fine SAND 10'-11' (Fill/SP), trace SILT, no stain, no odor. Light brown f-c SAND & f-m round GRAVEL, 11'-11.3', trace SILT, no stain, no odor.	0 ppm	

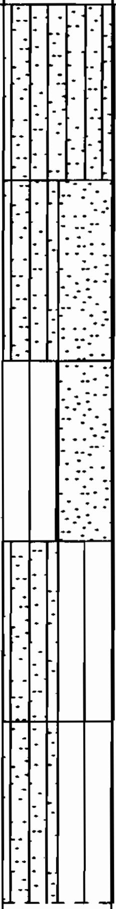
TRC

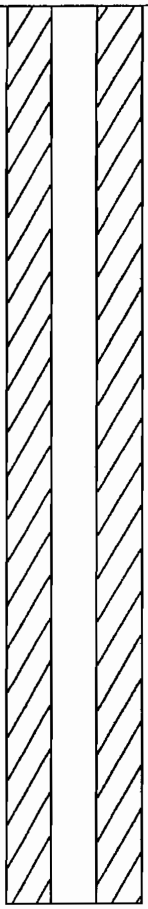
5 Waterside Crossing
Windsor, CT 06095
(860) 298-9692
FAX (860) 298-6399

Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector

Site Id: SB-1	
Date(s): 07/22/03 - 07/22/03	
Total Depth: 22.00'	
Project Name: Malone	
Location:	
Logged By: S. Fischer	







Depth (ft)	Sample No.	Blow Count	Material Description	Field Screening (ppm)
13	7	3 4 4 7	Light brown fine SAND, trace SILT, no stain, no odors, moist (SM)	0 ppm
14	8	2 5 5 4	Medium brown silty SAND, 14'-14.3', trace f-m round GRAVEL, no stain, no odors, moist-wet. Medium brown very fine SAND & SILT, 14.3'-14.5'. Medium brown silty SAND (VF), 14.5'-14.9'. Tan fine SAND, 14.9'-15.3'. Medium brown SILT & VF SAND & Wet, 15.3'-15.8'. (SM/SP) Sample MALO-SB01-1416 collected.	0 ppm
16	9	1 2 2 3	Medium brown SILT, 16'-16.4', some clay, trace VF SAND, horizontal orange parting @ 16.35'. Medium brown, 16.4'-16.7', VF-F SAND, trace SILT. Medium brown SILT, 16.7'-17', trace VF SAND. Tan, fine SAND, 17'-17.3', no stains, no odors, moist-wet. (ML/SP)	0 ppm
18	10	2 2 4 8	Medium brown alternating seams (2"-3") of silty fine SAND & Clayey SILT, horizonal orange partings in SILT. Tan fine SAND seam 18.8'-18.9', no stains, no odors, moist-wet. (SM/ML) Sample MALO-SB01-1820 collected.	0 ppm
20	11	8 11 11 11	Light brown fine SAND, 20'-20.6', trace SILT. Medium brown SILT, 20.6'-21.5', some clay, trace VF SAND. Tan fine SAND seam @ 21', no stains, no odors, moist-wet. (SM/ML)	0 ppm
22			No spoon advance beyond 22', no water in boring.	
23			End of Boring.	
24				
25				
26				

TRC 5 Waterside Crossing
Windsor, CT 06095
(860) 298-9692
FAX (860) 298-6399

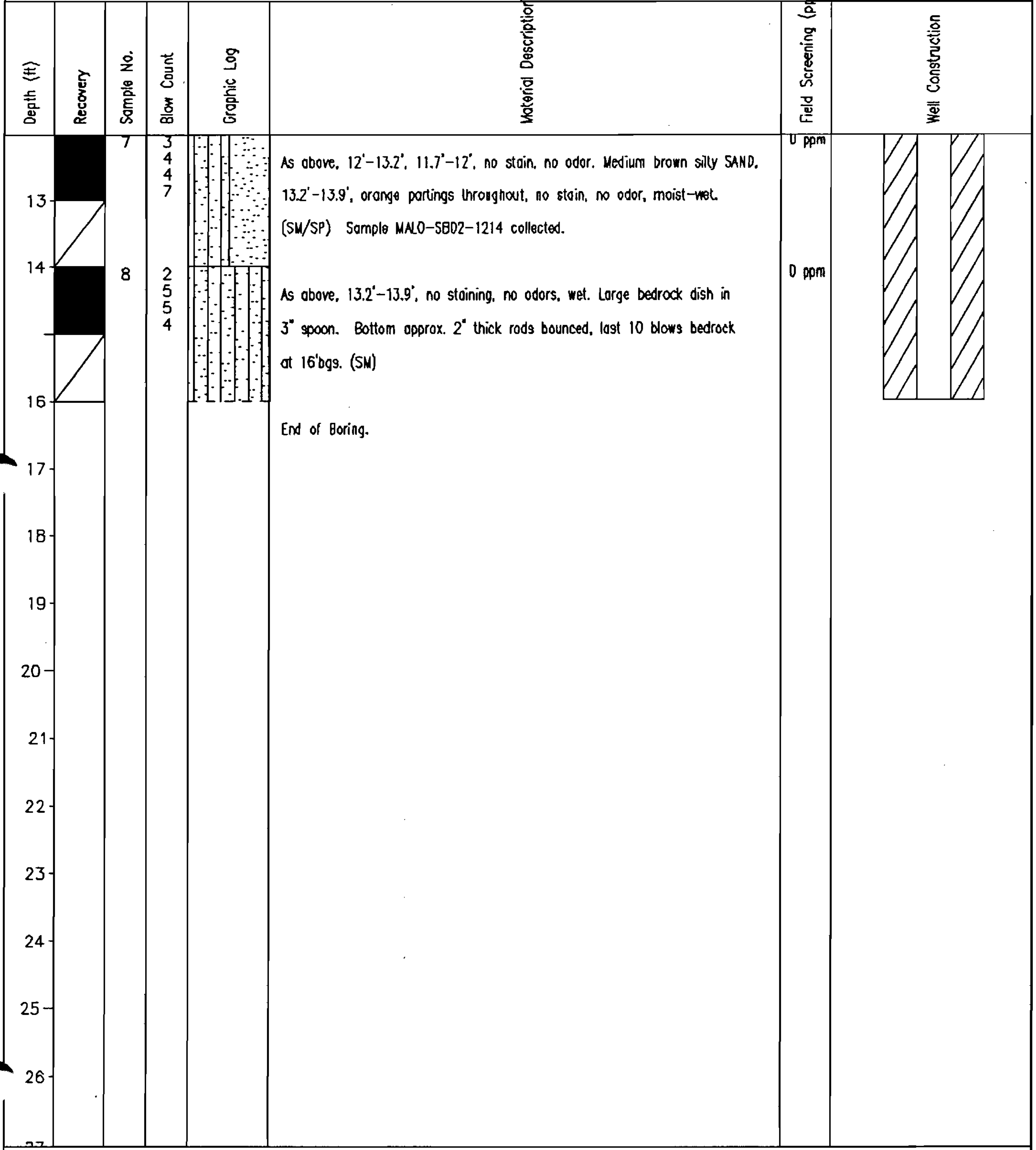
Project Name: Malone	Site Id: SB-2
Project Number:	Date(s): 07/24/03 - 07/24/03
Location:	Total Depth: 16.00'
Logged By: S. Fischer	Borehole Dia.: 6.25in
Contractor: Lyon Drilling	Screens: type: size: dia: fm: to:
Drilling Method: Hollow Stem Auger	Blank Casing: type: dia: 0.00in fm: 0.0' to: 16.00'
Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector	Annular Fill: type: Grout fm: 0.00' to: 16.00' type: fm: to: type: fm: to:
	Measuring Point: 0.00'
Ground Elevation: 687.40'	Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
1		1	1 1 2 3		Dark brown, silty SAND(fine), trace fine round GRAVEL, roots & organics, trace weathered hard CT, ash & cinders. No stain, no odor, Slightly moist. (Fill/SM)	0.4 ppm	
2 3		2	3 30 10 10		As above, trace m-c round GRAVEL, trace ash & cinders, some black staining, no odors, Slightly moist. (Fill/SM)	0.7 ppm	
4 5		3	4 3 1 1		Brown, f-c SAND, trace SILT & f-m round GRAVEL, single 3" cobble, brick fragments, porcelain fragments. No stain, no odor, Slightly moist. (Fill/SW) Sample MALO-SB02-46 and MALO-SB02-57 collected.	0 ppm	
6 7		4	4 3 3 4		Tan, fine SAND, trace SILY, 1/8", orange partings @ 6.4', no stain, no odor, moist. (SP)	0 ppm	
8 9		5	4 7 2 7		Dark brown fine SAND 8'-8.3', some SILT, trace organics 8.3'-8.8', tan Fine SAND w/intermittent orange partings -1/32", Light brown SILT & SAND 8.8'-9.6', trace clay, no stain, no odor, moist. (SW/SM) Sample MALO-SB02-0810 collected.	0 ppm	
10 11		6	4 3 9 20		Light brown silty SAND 10'-11.7', trace clay, Dark brown SILT partings 10'-10.5', orange partings throughout (horizontal), Tan fine SAND 11.7'-12', no stain, no odor, moist-wet. (SM/SP)	0 ppm	

