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Geotechnical
Environmental
Water Resources
Ecological

Operable Unit 1 Site Management Plan
East 173rd Street Works Former MGP Site

Starlight Park, Bronx, New York
VCA Index No. D2-0003-02-08
Site #: V00552

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Project 013943-3-1103

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Abbreviations and Acronyms

AWQS	Ambient Water Quality Standards
cf	Cubic Foot
CFR	Code of Federal Regulations
cgs	Current Ground Surface
DNAPL	Dense Non-Aqueous Phase Liquid
ECL	Environmental Conservation Law
EPA	United States Environmental Protection Agency
FRI	Focused Remedial Investigation
FSP	Field Sampling Plan
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Respons
MGP	Manufactured Gas Plant
NYSDEC	New York State Department of Environmental Conservatio
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
OSHA	Occupational Health & Safety Administration
OU	Operable Unit
PID	Photoionization Detector
ppm	Parts Per Million
QA/QC	Quality Assurance/ Quality Control
QAPP	Quality Assurance Project Plan
RA	Remedial Action
RAWP	Remedial Action Work Plan
SCOs	Soil Cleanup Objectives
SMP	Site Management Plan
SRI	Supplemental Remedial Investigation
SVOCs	Semivolatile Organic Compounds
TAGM	Technical and Administrative Guidance Memorandum
TCL	Target Compound List
USGS	United States Geological Survey
VCA	Voluntary Cleanup Agreement
VOCs	Volatile Organic Compounds

1. Introduction

This document and its appendices present the Site Management Plan (SMP) for Operable Unit 1 (OU-1) of the East 173rd Street Works Site (Site No. V00552-2), the grounds of a former manufactured gas plant (MGP) that was located within what is now a portion of the City of New York's Starlight Park in the Bronx, New York. This plan was developed in accordance with the terms of Voluntary Cleanup Agreement (VCA) Index No. 02-0003-02-08, dated August 15, 2002, between Consolidated Edison Company of New York (Con Edison) and the New York State Department of Environmental Conservation (NYSDEC), the NYSDEC-approved Remedial Action Work Plan (RAWP) for OU-1 of the former East 173rd Street Works Site (Site) dated August 24, 2004, the NYSDEC-approved OU-1 Final Design Report for the Site dated July 2005, the November 9, 2006 Access Agreement between Con Edison and the New York City Parks Department identifying post-RA responsibilities, the requirements contained in the NYSDEC's Draft Voluntary Cleanup Program Guide, dated May 2002 and the guidance provided in the NYSDEC's Draft DER-10 Technical Guidance for Site Investigation and Remediation, dated December 2002. This SMP will be implemented following the completion of the remedial action (RA) construction activities specified in the NYSDEC-approved RAWP and OU-1 Final Design Report.

The objective of this plan is to establish a set of procedures and restrictions to manage potential future human exposure to MGP-impacted soil and groundwater left in place below the demarcation barrier and clean fill cover that will be installed at the Site as part of required (OU-1) RA construction activities and to ensure that the remedy NYSDEC selected for OU-1 of the Site remains protective of human health and the environment. The SMP procedures and restrictions include a post-remediation groundwater-monitoring program, institutional controls (i.e., inspection, certifications, groundwater and land use prohibitions, and notifications) and excavated material management procedures. This SMP is a guide for implementing these procedures and prohibitions, and for ensuring that the procedures continue and are complied with after the completion of the RA construction activities.

This SMP is organized into the following six sections:

1 – Introduction	Provides background information about the Site.
2 – Post RA Groundwater Monitoring	Presents a description and schedule for the groundwater monitoring activities that will be implemented following the completion of the RA construction activities.

3 – Annual Inspection and Certifications	Describes inspection requirements for certifying that engineering and institutional controls are in place, are being complied with, and remain effective to protect human health and the environment.
4 – Notifications	Discusses notification procedures for post RA activities.
5 – Soil Management Plan	Presents procedures for the management of soil during any future intrusive activities.
6 – Reporting	Identifies the reporting requirements and information be provided in association with site management activities.

The health and safety practices, field sampling plan procedures, and quality assurance/quality control procedures that need to be followed during the implementation of post-RA groundwater monitoring and excavation activities conducted below the clean fill cover and demarcation barrier are discussed in detail in the following appendices:

- Health and Safety Plan (HASP) (Appendix A) - provides a mechanism for establishing safe working conditions at the Site.
- Field Sampling Plan (FSP) (Appendix B) – provides the details for obtaining field samples in support of monitoring and excavation activities.
- Quality Assurance Project Plan (QAPP) (Appendix C) - presents field inspection and laboratory quality assurance/quality control (QA/QC*)* procedures, as well as standards and guidelines regarding sample analysis, validation, and reporting.
- Appendix D to this SMP contains a copy of the Access Agreement between Con Edison and the City of New York pertaining to the implementation of the requirements of this SMP and compliance with the land use and institutional controls imposed by the NYSDEC as part of its selected remedy for the OU-1 Site.

1.1 Site Description

The East 173rd Street Works Site is located between the Sheridan Expressway and the Bronx River in the West Farms section of the Borough of the Bronx, Bronx County, New York. The location of the Site is illustrated on Figure 1, taken from a portion of the United States Geological Survey (USGS) Topographic Map of the Central Park, New York, the New Jersey Quadrangle, and the Flushing, New York Quadrangle.

The former grounds of the MGP at the Site occupied a single parcel of land that is currently owned by the City of New York and operated by the New York City Department of Parks and Recreation (Parks Department). The Site is located within Starlight Park, a part of the City of New York's Bronx River Park. Starlight Park is zoned R7-1, a general residential district. The current and intended future use of the Site is a New York City-owned public park. The former MGP was located in the middle portion of Starlight Park and occupied an area of approximately 3 acres. The boundaries and former structures of the MGP are shown on Figure 2. Starlight Park is approximately 7.3 acres in size, and is currently designated by the Bronx Assessor's Office as Block 03019, Lot 0100.

1.2 Site History

This section presents a brief history of the East 173rd Street Works Site. A more detailed discussion of the Site's history is presented in the following report that was filed with the NYSDEC by Con Edison: *Manufactured Gas Plant History, East 173rd Street Works, Bronx, New York* (GEI, October 2002).

Several Con Edison predecessor companies owned the Site from 1859 to1936. From 1936 to 1945, Con Edison owned the Site. Since 1945, the Site has been owned by the City of New York. Historic records indicate that an MGP operated at the Site from possibly as early as the 1870s until 1923. Between 1912 and 1923, the Site was used primarily for gas storage, and the standby facility. In 1924, a 130,400 cubic foot (cf) gas holder and a 60,000 cf gas holder were taken down and some plant buildings were partially removed. Sometime prior to 1943, a 75,000-cf gas holder was taken down. The Site area was used by Con Edison as a storage facility and garage until it was sold to the City of New York in December 1945. Up until this time, the main channel of the Bronx River flowed past the south side of the Site, as depicted in the historical footprint in Figure 2. The last plant building was taken down in the 1950s. Starlight Park was reportedly constructed in the 1960s, at the same time that the Bronx River was rerouted and reconstructed to its current location and the Sheridan Expressway was first constructed.

1.3 Project Background

1.3.1 Remedial Investigations

Con Edison has completed a comprehensive NYSDEC-approved remedial investigation for the Site pursuant to the VCA. The following reports and work plans were submitted to the NYSDEC in connection with the Site investigation.

- *Focused Remedial Investigation Work Plan, East 173rd Street Works Former Manufactured Gas Plant Site* (GEI, May 2002)

- *Focused Remedial Investigation, East 173rd Street Works Former Manufactured Gas Plant Site* (GEI, April 2003)

- *Supplemental Remedial Investigation Work Plan, East 173rd Street Works, Bronx, New York* (GEI, May 2003)

- *Supplemental Remedial Investigation, East 173rd Street Works, Bronx, New York, Data Summary Report* (GEI, April 2004)

The April 2003 Focused Remedial Investigation (FRI) report and April 2004 Supplemental Remedial Investigation (SRI) report provided documentation and a description of the procedures and findings of the remedial investigation activities conducted at Starlight Park. The remedial investigations, in general, consisted of sampling and analyses of soil and groundwater within Starlight Park, and sediment and surface water in the Bronx River.

The compounds detected in the soil and groundwater at the Site includes volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and inorganic compounds. Many of the inorganic and organic compounds detected in the on-Site soil and groundwater can be associated with MGP residues; however, some of these detected compounds also typically occur in urban fill, which forms the uppermost soil layer of the Site. The chemical and physical data presented in the remedial investigation reports are summarized below according to media.