TRC
5 Waterside Crossing
Windsor, CT 06095
(860) 298-9692
FAX (860) 298-6399

Site Id: SB-2	
Date(s): 07/24/03 - 07/24/03	
Total Depth: 16.00'	
Project Name: Malone	
Location:	
Logged By: S. Fischer	

Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector



Depth (ft)	Sample No.	Blow Count	Material Description	Field Screening (ppm)
12–14	7	3 4 4 7	As above, 12'-13.2', 11.7'-12', no stain, no odor. Medium brown silty SAND, 13.2'-13.9', orange partings throughout, no stain, no odor, moist-wet. (SM/SP) Sample MALO-SB02-1214 collected.	0 ppm
14–16	8	2 5 5 4	As above, 13.2'-13.9', no staining, no odors, wet. Large bedrock dish in 3" spoon. Bottom approx. 2" thick rods bounced, last 10 blows bedrock at 16'bgs. (SM)	0 ppm
			End of Boring.	

TRC 5 Waterside Crossing
Windsor, CT 06095
(860) 298-9692
FAX (860) 298-6399

Project Name: Malone	Site Id: SB-3
Project Number:	Date(s): 07/22/03 - 07/22/03
Location:	Total Depth: 22.00'
Logged By: S. Fischer	Borehole Dia.: 6.25in
Contractor: Lyon Drilling	Screens: type: size: dia: fm: to:
Drilling Method: Hollow Stem Auger	Blank Casing: type: dia: 0.00in fm: 0.0' to: 22.00'
Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector	Annular Fill: type: Grout fm: 0.00' to: 22.00' type: fm: to: type: fm: to:
	Measuring Point: 0.00'
Ground Elevation: 694.50'	Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
1		1	1 1 4 5		Dark brown silty SAND 0-0.5', roots, trace organics & f-m round GRAVEL. Tan fine SAND 0.5'-1', trace SILT & coarse round GRAVEL, coal frags, cinders, large bleb of coal tar @ 0.9', strong odor, slightly moist. (Fill/SM)	7.5 ppm	
2 3		2	2 2 4 3		Light brown f-m SAND & SILT, trace f-m and GRAVEL, some ash, cinders, Coal fragments, coal tar 2'-2.1'. Strong coal tar odor, slightly moist. (Fill/SM) Sample MALO-SB03-0810 collected.	18 ppm	
4 5		3	2 3 3 4		Dark brown SILT & f-m SAND 4'-4.6', trace coarse SAND, cinders, ash, coal fragments, tan fine SAND 4.6'-5.6', coal tar odor, slightly moist. (Fill/SP)	7.2 ppm	
6 7		4	5 4 5 3		Light brown fine SAND, trace fine round GRAVEL, no stain, slight coal tar Odor, slightly moist. (Fill/SP)	1 ppm	
8 9		5	5 7 9 4		Tan/orange fine SAND, some black staining, slight coal tar odors, slightly moist. (Fill/SP) Sample MALO-SB03-0810 collected.	1 ppm	
10 11		6	3 5 5 4		Orange brown fine SAND, trace SILT, trace black staining, no odor, slightly moist. (Fill/SP)	0.4 ppm	

TRC

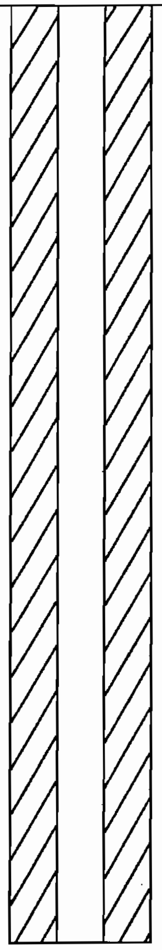
5 Waterside Crossing
Windsor, CT 06095
(860) 298-9692
FAX (860) 298-6399

Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector

Site Id: SB-3
Date(s): 07/22/03 – 07/22/03
Total Depth: 22.00'
Project Name: Malone
Location:
Logged By: S. Fischer

Depth (ft)	Sample No.	Blow Count	Material Description	Field Screening (ppm)
13	7	12 10 15 10	Light brown fine SAND, trace SILT m-c SAND & fine round GRAVEL, trace angular bedrock fragments in spoon shoe. No stains, no odor, slightly moist. (SP)	0.4 ppm
14	8	10 12 14 16	Tan fine SAND 14'-14.8', trace SILT, no stain, no odor. Orange/brown silty fine SAND 14.8'-15.4', some orange staining, no odor, slightly moist. (SP) Sample MALO-SB03-1416 collected.	0.3 ppm
16	9	50 R/5" 1 1	16'-16.4': Medium brown fine SAND, trace SILT, no stain, no odor, moist. (SP)	0.2 ppm
17			17'-19': Medium brown silty fine SAND, 1/32" (3) VF SAND (tan) horizontal stringers between 17.6'-17.8'. Tan fine SAND from 17.9'-18.3', trace-some SILT, no stain, no odor, moist. (SM)	0 ppm
18	10	3 5 3 19		
19			19'-21': Tan to light brown fine SAND, trace SILT, no stain, no odor, moist. (SP) Sample MALO-SB03-1921 collected.	0 ppm
20	11	30 12 50 R/4"		
21			21'-21.3': Tan fine SAND, trace SILT, no stain, no odor, moist. Trace weathered bedrock fragments.	0 ppm
22				
23			Augers grind without advance at 21.1' for approx. 10 mins. Drive Additional spoon to 21.4'. Rock floor and bedrock fragments.	
24			Top of rock at 21.4'.	
25			End of Boring.	
26				

Well Construction



TRC 5 Waterside Crossing Windsor, CT 06095 (860) 298-9692 FAX (860) 298-6399	Site Id: SB-4 Date(s): 07/28/03 - 07/28/03
Project Name: Malone	Total Depth: 8.00'
Project Number:	Borehole Dia.: 6.25in
Location:	Screens: type: size: dia: fm: to:
Logged By: S. Fischer	Blank Casing:
Contractor: Lyon Drilling	type: dia: 0.00in fm: 0.0' to: 8.00'
Drilling Method: Hollow Stem Auger	Annular Fill: type: Grout fm: 0.00' to: 8.00' type: fm: to: type: fm: to:
Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector	Measuring Point: 0.00'
Ground Elevation: 649.70'	Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
0–2		1	1 1 1 2		Dark brown silty fine SAND 0-0.2', trace m-c SAND & organics. Orange/brown silty SAND, trace f-c SAND & f-c round GRAVEL 0.2'-0.5', no staining, no odors, wet. (SP)	0 ppm	
2–4		2	2 1 1 5		Orange/brown silty fine SAND, trace m-c SAND & f-c round GRAVEL, trace organics, no stain, no odor, wet. (SM) Sample MALO-SB04-24 collected.	0 ppm	
4–6		3	WOR 1 1 2		As above, no stains, no odors, saturated (SM)	0 ppm	
6–8		4	2 4 6 7		As above to 6.5', grades to brown material as above stained black, MCP waste Odors, saturated (SM) Sample MALO-SB04-68 collected.	2 ppm	
8					Brown silty SAND, black staining strong coal tar odor, 2" seam of possibly mobile tar w/sheen, saturated. [SM)	85 ppm	
					End of Boring.		

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

TRC

5 Waterside Crossing
Windsor, CT 06095
(860) 298-9692
FAX (860) 298-6399

Site Id: SB-3
Date(s): 07/22/03 - 07/22/03
Total Depth: 22.00'
Project Name: Malone
Location:
Logged By: S. Fischer

Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
13		7	12 10 15 10		Light brown fine SAND, trace SILT m-c SAND & fine round GRAVEL, trace angular bedrock fragments in spoon shoe. No stains, no odor, slightly moist. (SP)	0.4 ppm	
14		8	10 12 14 16		Tan fine SAND 14'-14.8', trace SILT, no stain, no odor. Orange/brown silty fine SAND 14.8'-15.4', some orange staining, no odor, slightly moist. (SP) Sample MALO-SB03-1416 collected.	0.3 ppm	
16		9	50 R/5" 1 1		16'-16.4': Medium brown fine SAND, trace SILT, no stain, no odor, moist. (SP)	0.2 ppm	
17					17'-19': Medium brown silty fine SAND, 1/32" (3) VF SAND (tan) horizontal stringers between 17.6'-17.8'. Tan fine SAND from 17.9'-18.3', trace-some SILT, no stain, no odor, moist. (SM)	0 ppm	
18		10	3 5 3 19				
19					19'-21': Tan to light brown fine SAND, trace SILT, no stain, no odor, moist. (SP) Sample MALO-SB03-1921 collected.	0 ppm	
20		11	30 12 50 R/4"				
21					21'-21.3': Tan fine SAND, trace SILT, no stain, no odor, moist. Trace weathered bedrock fragments.	0 ppm	
22							
23					Augers grind without advance at 21.1' for approx. 10 mins. Drive Additional spoon to 21.4'. Rock floor and bedrock fragments. Top of rock at 21.4'.		
24							
25					End of Boring.		
26							

TRC

5 Waterside Crossing
Windsor, CT 06095
(860) 298-9692
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Site Id: SB-5

Date(s): 07/23/03 - 07/23/03

Project Name: Malone

Total Depth: 20.00'

Project Number:

Borehole Dia.: 6.25in

Location:

Screens:
type: size: dia: fm: to:

Logged By: S. Fischer

Blank Casing:
type: dia: 0.00in fm: 0.0' to: 20.00'

Contractor: Lyon Drilling

Drilling Method: Hollow Stem Auger

Annular Fill:
type: Grout fm: 0.00' to: 20.00'
type: fm: to:
type: fm: to:

Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector

Measuring Point: 0.00'

Ground Elevation: 694.50'

Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
1		1	2 4 4 3		Dark brown silty SAND 0-0.25', trace roots & organics. Tan f-c SAND & fine round GRAVEL, trace SILT, no staining, no odor, slightly moist. (Fill/SW)	0.1 ppm	
2 3		2			As above, no staining, no odor.	0.1 ppm	
4 5		3	3 3 4 4		Tan/orange f-c SAND, trace f-c round GRAVEL to 1.5" dia, trace SILT, no staining, no odor. (Fill/SW) Sample MALO-SB05-46 collected.	0.1 ppm	
6 7		4	4 2 2 1		As above. Light brown.	0.1 ppm	
8 9		5	3 2 1		Medium brown fine silty SAND, grades to f-c SAND & f-c round GRAVEL, trace SILT, no stains. Slight MGP residual odor, wet. (Fill-SP/SW)	0.1 ppm	
10 11		6	1 WOR 1 WOR		Gray, f-c round GRAVEL & f-c SAND, trace SILT, no staining, slight MGP residual odor, saturated. (Fill/GP)	1 ppm	

TRC

5 Waterside Crossing
Windsor, CT 06095
(860) 298-9692
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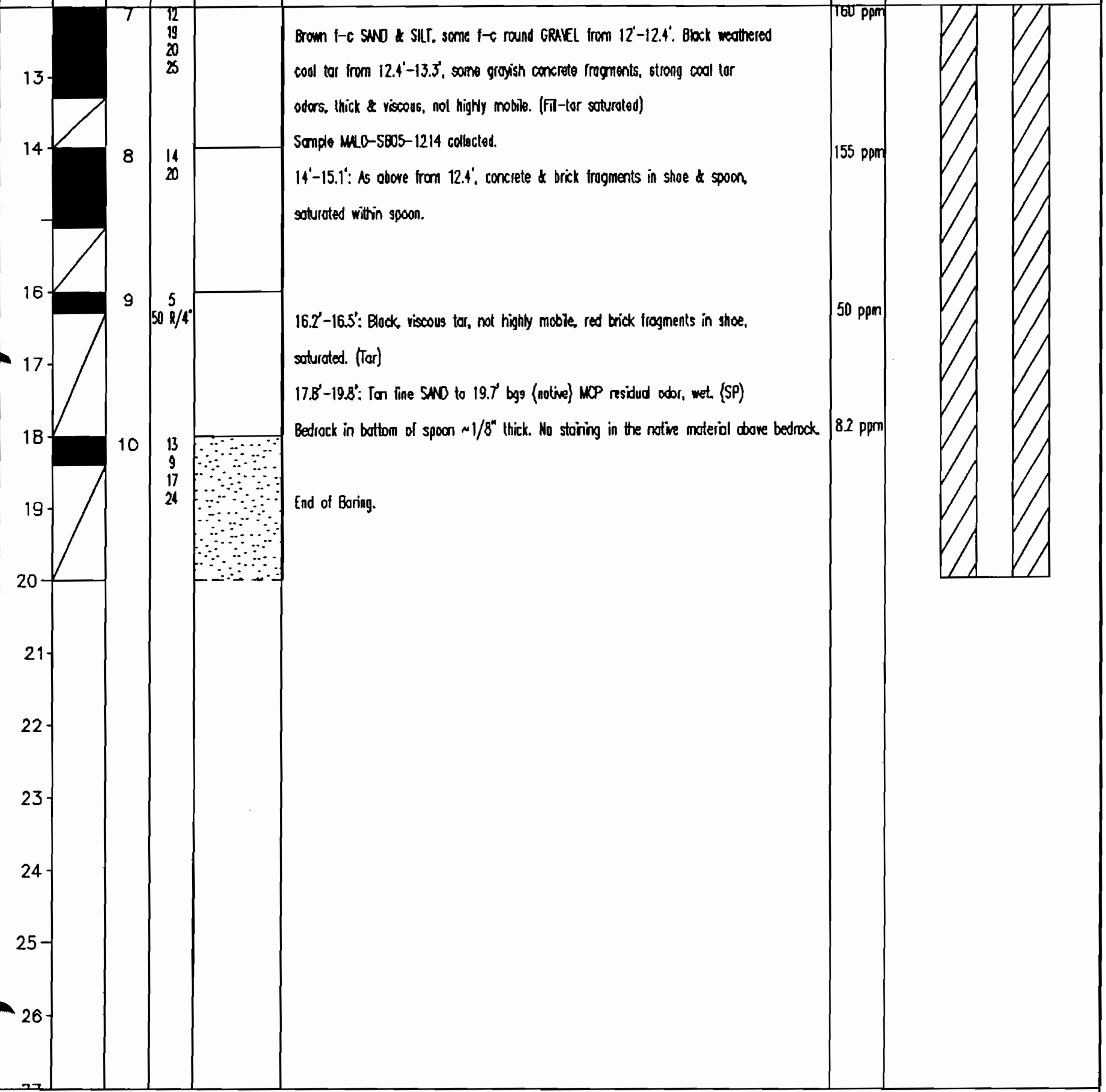
Site Id: SB-5
Date(s): 07/23/03 - 07/23/03
Total Depth: 20.00'
Project Name: Malone
Location:
Logged By: S. Fischer

Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector



Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
		7	12 19 20 25		Brown f-c SAND & SILT, some f-c round GRAVEL from 12'-12.4'. Black weathered coal tar from 12.4'-13.3', some grayish concrete fragments, strong coal tar odors, thick & viscous, not highly mobile. (Fil-tar saturated)	160 ppm	
13							
14		8	14 20		Sample MALO-SB05-1214 collected. 14'-15.1': As above from 12.4', concrete & brick fragments in shoe & spoon, saturated within spoon.	155 ppm	
16		9	5 50 R/4"		16.2'-16.5': Black, viscous tar, not highly mobile, red brick fragments in shoe, saturated. (Tar)	50 ppm	
17					17.8'-19.8': Tan fine SAND to 19.7' bgs (native) MCP residual odor, wet. (SP)		
18		10	13 9 17 24		Bedrock in bottom of spoon ~1/8" thick. No staining in the native material above bedrock.	8.2 ppm	
19					End of Boring.		
20							
21							
22							
23							
24							
25							
26							

TRC 5 Waterside Crossing
Windsor, CT 06095
(860) 298-9692
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Site Id: SB-6

Date(s): 07/23/03 - 07/23/03

Project Name: Malone

Total Depth: 18.00'

Project Number:

Borehole Dia.: 6.25in

Location:

Screens:
type: size: dia: fm: to:

Logged By: S. Fischer

Contractor: Lyon Drilling

Blank Casing:
type: dia: 0.00in fm: 0.0' to: 18.00'

Drilling Method: Hollow Stem Auger

Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector

Annular Fill:
type: Grout fm: 0.00' to: 18.00'
type: fm: to:
type: fm: to:

Measuring Point: 0.00'

Ground Elevation: 693.80'

Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
1		1	1 1 2 2		Brown f-c SAND 0-0.3', trace fine round GRAVEL, trace root, SILT & organics, no staining or odor, moist. (Fill/SW)	0.1 ppm	
2 3		2	2 4 7 7		Brown f-c SAND 2-2.8', trace f-m round GRAVEL & SILT, no staining or odor, moist. Black, viscous, weathered coal tar 2.8'-3'. (Fill/SW) Sample MALO-SB06-24 collected.	0.2 ppm 25 ppm	
4 5		3	3 4 3 5		As above, 2'-2.8', no staining, slight coal tar odor, moist-wet. (Fill/SW)	3 ppm	
6 7		4	5 6 3 5		Brown f-c SAND, trace f-m round GRAVEL & SILT, no staining, slight coal tar odor 6'-6.7'. Black, viscous weathered coal tar, strong odor, wet, not highly mobile 6.7'-6.9'. (Fill/SW)	30 ppm	
8 9		5	5 5 5 3		Black, runny coal tar, mobile, strong odor & sheen, wet. (Tar) Sample MALO-SB06-0810 collected.	50 ppm	
10 11		6	2 2 1 1		Black, viscous, coal tar, not highly mobile, some f-c SAND & trace fine round GRAVEL, strong odor, wet. (Tar/SW)	50 ppm	

TRC

5 Waterside Crossing
Windsor, CT 06095
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Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector	Site Id: SB-6
	Date(s): 07/23/03 - 07/23/03
	Total Depth: 18.00'
	Project Name: Malone
	Location:
	Logged By: S. Fischer

Depth (ft)	Sample No.	Blow Count	Material Description	Field Screening (ppm)
13	7	1 10 19 34	Black viscous, coal tar, slightly mobile, sheen, strong odor & f-c SAND/ f-m round GRAVEL, trace coarse round GRAVEL up to 2" dia, wet-saturated. (Tar/SW) Sample MALO-SB06-1214 collected.	155 ppm
14	8	16 18 20 16	As above, 3" cobble lodged in split spoon shoe. (Tar/SW)	150 ppm
16 17	9	12 15	As above, brick & mortar in shoe - hard, solid blows @ 16.6'. Rods bounced last 12 blows. Holder bottom @16.6'.	100 ppm
18			End of Boring.	
19				
20				
21				
22				
23				
24				
25				
26				

TRC
5 Waterside Crossing
Windsor, CT 06095
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Project Name: Malone	Site Id: SB-7
Project Number:	Date(s): 07/21/03 - 07/21/03
Location:	Total Depth: 22.00'
Logged By: S. Fischer	Borehole Dia.: 6.25in
Contractor: Lyon Drilling	Screens: type: size: dia: fm: to:
Drilling Method: Hollow Stem Auger	Blank Casing: type: dia: 0.00in fm: 0.0' to: 22.00'
Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector	Annular Fill: type: Grout fm: 0.00' to: 22.00' type: fm: to: type: fm: to:
	Measuring Point: 0.00'
Ground Elevation: 695.40'	Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
1		1	2 2 4 6		Dark brown, sandy SILT, trace roots & organics, trace med. and GRAVEL, trace concrete, ash, cinders & coal fragments, black staining, no odors, slightly moist. (Fill)	0.1 ppm	
2 3		2	2 3 3 2		Tan, fine SAND, some orange dartings, no staining, no odors, moist. (Fill/SP)	0 ppm	
4 5		3	2 1 2 2		As above, no staining, no odors, moist. (Fill/SP) Sample MALO-SB07-46 collected.	0 ppm	
6 7		4	1 2 2 2		As above from 6'-6.6'. Light brown, silty SAND from 6.6'-7.2'. Wet @ 6.9 (F-VF sand), no staining, no odors. (Fill-SP/SM)	0 ppm	
8 9		5	2 1 2 3		Light brown, silty SAND, no stain, no odors, last 2" of spoon tan, fine SAND, no staining, no odor, wet. (Fill/SM) Sample MALO-SB07-0810 collected.	0 ppm	
10 11		6	1 1 1 1		Light brown, silty SAND, no staining, no odors, trace to some clay in last 2"-3" of spoon, wet. (Fill/SM)	0 ppm	

TRC

5 Waterside Crossing
Windsor, CT 06095
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Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector

Site Id: SB-7

Date(s): 07/21/03 - 07/21/03

Total Depth: 22.00'