Urban Fill **–** The uppermost soils of the Site (from the ground surface to approximately 5 feet below the current ground surface [cgs]) consisted of urban fill materials that were not impacted by the former MGP operations at the Site. The current ground surface is the surface post remediation and does not reflect the final surface following the construction of the athletic fields

Subsurface Soil **–** Physical evidence of MGP residue and analytical results indicated that on-Site subsurface soils were impacted by the former MGP operations. VOCs and SVOCs were detected in subsurface-soil samples at concentrations that exceed the NYSDEC-established project Soil Cleanup Criteria (i.e., soil containing dense non-aqueous phase liquid (DNAPL) tar and/or concentrations of total SVOCs greater than 500 parts per million (ppm), and/or concentrations of VOCs greater than 10 ppm). The samples exhibiting the highest SVOC concentrations were collected from on-Site subsurface soils containing DNAPL tar. The DNAPL tar was limited to discrete areas within the former MGP boundary, at depths between 8 and 20.5 feet below cgs.

Groundwater **–** Groundwater samples collected from on-Site wells located in areas of MGP-impacted subsurface soils and along the hydraulically downgradient Site boundary contained concentrations of VOCs and SVOCs above the New York State Ambient Water Quality Standards (AWQS) for a GA Water Class. The DNAPL tar represented a continuing source for

VOC and SVOC groundwater contamination. Groundwater at Starlight Park is not used for irrigation or as a drinking water source.

MGP Structures – Several remnant MGP structures were present beneath the surface of the Site. The rims or walls of the two subsurface water-seal gas holders were encountered at a depth starting approximately 6 feet below cgs. The holder bottoms were encountered at depths of 22 feet and 25 feet below cgs. The bottom slab of the former above-grade gas holder was uncovered at a depth of approximately 4.5 feet below cgs. The floors of several of the former MGP buildings were encountered at depth of between 3 and 5 feet below cgs.

1.3.2 Remedial Action

Based on the findings and conclusions of the NYSDEC-approved Remedial Investigation (RI) Reports identified above, the NYSDEC and New York State Department of Health (NYSDOH) determined that remediation is necessary for OU-1 of the Site, which as defined by the NYSDEC and NYSDOH, comprises the portion of Starlight Park located within the footprint of the former MGP and those areas outside the MGP footprint for which remedial action is necessary to meet the cleanup objectives established by these agencies for the OU-1 area. The documents listed below were submitted to the NYSDEC in association with the RA conducted at the Site.

- *Proposed Remedial Approach, East 173rd Street Works (Starlight Park), Bronx, New York* (GEI, April 2003)

- *Remedial Action Work Plan, East 173rd Street Works Former Manufactured Gas Plant Site* (GEI, August 2004)

- Operable Unit 1 Final Design Report, East 173rd Street Works (Starlight Park), Bronx, New York (GEI, July 2005)

The Proposed Remedial Approach was prepared to allow the NYSDEC, the NYSDOH, the Parks Department, and community stakeholders the opportunity to review and provide input early in the development of the RAWP. The NYSDEC-approved RAWP provided expanded descriptions of the remedial activities described in the Proposed Remedial Approach, and incorporates modifications to the Proposed Remedial Approach based on comments received from NYSDEC, NYSDOH, Parks Department, and community stakeholders. The selected RA is described in a detailed set of design plans, written specifications, work plans, and background reports combined into a package collectively referred to as the OU-1 Final Design Report. This report also presents the geotechnical and environmental data from both the FRI and SRI in support of the selected RA.

The required NYSDEC-approved remedial actions for OU-1 of the Site include remedial construction activities, the implementation of post-remediation groundwater monitoring, and institutional controls.

1.4 Remedial Action Description

1.4.1 Required Remedial Construction Activities

The NYSDEC-approved RAWP and OU-1 Final Design Report specified the following remedial construction activities for OU-1 of the Site:

- The removal and off-Site disposal of soils within the former MGP footprint and any areas identified outside the MGP footprint boundary that contained MGP source materials (DNAPL tar, tar saturated soil, MGP purifier waste), and/or concentrations of total SVOCs greater than 500 ppm, and/or concentrations of VOCs greater than 10 ppm. The 500 ppm total SVOC/10 ppm total VOC cleanup criteria were established by the NYSDEC and the NYSDOH as the cleanup objective for the OU-1 area of the Site, and are consistent with the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046.

- The installation and maintenance of a clean fill cover cap and underlying visible demarcation barrier in all portions of the OU-1 area where excavation was required to meet the OU-1 cleanup objectives. For the portion of the OU-1 that is being redeveloped by the Parks Department as a ball field, a visible demarcation barrier and 3-foot-thick cover of clean fill (complying with all NYSDEC individual TAGM 4046 recommended soil cleanup objectives) below the final finished redevelopment grade of the new ball field was required. For the other OU-1 areas where excavation was required, a visible demarcation barrier and 6-foot-thick layer of clean fill below the redevelopment grade was required.

After completion of the RA construction activities, Starlight Park, including the OU-1 areas, will be reconstructed by the New York State Department of Transportation (NYSDOT) and Parks Department. The park redevelopment as-built details, the remedial excavation areas, and the clean fill cover system areas are all presented in the Remedial Action report.

1.4.2 Post-Remedial Groundwater Monitoring

After the NYSDEC determines that the required RA construction activities has been properly completed, Con Edison will perform periodic groundwater sample collection from on-Site monitoring wells to evaluate and document the improvement of groundwater quality. A detailed description of the post-remedial groundwater monitoring is provided in Section 2.

1.4.3 Institutional Controls

The institutional controls that will be implemented following the completion of the RA construction activities by Con Edison and the reconstruction of Starlight Park by the NYSDOT and Parks Department include:

- Annual inspection and certification by a New York State-Licensed Professional Engineer to confirm that the land use restrictions specified in the RAWP for the Site are being complied with, and that the engineering and institutional controls specified in the RAWP are in place and remain effective to control the risk of potential exposure to subsurface residual contamination by users of Starlight Park, Parks Department employees, or permittees.

- Notification to the NYSDEC prior to any action that could jeopardize the integrity of the completed RA construction activities, including excavation work below the clean fill cover and demarcation barrier installed at the Site as part of RA construction activities.

- A prohibition on the use of the Site for any purpose other than a public park without the prior written approval of the NYSDEC.

- A prohibition on the development of water supply or irrigation wells on the Site.

- Implementation of a NYSDEC-approved Soil Management Plan for intrusive work performed below the clean fill cover and demarcation barrier installed at the Site.

The institutional controls will only apply to the area within the boundary of the former MGP footprint and any areas outside the MGP footprint boundary for which the excavation of contaminated soil and installation of an underlying demarcation barrier was required as part of the RA construction activities. A detailed description of the institutional controls is provided in Sections 3, 4, and 5.

2. Post-Remediation Groundwater Monitoring

The on-Site monitoring wells that will be periodically sampled after the completion of the RA construction activities are depicted on Figure 3 of this SMP as MW-1S/1D, MW-3S/3D, MW-4S/4D, MW-5S/5D and MW-6S/6D. Following the NYSDEC's determination that the RA construction activities have been properly completed, groundwater samples will be collected from these monitoring wells semi-annually for a minimum of two years. The first sampling round will be performed six months after RA construction activities are deemed properly completed. Groundwater sampling will commence six months after the completion of the remedy. Approximately two years after completion of the remedy, a recommendation will be made to the NYSDEC to discontinue sampling at monitoring wells where the analytical results of three consecutive rounds of sampling confirm that the samples from the well do not contain MGP-related contaminants at concentrations that exceed New York State AWQS for Class GA Water. The NYSDEC will evaluate recommendation and the groundwater quality data to determine scope and frequency of any additional future groundwater monitoring requirements.

3. Annual Inspection and Certification

The Annual Certification will be a written statement by a New York State-licensed professional engineer that the engineering and institutional controls employed at the Site are unchanged from the completion of the required RA construction activities (or previous annual certification), or that any changes to the controls at the Site were approved by the NYSDEC, and that nothing has occurred that would impair the ability of such controls to protect public health and the environment or constitute a violation or failure to comply with this SMP. The Annual Inspection and Certification Checklist (Exhibit 1) will be used for each required annual inspection. The professional engineer who conducts the annual inspection will be familiar with the remedy, RA construction activities as-built figure details, and park construction maps.

The engineering controls installed at the Site will be inspected annually to determine if, and when, maintenance activities are required to maintain the integrity of these features. The NYSDEC and NYSDOH approved remedy for OU-1 of the Site includes the following engineering controls: maintaining a 3-foot-thick cover of clean fill below the final redevelopment grade in the area within the footprint of the planned new ball field area of Starlight Park, and a minimum 6-foot-thick layer of clean fill below the redevelopment grade in specific areas outside the ball field boundary. The required engineering controls also include a warning/demarcation barrier below the clean fill cover to separate the cover from the underlying material and to serve as a visual indicator, for example, to park redevelopment workers. The RA as-built construction details and locations of the clean fill cover and warning/demarcation barrier are illustrated in Figures 4 and 5 of this SMP. The clean fill cover will be visually inspected at least annually for signs of erosion or other disturbances. The surface elevation of the clean cover will be surveyed at least annually to determine the thickness of the cover. The clean cover will also be visually inspected and surveyed following intrusive excavation that requires notification to the NYSDEC. If damage to the clean fill cover is visually observed and/or determined by survey, the engineering controls will be restored. During each survey, locations and elevations will be referenced to an existing benchmark installed at the Site (utilized previously for the RA as-built figures) that all future measurements will be compared against. Elevations will be determined with a vertical accuracy of ±0.01 foot. The monitoring wells will be inspected during sampling events. They will also be inspected annually to confirm their location and confirm they are still serviceable.