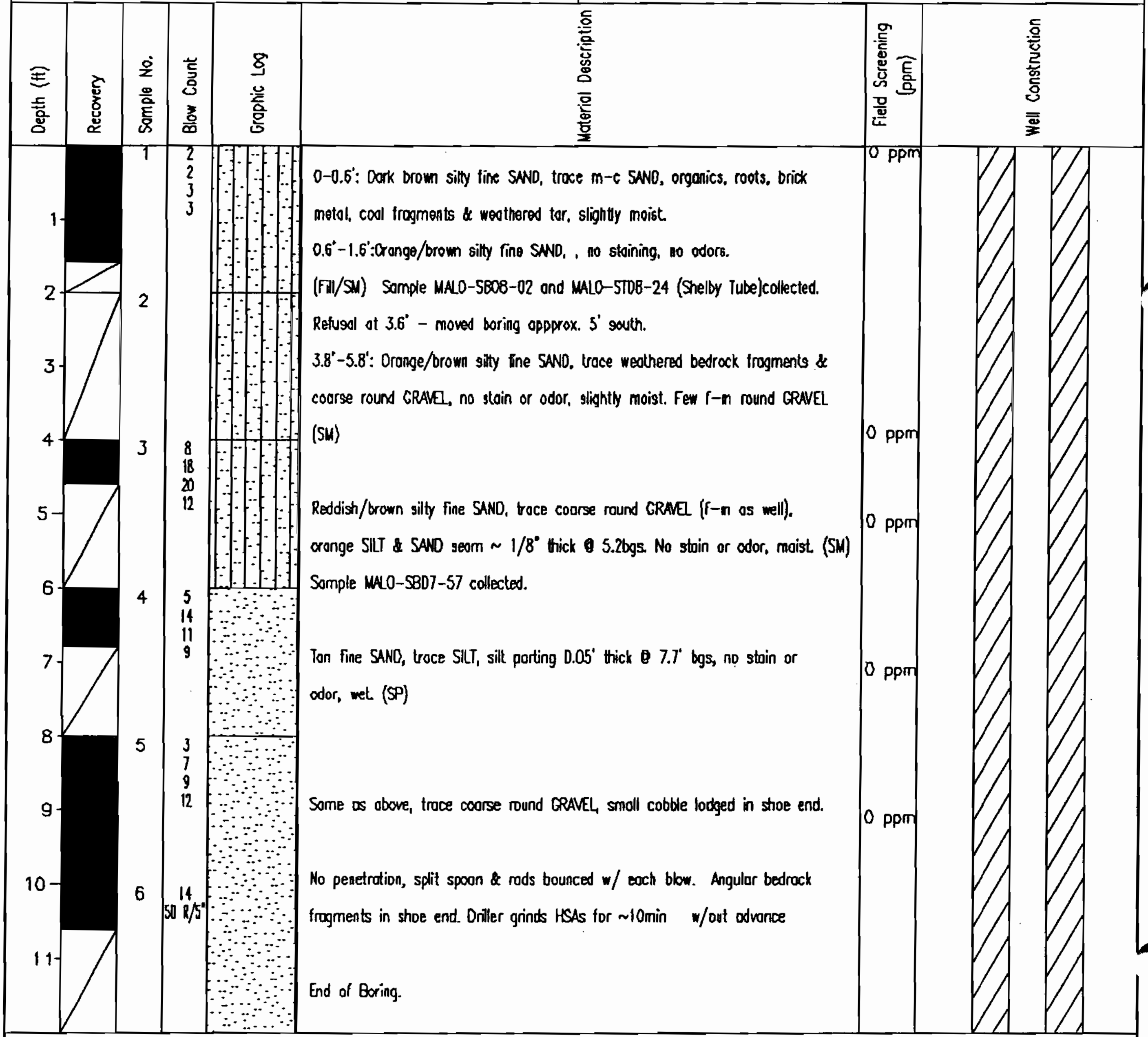
Project Name: Malone

Location:

Logged By: S. Fischer

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
13		7	2 3 3 7		Light brown, silty SAND, alternating w/ tan fine SAND 2"-3" layers. No staining, no odor, moist to wet. (Fill-SP/SM) Sample MALO-SB07-1214.	0 ppm	
14		8	3 6 6 10		14'-15.4': Light brown, silty SAND, silt & VF SAND. Intermittent orange staining. 15.4'-15.5': Tan, fine SAND; 15.5'-15.7': medium brown silt & clay, no staining, no odors, very moist. (Fill/SM)	0 ppm	
16 17		9	10 15 23 28		Medium brown, silt & VF to fine SAND. Intermittent orange staining, trace to some clay, fine SAND seam 17' to 17.2'. No staining or odors, moist to wet. (Fill/SM) Sample MALO-SB07-1618 collected.	0 ppm	
18 19		10	7 16 50 R/1"		Medium brown silty SAND, orange staining, trace clay, 6" tan fine sand seam @ 18.9'. No staining, no odor, wet. Angular Qte SS/Quartsite in last 1" of spoon. Driller inserts boulder buster, advanced to 19.9'. (Fill/SM)	0 ppm	
20 21 22		11	19 26 20 50 R/4"		Tan, fine sand, angular sandstone fragments. No stains or odor, very moist. Rough drilling, spoon appears to have passed boulder/cobble, 4.25-inch augers would not pass, drive spoon. (SP)	0 ppm	
23 24 25 26					Driller grinds HSAs at 20' for ~15min. No advance, 2-inch spoon driven 0.3'. Likely bedrock (fragments same as outcrops in river). End of Boring.		

TRC 5 Waterside Crossing Windsor, CT 06095 (860) 298-9692 FAX (860) 298-6399	Site Id: SB-8 Date(s): 07/28/03 - 07/28/03
Project Name: Malone	Total Depth: 12.00'
Project Number:	Borehole Dia.: 6.25in
Location:	Screens: type: size: dia: fm: to:
Logged By: S. Fischer	Blank Casing:
Contractor: Lyon Drilling	type: dia: 0.00in fm: 0.0' to: 12.00'
Drilling Method: Hollow Stem Auger	Annular Fill: type: Grout fm: 0.00' to: 12.00' type: fm: to: type: fm: to:
Remarks: Field screening conducted using a calibrated Mini RAE photoionization detector	Measuring Point: 0.00'
Ground Elevation: 669.90'	Static Water Level:



Depth (ft)	Sample No.	Blow Count	Material Description	Field Screening (ppm)
0	1	2 2 3 3	0-0.6': Dark brown silty fine SAND, trace m-c SAND, organics, roots, brick metal, coal fragments & weathered tar, slightly moist. 0.6'-1.6': Orange/brown silty fine SAND, , no staining, no odors. (Fill/SM) Sample MALO-SB08-02 and MALO-STD8-24 (Shelby Tube)collected.	0 ppm
2	2		Refusal at 3.6' - moved boring appprox. 5' south. 3.8'-5.8': Orange/brown silty fine SAND, trace weathered bedrock fragments & coarse round GRAVEL, no stain or odor, slightly moist. Few f-m round GRAVEL (SM)	
4	3	8 18 20 12		0 ppm
5			Reddish/brown silty fine SAND, trace coarse round GRAVEL (f-m as well), orange SILT & SAND seam ~ 1/8" thick @ 5.2bgs. No stain or odor, moist. (SM) Sample MALO-SBD7-57 collected.	0 ppm
6	4	5 14 11 9		
7			Tan fine SAND, trace SILT, silt parting 0.05' thick @ 7.7' bgs, no stain or odor, wet. (SP)	0 ppm
8	5	3 7 9 12		
9			Same as above, trace coarse round GRAVEL, small cobble lodged in shoe end.	0 ppm
10	6	14 50 R/5"	No penetration, split spoon & rods bounced w/ each blow. Angular bedrock fragments in shoe end. Driller grinds HSAs for ~10min w/out advance	
11			End of Boring.	