The required annual inspections will also confirm that the Site is being used as a public park in the manner specified in the Parks Department's Starlight Park reconstruction plan and irrigation or drinking water wells have not been installed at the Site without the NYSDEC's approval. While the Site remains under the ownership of the City of New York, compliance with the required institutional controls will be secured through the Access Agreement between Con Edison and the City of New York. A copy of the Access Agreement is contained in Appendix D.

In the event that the City of New York sells the Site, the City will grant an Environmental Easement meeting the requirements of Article 71, title 36 of the New York Environmental Conservation Law (ECL) to the State of New York for the lands comprising the Site and will file that Environmental Easement with the New York City Register for recording against fee title to the Site lands. As specified ECL Article 71, title 36, the Environmental Easement will made enforceable by the NYSDEC and will require all owners and users of the Site lands to comply with the engineering and institutional controls called for in the NYSDEC-approved RA for the Site.

If the City grants an Environmental Easement to the State for the Site lands, the annual inspection for the Site's institutional controls will include confirming that the Environmental Easement remains on file in the Land Division Records of the New York City Register's Office and that any NYSDEC-approved amendments to the Environmental Easement have been properly recorded.

4. Notifications

In accordance with the requirements of the Access Agreement between the City of New York and Con Edison, Con Edison will be notified by the Parks Department as early as practicable in advance of any planned excavation activities in the area of the clean fill cover installed at the Site as part of the required RA construction activities. The NYSDEC and Con Edison will be notified by the Parks Department as early as practicable in advance of any planned activities involving excavation work beneath the clean fill cover and underlying warning/demarcation barrier installed at the Site as part of the required RA construction activities. In the event of an unplanned work or emergency work, the Parks Department will provide advance notification that is reasonable under the circumstances. The Parks Department's notification to the NYSDEC and Con Edison will include a description of the nature of the proposed excavation work, the dates by which the work must be performed, and the estimated volume of soil that must be removed. The Parks Department will also notify Con Edison and the NYSDEC in writing of any planned Site land development for any use other than a park.

5. Soil Management Plan

This Soil Management Plan presents the procedures that will be followed for the management of soil during any intrusive activities that extend beneath the clean fill cover and warning/ demarcation barrier system installed at the Site as part of the RA construction activities.

5.1 Management of Fill and Long Term Maintenance of the Clean Fill Cover

The purpose of this section is to provide safe procedures for handling and management of subsurface fill/soils at the Site. A New York State-licensed professional engineer must oversee any excavation work conducted to ensure that the work is performed in accordance with the requirements of this plan. Figure 6 contains a flow chart of the requirements and procedures of the Soil Management Plan. The plan provides for the following procedures and requirements:

- For activities involving disturbances of the clean fill cover that do not extend below the warning/demarcation barrier, including planned activities such as new construction or utilities maintenance work, the cover must be reconstructed in accordance with the clean fill cover design criteria specified in the NYSDEC-approved OU-1 Final Design Report using materials meeting Restricted Residential Use Soil Cleanup Objectives (SCOs) identified in 6 NYCRR Part 375. Fill removed from above the barrier can be reused as on-Site backfill. If additional fill is needed, the soil must be from an acceptable borrow source(s) free of industrial and/or other potential sources of chemical or petroleum contamination and must meet Restricted Residential Use SCOs. The repair must include replacement of any damaged section of warning/ demarcation barrier or disturbed sections of the clean fill cover. A breach of the cover system outside the new Starlight Park ball field area may require replacement of any damaged surfacing product such as concrete or asphalt. A New York-licensed professional engineer must supervise cover system repair.

- The NYSDEC will be notified prior to the commencement of any excavation below the clean fill cover and warning/demarcation barrier that were installed at the Site as part of the completed RA construction activities.

- In the event of a planned excavation below the warning/demarcation barrier, the material below the barrier must be pre-characterized before commencing excavation activities below the warning/demarcation barrier (subsection 5.2).

- Prior to any excavation activities beneath the warning/demarcation barrier and clean fill cover, the workers who will undertake those activities are to be notified of the Site conditions with clear instructions regarding how the work is to proceed. Excavation activities conducted below the clean fill cover and warning/demarcation barrier in areas that have been pre-characterized and found to contain concentrations of individual VOCs or SVOCs that exceed Restricted Residential Use SCOs and/or that contain visual DNAPL tar, will be performed by 40-hour trained Occupational Health & Safety Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER)-certified personnel that are qualified to perform environmental work.

- Soil excavated from below the warning/demarcation barrier may be reused as on-Site backfill material beneath the demarcation/warning barrier provided the soil contains no visual evidence of DNAPL tar, has concentrations of total VOCs that do not exceed 10 ppm, and has concentrations of total SVOCs that do not exceed 500 ppm. Soil or fill that contains evidence of DNAPL tar, and/or does not meet the 500 ppm total SVOC/10 ppm total VOC criteria, must be transported off Site for disposal at a permitted facility.

- Site soil or fill that is excavated below the warning/demarcation barrier and that is transported off Site for disposal must be managed, characterized, and properly disposed of in accordance with NYSDEC regulations and directives.

- Soil excavated from below the warning/demarcation barrier shall be placed on plastic sheeting and covered with plastic while stockpiled.

- Any groundwater that is encountered during excavation work below the clean fill cover, and that must be removed from the excavation to accommodate this work, will be containerized and characterized for off-Site treatment and disposal in accordance with applicable NYSDEC rules and regulations.

- Any off-Site fill material brought to the Site for filling and grading purposes must be from an acceptable borrow source(s) free of industrial and/or other potential sources of chemical or petroleum contamination and meet Restricted Residential Use SCOs.

- The HASP presented in Appendix A addresses the health and safety practices that will be employed by all Site workers participating in excavation activities conducted below the warning/demarcation barrier in areas that have been pre-characterized and contain concentrations of individual VOCs or SVOCs that exceed Restricted Residential Use SCOs and/or visual DNAPL tar. The HASP also addresses, among other things, community air monitoring, odor control, and dust control. All activities performed under the HASP will comply with OSHA Regulations 29 Code of Federal Regulations (CFR)

Part 1910 and 1926, and all other applicable local, state, and federal regulations to protect worker health and safety. When necessary, the HASP will be amended to address any work-specific health and safety issues.

5.2 Pre-Characterization Sampling and Analyses

5.2.1 Sampling and Analyses

Soil or fill that will be disturbed below the clean fill cover and warning/demarcation barrier must be pre-characterized prior to commencing excavation activities. Continuous soil samples will be collected from selected boring location(s) using a Geoprobe™ or other sub-surface drilling method selected based on the work to be performed. The borings will be advanced to a final depth that is approximately 12 to 18 inches deeper than the anticipated depth of the planned excavation. Each continuous soil sample will be screened in the field using a Photoionization Detector (PID). One composite sample and one duplicate composite sample consisting of five grab samples, will be collected for laboratory analyses for every 2,000 cubic yards of estimated excavated material from below the clean fill cover and warning/demarcation barrier. In addition to the composite samples, one grab sample will be collected for analyses from the individual location with the highest PID measurement. If none of the five individual grab sample locations exhibit PID readings, one location will be selected at random. All sampling will take place in accordance with the FSP (Appendix B).

If the soil or fill is expected to be reused as backfill below the warning/demarcation barrier, the composite sample will be analyzed by a NYSDOH ELAP-certified laboratory for Target Compound List (TCL) SVOCs by United States Environmental Protection Agency (EPA) Method 8270C. The grab sample will be analyzed for TCL SVOCs by EPA method 8270C and TCL VOCs by EPA Method 8260B. Site soil or fill that is excavated below the warning/ demarcation barrier that must be disposed of at an approved off-Site facility may require additional analyses to satisfy the off-Site disposal facility's acceptance criteria requirements. Additional samples may also be required by the off-Site disposal facility. Detailed guidelines regarding sample QA/QC is presented in the QAPP (Appendix C).

6. Reporting

Written progress reports will be submitted to the NYSDEC annually as long as Site management activities are conducted. During periods of site construction activities, reports may be provided more frequently as directed by the NYSDEC.. The first progress report will be completed 6 months after the completion of the remedial action construction activities. Any NYSDEC-approved modifications to this Site Management Plan will be described in the progress reports. These reports will provide (at a minimum) the following information:

- A description of all Site management activities during that period.
- An as-built remediation excavation map (for any new intrusive activities).
- An as-built clean fill cover map (for any new intrusive activities).
- If the clean fill cover has been breached, the progress report will document that all work was performed in conformance with the SMP.
- Identification of all deliverables completed and submitted during the reporting period.
- All sampling results (e.g., post-remediation groundwater monitoring) and all other data received or generated by Con Edison or Con Edison’s contractors or agents, including certification and any notification information received from the Parks Department.
- Identification of all actions, including, but not limited to, data collection and implementation of the SMP that are scheduled for the next reporting period.
- An appendix containing all relevant correspondence for the reporting period.