TRC
5 Waterside Crossing
Windsor, CT 06095
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Site Id: MW-3

Date(s): 07/28/03 - 07/28/03

Project Name: Malone

Total Depth: 12.50'

Project Number:

Borehole Dia.: 6.25in

Location:

Screens:
type: Slotted size: 0.010india: 2.00in fm: 7.00' to: 12.00'

Logged By: S. Fischer

Contractor: Lyon Drilling

Blank Casing:
type: PVC dia: 2.00in fm: 7.0' to: 7.00'

Drilling Method: Hollow Stem Auger

Annular Fill:
type: Concrete fm: 0.00' to: 3.00'
type: Betonite Pellets fm: 3.00' to: 5.00'
type: Sand Pack (generic) fm: 5.00' to: 12.50'

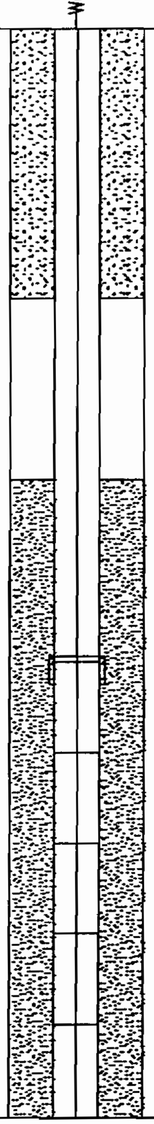
Remarks:

Measuring Point: 0.00'

Ground Elevation: 659.10'

Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							



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5 Waterside Crossing
Windsor, CT 06095
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Site Id: MW-3

Date(s): 07/28/03 - 07/28/03

Total Depth: 12.50'

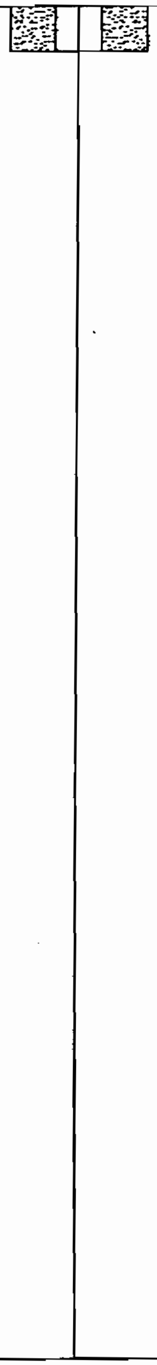
Project Name: Malone

Location:

Logged By: S. Fischer

Remarks:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
13							
14							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							



TRC

5 Waterside Crossing
Windsor, CT 06095
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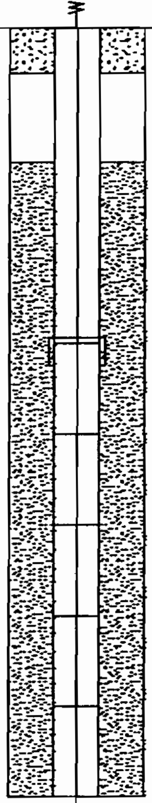
Project Name: Malone	Site Id: MW-4
Project Number:	Date(s): 07/28/03 - 07/28/03
Location:	Total Depth: 8.50'
Logged By: S. Fischer	Borehole Dia.: 6.25in
Contractor: Lyon Drilling	Screens: type: Slotted size: 0.010india: 2.00in fm: 3.50' to: 8.50'
Drilling Method: Hollow Stem Auger	Blank Casing: type: PVC dia: 2.00in fm: 3.5' to: 3.50'
Remarks:	Annular Fill: type: Concrete fm: 0.00' to: 0.50' type: Betonite Pellets fm: 0.50' to: 1.50' type: Sand Pack (generic) fm: 1.50' to: 8.50'
	Measuring Point: 0.00'
Ground Elevation: 649.70'	Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
					See log for Soil Boring SB-4.		
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							

TRC

5 Waterside Crossing
Windsor, CT 06095
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Project Name: Malone	Site Id: TP-1
Project Number:	Date(s): 07/16/03 - 07/16/03
Location:	Total Depth: 8.20'
Logged By: S. Fischer	Borehole Dia.: 0.00in
Contractor: Lyon Drilling	Screens: type: size: dia: fm: to:
Drilling Method: Backhoe	Blank Casing: type: dia: 0.00in fm: 0.0' to: 8.20'
Remarks: Test Pit Dimensions: 37 ft long x 4 ft wide x 8.2 ft deep	Annular Fill: type: fm: to: type: fm: to: type: fm: to:
	Measuring Point: 0.00'
Ground Elevation: 694.50'	Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
					0-0.5': Medium brown, f-c SAND & SILT, trace round GRAVEL, roots, trace organics slightly moist. Brick & brick fragments.		
1					0.5-2': Light brown, f-c SAND & SILT, fine-coarse round GRAVEL (some), trace cobbles, slightly moist. 4'length of 2" steel pipe, slight CT odor.		
2					3" coal tar seam @ 2' bgs - some black stained soil, slight to no odor.		
3							
4					4'-5': 4" concrete pipe n-s trend w/in trench, full of coal tar, strong odor		
5							
6							
7							
8					End of Test Pit.		
9							
10							
11							

TRC
5 Waterside Crossing
Windsor, CT 06095
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Site Id: TP-3

Date(s): 07/17/03 - 07/17/03

Project Name: Malone

Total Depth: 3.50'

Project Number:

Borehole Dia.: 0.00in

Location:

Screens:
type: size: dia: fm: to:

Logged By: S. Fischer

Blank Casing:
type: dia: 0.00in fm: 0.0' to: 3.50'

Contractor: Lyon Drilling

Drilling Method: Backhoe

Annular Fill:
type: fm: to:
type: fm: to:
type: fm: to:

Remarks: Test Pit Dimensions: 10 ft long x 8 ft wide x 3.5 ft deep

Measuring Point: 0.00'

Ground Elevation: 693.00'

Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
					0-4": Dark brown, f-c- SAND & SILT, trace GRAVEL & roots & Organics.		
1							
					4"-1': Medium brown, f-c SAND & round GRAVEL & SILT.		
2					Thick tar @ 1'-2', strong coal tar odor.		
					~ 3' down along fence line, low viscosity tar flowed into test pit		
3					Weathered tar seam ~ 3"-4" thick across entire test pit ~2'bgs.		
4							
					End of Test Pit.		
5							
6							
7							
8							
9							
10							
1							

TRC
5 Waterside Crossing
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	Site Id: TP-2
	Date(s): 07/16/03 - 07/16/03
Project Name: Malone	Total Depth: 4.50'
Project Number:	Borehole Dia.: 0.00in
Location:	Screens: type: size: dia: fm: to:
Logged By: S. Fischer	Blank Casing: type: dia: 0.00in fm: 0.0' to: 4.50'
Contractor: Lyon Drilling	
Drilling Method: Backhoe	Annular Fill: type: fm: to: type: fm: to: type: fm: to:
Remarks: Test Pit Dimensions: 14 ft long x 4 ft wide x 4.5 ft deep	Measuring Point: 0.00'
Ground Elevation: 694.10'	Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
					0-4.5': Medium brown, slightly moist f-c SAND & GRAVEL (round) & SILT,		
1					trace cobbles, roots and organics (fill material). 4" top soil.		
2					Wall Construction As TP-01		
3					2.5'-4.5' Black, viscous, tar material w/petroleum odor. Bottom of pit filled w/tar.		
4							
					End of Test Pit.		
5							
6							
7							
8							
9							
10							
11							