The progress report contents and submittal schedule may be modified by the NYSDEC to reflect changes in the SMP activities.

Table

Table 1
Groundwater Sample Collection and Analytical Summary
East 173rd Street Works
Site Management Plan

Medium	Sampling Method	Analytical Parameters	Number of Samples[1]	Number of Field Blanks	Number of Trip Blanks	Number of Field Duplicates
Groundwater	Peristaltic pump, submersible pump, positive displacement pump	VOCs SVOCs	10	1	1	1
Purge Water	Grab from 55-gallon drums or polyethylene agricultural tank	TBD[2]	TBD[2]	TBD[2]	TBD[2]	TBD[2]

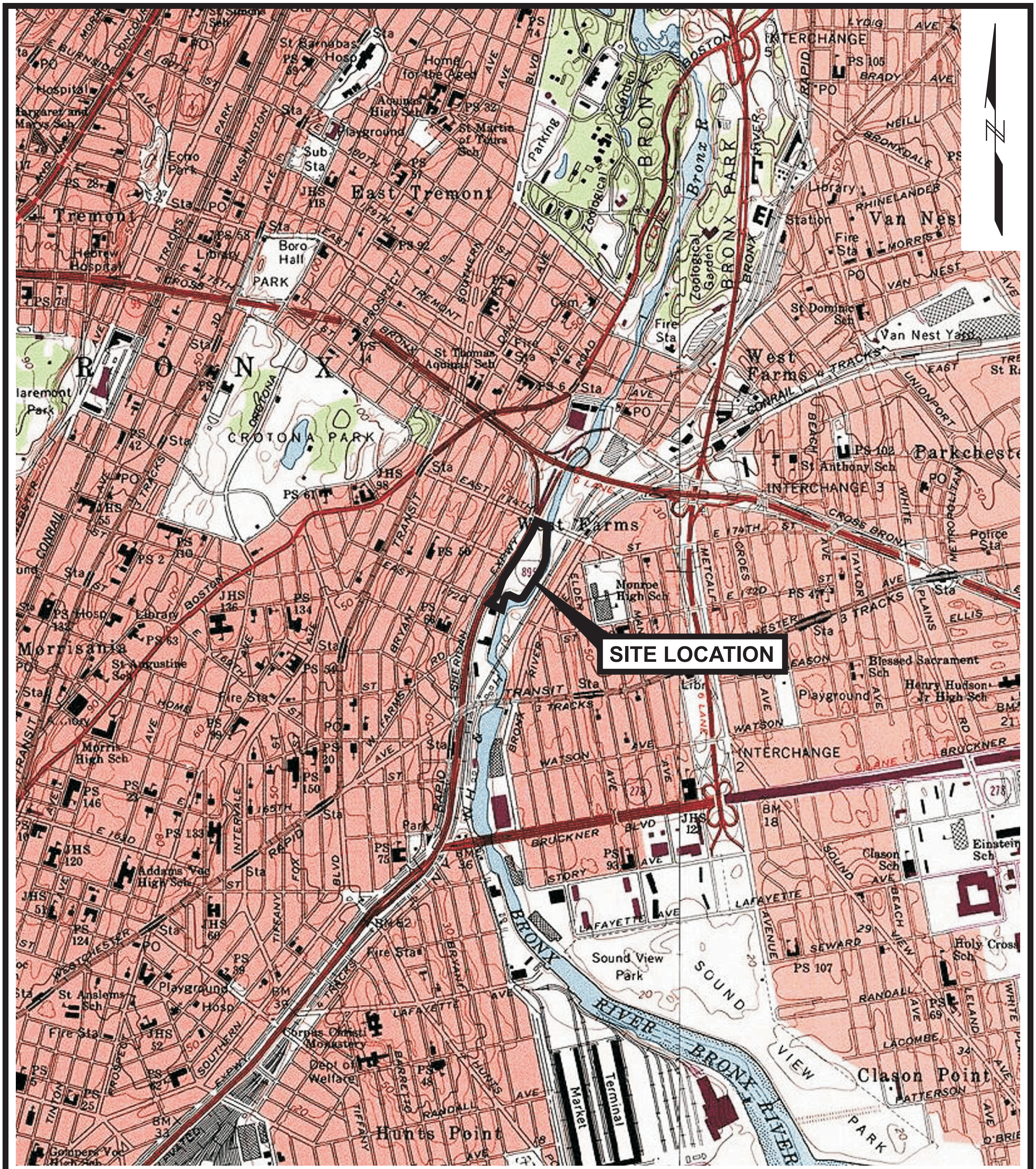
Methods:

[1] Number of groundwater samples collected per sampling round.

[2] The exact number of samples collected and analytical parameters analyzed for waste characterization will be dictated by the selected disposal facility.

TBD - to be determined
VOCs - EPA Method 8260B
SVOCs - EPA Method 8270C

Figures



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

0 2000 4000

SCALE, FEET

SITE MANAGEMENT PLAN
EAST 173RD STREET WORKS
BRONX, NEW YORK

CONSOLIDATED EDISON COMPANY
OF NEW YORK, INC.

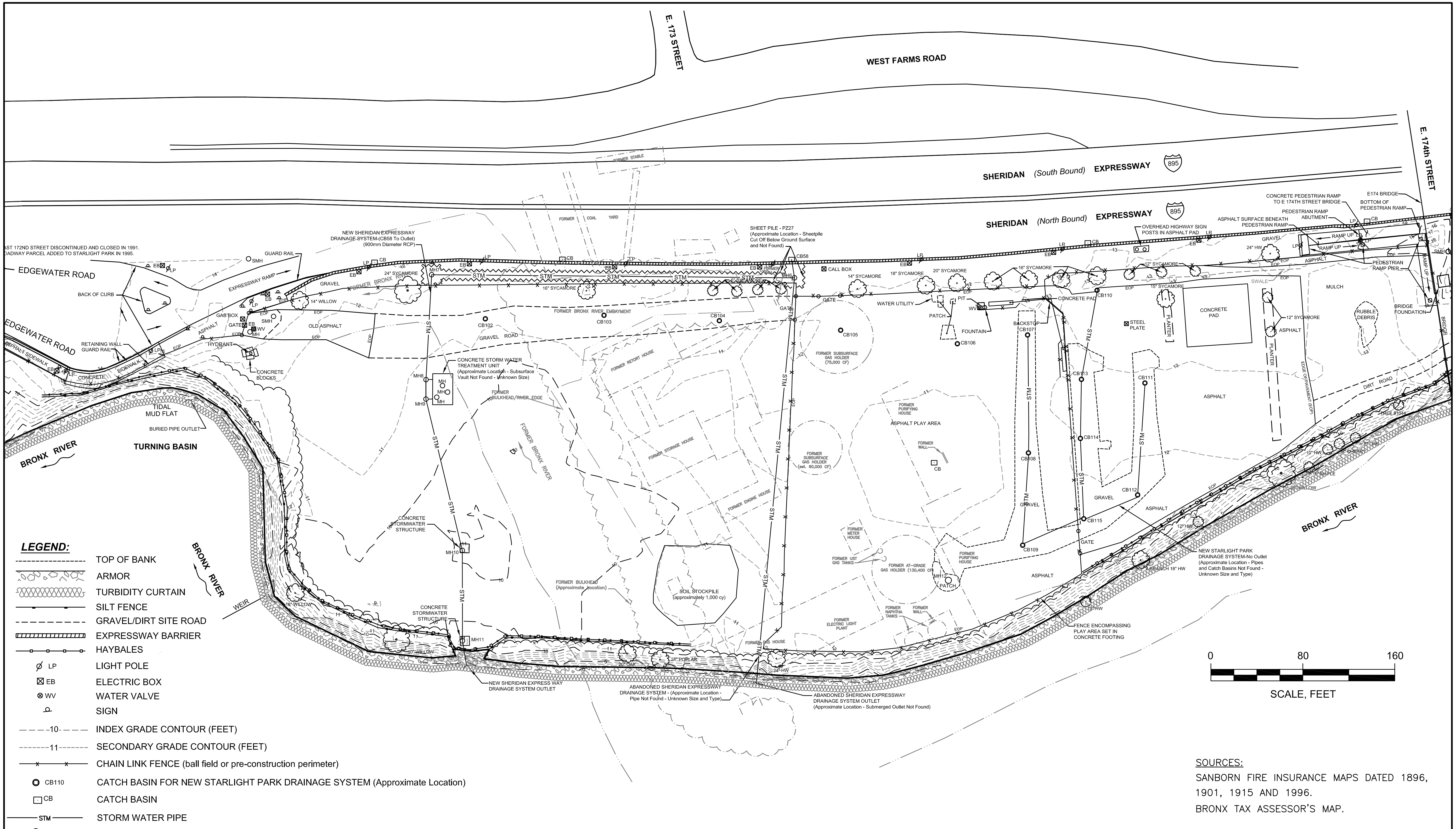
GEI Consultants

Project 013943-3-1103

SITE LOCATION MAP

March 2010

Figure 1



LEGEND:

TOP OF BANK
ARMOR
TURBIDITY CURTAIN
SILT FENCE
GRAVEL/DIRT SITE ROAD
EXPRESSWAY BARRIER
HAYBALES
LP LIGHT POLE
EB ELECTRIC BOX
WV WATER VALVE
SIGN
10 INDEX GRADE CONTOUR (FEET)
11 SECONDARY GRADE CONTOUR (FEET)
CHAIN LINK FENCE (ball field or pre-construction perimeter)
CB110 CATCH BASIN FOR NEW STARLIGHT PARK DRAINAGE SYSTEM (Approximate Location)
CB CATCH BASIN
STM STORM WATER PIPE
MH12 MANHOLE
WEED LINE/TREE LINE
12" SYCAMORE TREE
METER HOUSE HISTORICAL STRUCTURE (Approximate Location)
HISTORICAL WATER FEATURE (Approximate Location)

SOURCES:

SANBORN FIRE INSURANCE MAPS DATED 1896, 1901, 1915 AND 1996.

BRONX TAX ASSESSOR'S MAP.

SITE MANAGEMENT PLAN
EAST 173RD STREET WORKS
BRONX, NEW YORK

CONSOLIDATED EDISON COMPANY OF
NEW YORK, INC.

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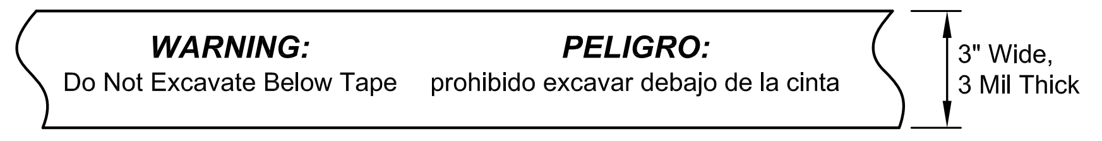
HISTORICAL STRUCTURES

Project 013943-3-1103
March 2010
Figure 2

WARNING DEMARCATION BARRIER DETAIL
NOT TO SCALE



WARNING TAPE DETAIL
NOT TO SCALE

LEGEND:

—·—·—	PROJECT LIMITS
– – 12 – –	GROUND SURFACE CONTOURS
—s—	SILT FENCE
x—x—x—x—x	CHAIN-LINK FENCE
●	TREE
⌇⌇⌇	SHEET PILE
▬	ACTUAL EXCAVATION LIMIT
4.0±	ACTUAL EXCAVATION ELEVATION
▨	WARNING DEMARCATION BARRIER 6-FEET BELOW REMEDIAL RESTORATION GRADE
☐	WARNING DEMARCATION BARRIER 3-FEET BELOW REMEDIAL RESTORATION GRADE

NOTES:
SHEET 1 OF 3: SITE AS-BUILT MAP, OU-1 REMEDIAL ACTION, STARLIGHT PARK - EAST 173rd STREET, BRONX, NEW YORK, PREPARED BY KENNON SURVEYING SERVICES, INC., WARREN, NJ, DATE: 6-24-08

0 30 60
SCALE, FEET

SITE MANAGEMENT PLAN
EAST 173RD STREET WORKS
BRONX, NEW YORK

CONSOLIDATED EDISON COMPANY
OF NEW YORK, INC.

PROJECT 013943-3-1103

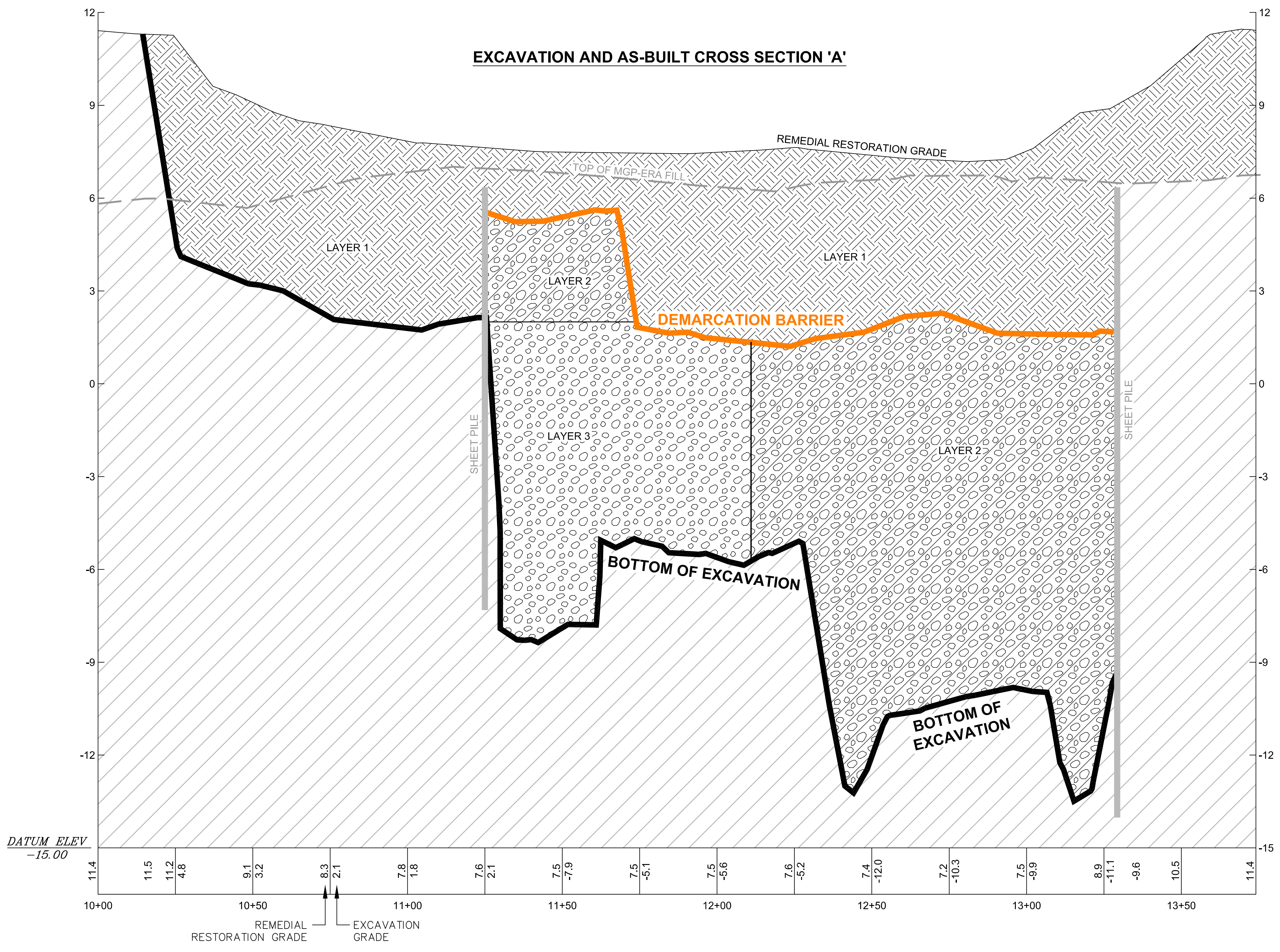
GEI Consultants
455 WINDING BROOK DRIVE
SUITE 201
GLASTONBURY, CONNECTICUT 06033