TRC

5 Waterside Crossing
Windsor, CT 06095
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Site Id: TP-4

Date(s): 07/17/03 - 07/17/03

Project Name: Malone

Total Depth: 7.00'

Project Number:

Borehole Dia.: 0.00in

Location:

Screens:
type: size: dia: fm: to:

Logged By: S. Fischer

Blank Casing:
type: dia: 0.00in fm: 0.0' to: 7.00'

Contractor: Lyon Drilling

Drilling Method: Backhoe

Annular Fill:
type: fm: to:
type: fm: to:
type: fm: to:

Remarks: Test Pit Dimensions: 13 ft long x 3 ft wide x 7 ft deep

Measuring Point: 0.00'

Ground Elevation: 695.00'

Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
					0-1.5': Light brown & orange, f-c SAND, SILT & GRAVEL, slightly moist,		
1					roots & trace organics (~ 4" top soil).		
2					1.5'-7.0': As above, mixes w/concrete & brick rubble. Some ash & cinders.		
3							
4							
5							
6							
7				- - - -	Hard bottom @ 7', flat, teeth scraping across hard bottom, most likely structure foundation. No staining, no odors.		
8					End of Test Pit		
9							
10							
11							

TRC 5 Waterside Crossing Windsor, CT 06095 (860) 298-9692 FAX (860) 298-6399	Site Id: TP-5 Date(s): 07/17/03 – 07/17/03
Project Name: Malone	Total Depth: 0.25'
Project Number:	Borehole Dia.: 0.00in
Location:	Screens: type: size: dia: fm: to:
Logged By: S. Fischer	Blank Casing: type: dia: 0.00in fm: 0.0' to: 0.25'
Contractor: Lyon Drilling	
Drilling Method: Backhoe	Annular Fill: type: fm: to: type: fm: to: type: fm: to:
Remarks: Test Pit Dimensions: 1 ft long x 1 foot wide x 0.25 ft deep	Measuring Point: 0.00'
Ground Elevation: 670.90'	Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
				- - - -	0-3": Dark brown SILT, trace f-c- SAND, roots, organics.		
1					slab on grade concrete foundation @ 3"bgs.		
2					End of Test Pit.		
3					Note:		
4					2'x2' Concrete sump on pad edge @ ~5:00 position, filled with soil, rocks & bricks. Some thick staining, no odors, visible weathered tar on some concrete within sump.		
5							
6							
7							
8							
9							
10							
11							

TRC
5 Waterside Crossing
Windsor, CT 06095
(860) 298-9692
FAX (860) 298-6399

Site Id: TP-6

Date(s): 07/17/03 - 07/17/03

Project Name: Malone

Total Depth: 7.00'

Project Number:

Borehole Dia.: 0.00in

Location:

Screens:
type: size: dia: fm: to:

Logged By: S. Fischer

Contractor: Lyon Drilling

Blank Casing:
type: dia: 0.00in fm: 0.0' to: 7.00'

Drilling Method: Backhoe

Remarks: Test Pit Dimensions: 7 ft long x 3 ft wide x
7 ft deep

Annular Fill:
type: fm: to:
type: fm: to:
type: fm: to:

Measuring Point: 0.00'

Ground Elevation: 666.00'

Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
					Noticable weathered tar, coke and slag on the slope east of lower holder slab.		
1					0-7': Brown, f-c SAND & round GRAVEL, some SILT & cobbles, some boulders, (Native material).		
2							
3					- Holder pad thickness @ 3:00 position = ~6'. - ~3' of concrete pad exposed above ground surface. - No staining or odors.		
4							
5							
6							
7				- - - -	End of Test Pit.		
8							
9							
10							
11							

TRC
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Project Name: Malone	Site Id: TP-7
Project Number:	Date(s): 07/18/03 – 07/18/03
Location:	Total Depth: 9.00'
Logged By: S. Fischer	Borehole Dia.: 0.00in
Contractor: Lyon Drilling	Screens: type: size: dia: fm: to:
Drilling Method: Backhoe	Blank Casing: type: dia: 0.00in fm: 0.0' to: 9.00'
Remarks: Test Pit Dimensions: 30 ft long x 3 ft wide x 9 ft deep	Annular Fill: type: fm: to: type: fm: to: type: fm: to:
	Measuring Point: 0.00'
Ground Elevation: 659.00'	Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
					Black weathered tar on ground surface.		
1					0-3": Dark brown, silty SAND, trace GRAVEL, roots, organics.		
2					3"-4': Coal fragments, cinders, ash, weathered (hard) tar & soft flowing tar throughout internal trace-natural material & metal, strong coal tar odor.		
3					*Consistent 10" tar seam @ ~3 bgs.		
4					4'-6.2': Dark brown/orange, fill material, SILT to cobble size, brick & rubble materials. Last 4' of trench (North End) is visibly clean fill material. No stains, tar, coal fragments (etc).		
5							
6					~ 5.5'-6' Native material is Light to orange brown boulder tin (f-c SAND & round GRAVEL, SILT, cobbles & boulders).		
7							
8					Water at 9.0' bgs		
9					End of Test Pit.		
10							
11							

TRC

5 Waterside Crossing
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(860) 298-9692
FAX (860) 298-6399

Project Name: Molone	Site Id: TP-8
	Date(s): 07/18/03 – 07/18/03
	Total Depth: 6.00'
Project Number:	Borehole Dia.: 0.00in
Location:	Screens: type: size: dia: fm: to:
Logged By: S. Fischer	
Contractor: Lyon Drilling	Blank Casing: type: dia: 0.00in fm: 0.0' to: 6.00'
Drilling Method: Backhoe	Annular Fill: type: fm: to: type: fm: to: type: fm: to:
Remarks: Test Pit Dimensions: 20 ft long x 3 ft wide x 6 ft deep	Measuring Point: 0.00'
Ground Elevation: 649.00'	Static Water Level:

Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	Material Description	Field Screening (ppm)	Well Construction
1					0-1.5': Gray, cinders, ash & coal fragments, some SILT & SAND, no stain, no odor, brick, concrete, construction rubble.		
2					1.5'-5': Orange/brown SILT & fine-coarse SAND & round GRAVEL, few cobbles, trace boulder-sized fragments of native till. No stain, no odor. Several boulder-sized chunks of float/weathered bedrock (pinkish quartzite). Water @ 4.5' bgs, no sheen.		
3							
4					4.5'-5.6': As above, saturated slight coal tar odor. Feels competent at 5.6', most likely bedrock surface.		
5							
6					End of Test Pit.		
7							
8							
9							
10							
1							