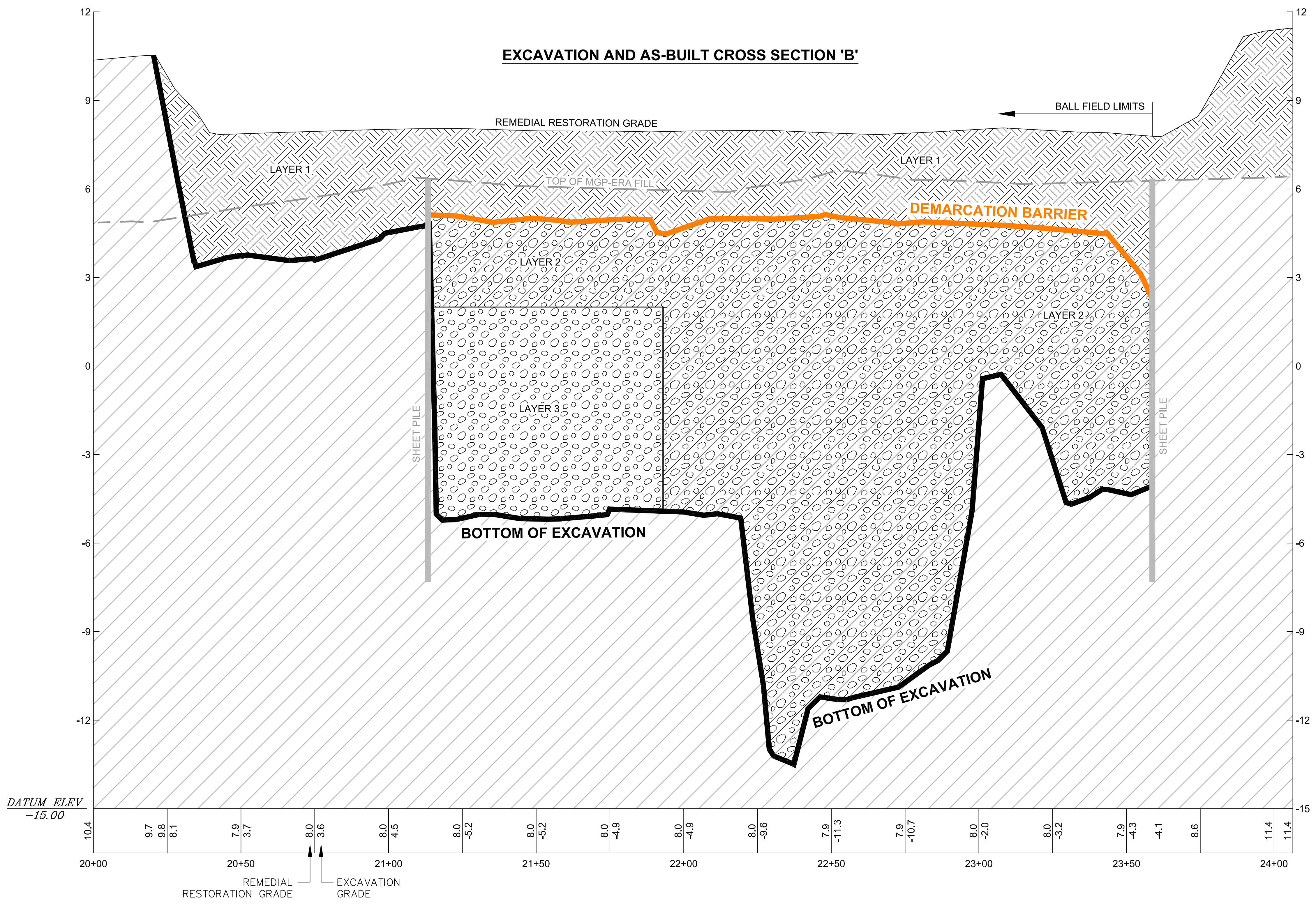
REMEDIAL SITE PLAN

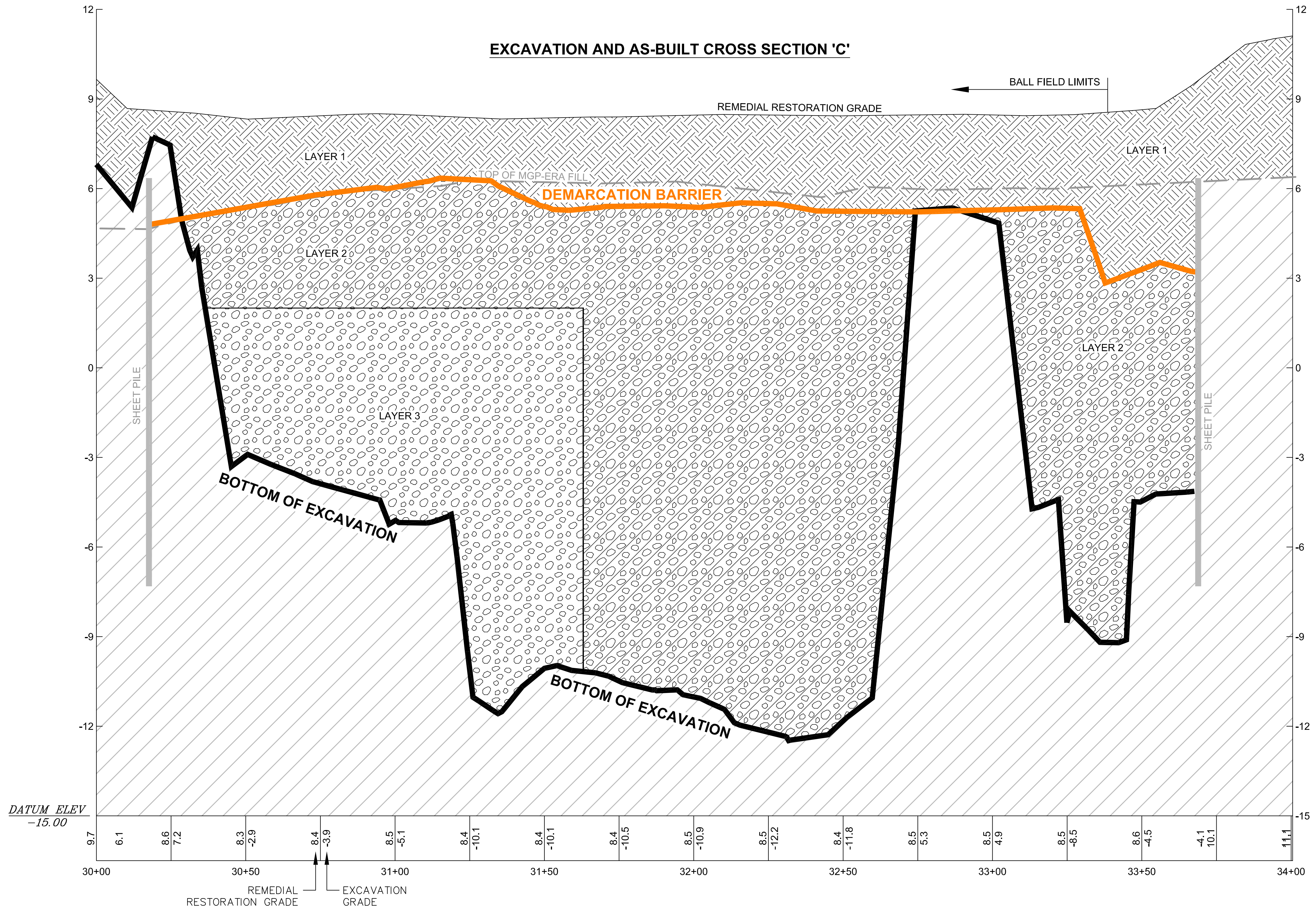
March 2010

Figure 3

I:\GEI\CON_ED\E 173rd\013943\SMP\03-12-2010\ E173 Remedial SITE PLAN.dwg \Mar 15, 2010





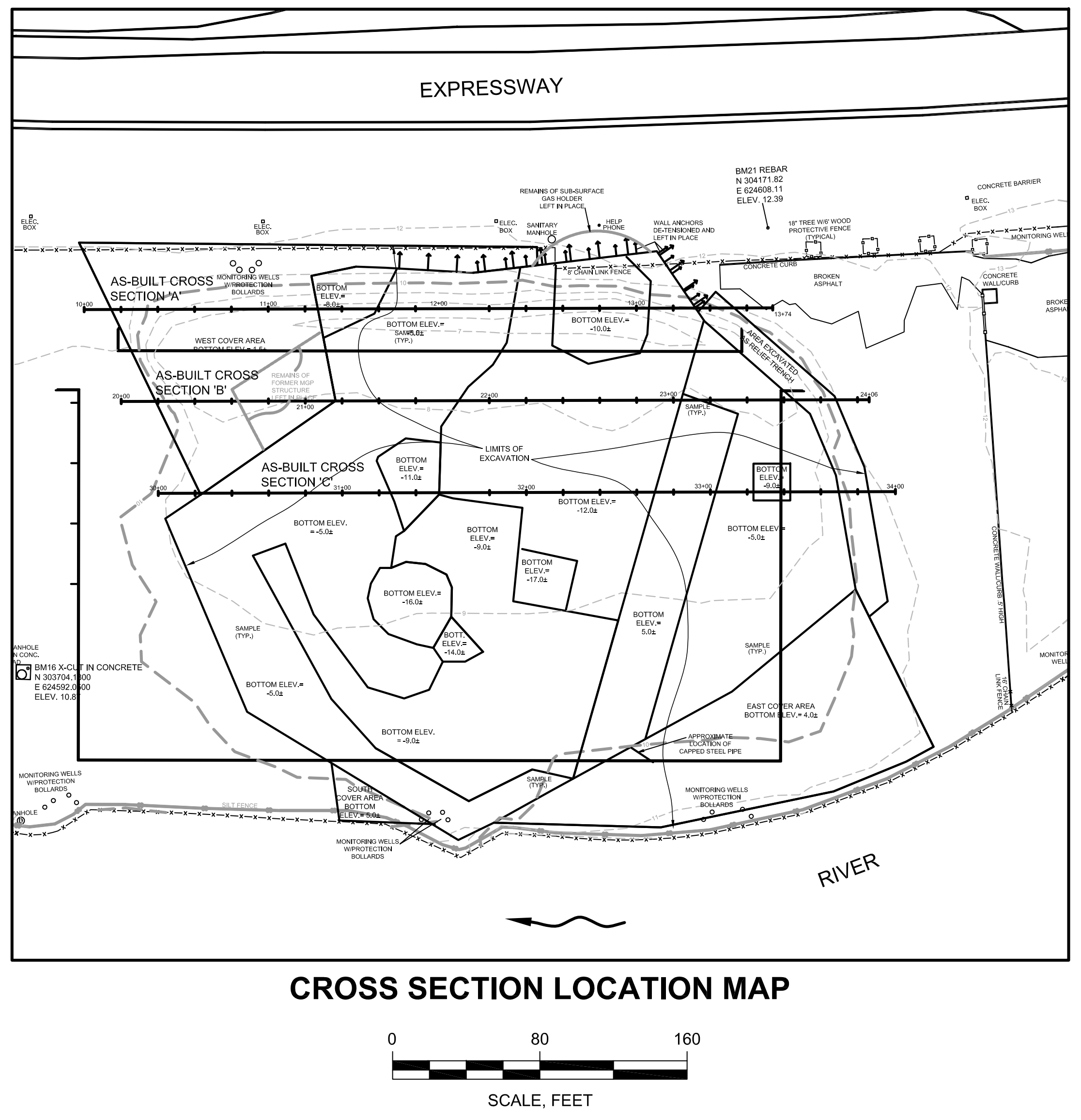


COVER LAYER LEGEND

▨ **LAYER 1** - IMPORTED CLEAN FILL

▨ **LAYER 2** - REUSED URBAN FILL AND/OR IMPORTED RECYCLED CONCRETE AGGREGATE

▨ **LAYER 3** - REUSED SUBSURFACE SOIL AND/OR REUSED URBAN FILL



CROSS SECTION LOCATION MAP

NOTES:

1. *SHEETS 1,2 AND 3 OF 3: SITE AS-BUILT MAP,* OU-1 REMEDIAL ACTION, STARLIGHT PARK - EAST 173rd STREET, BRONX, NEW YORK, PREPARED BY KENNON SURVEYING SERVICES, INC., WARREN, NJ, DATE: 6-24-08
2. ALL SHEET PILES WERE REMOVED.

SCALE: Horiz. 1" = 30'
Vert. 1" = 3'

SITE MANAGEMENT PLAN
EAST 173RD STREET WORKS
BRONX, NEW YORK

CONSOLIDATED EDISON COMPANY
OF NEW YORK, INC.

PROJECT 013943-3-1103

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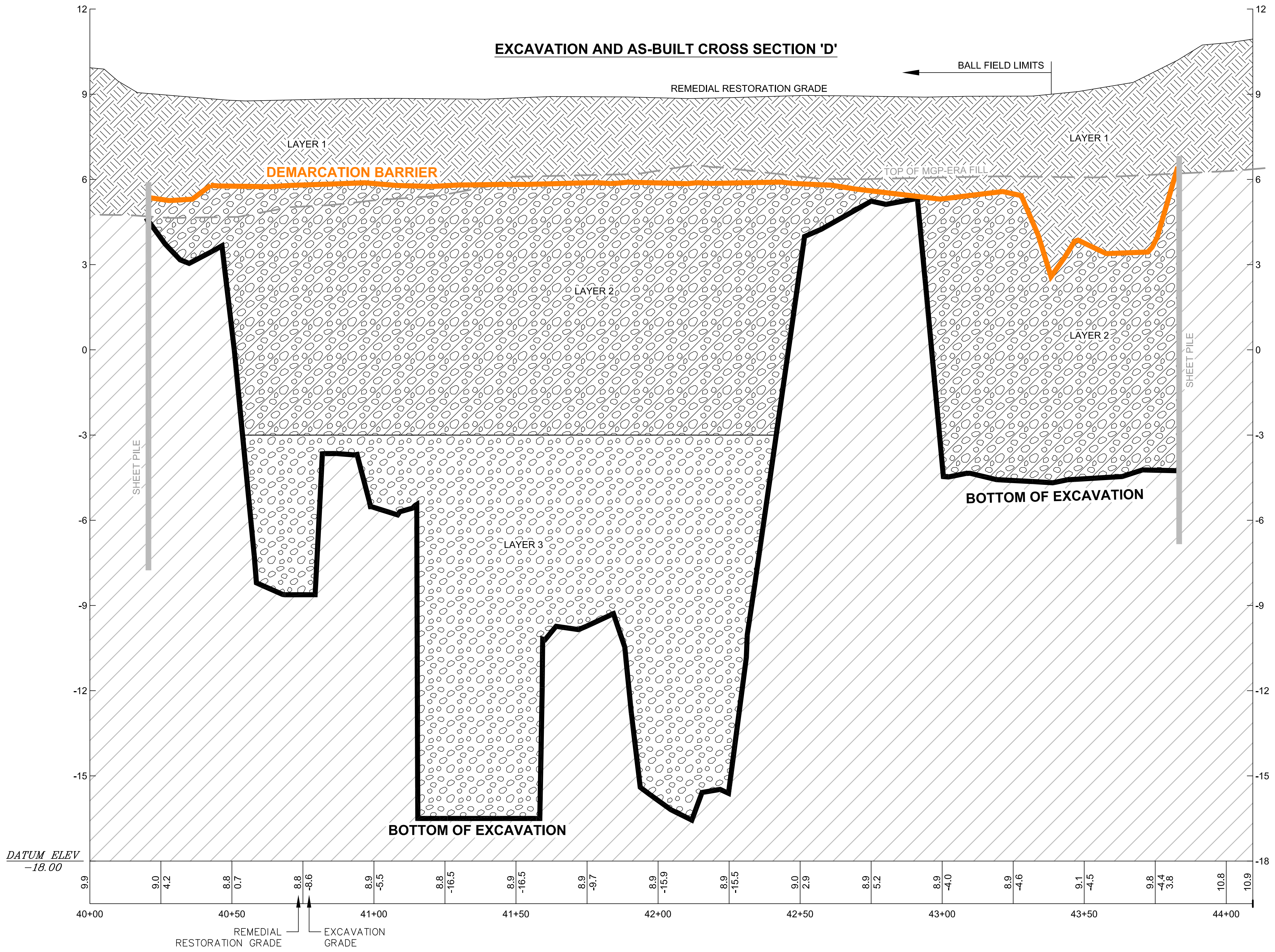
455 WINDING BROOK DRIVE
SUITE 201
GLASTONBURY, CONNECTICUT 06033

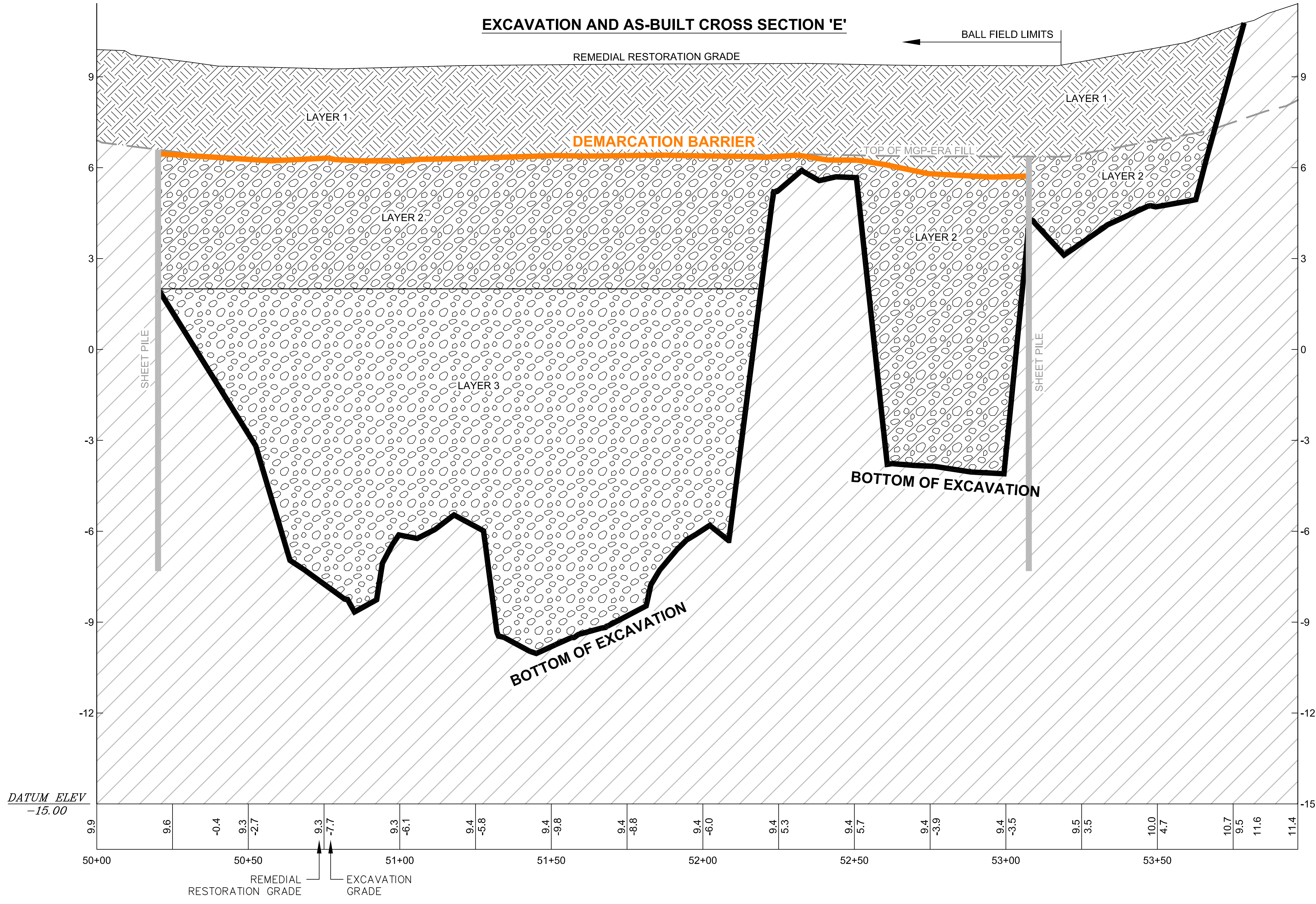
EXCAVATION CROSS SECTIONS A, B AND C

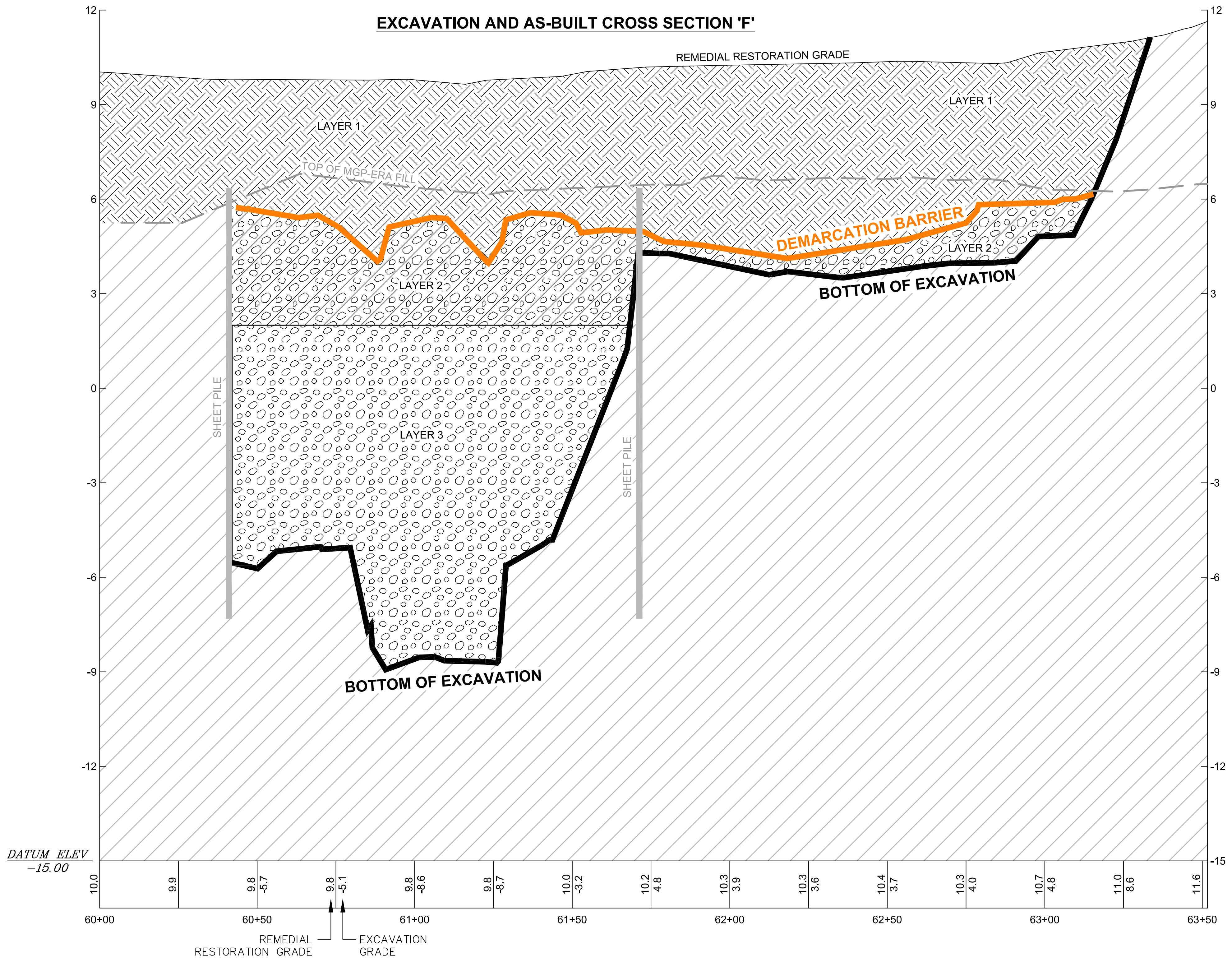
March 2010

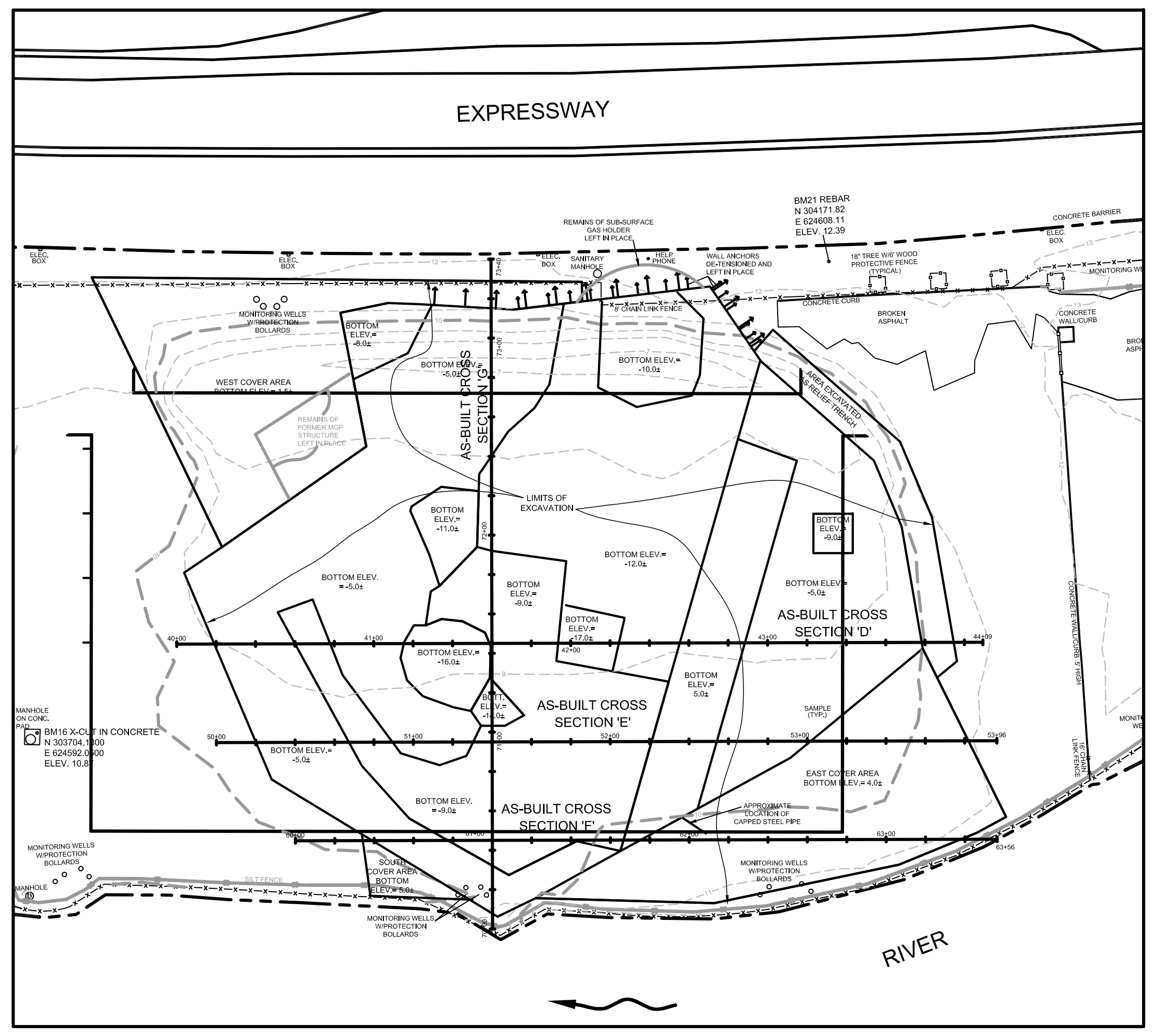
Figure 4

I:\GEI\CON_ED\E 173rd\013943\SMP\03-12-2010\ E173 Sections.dwg \Mar 15, 2010





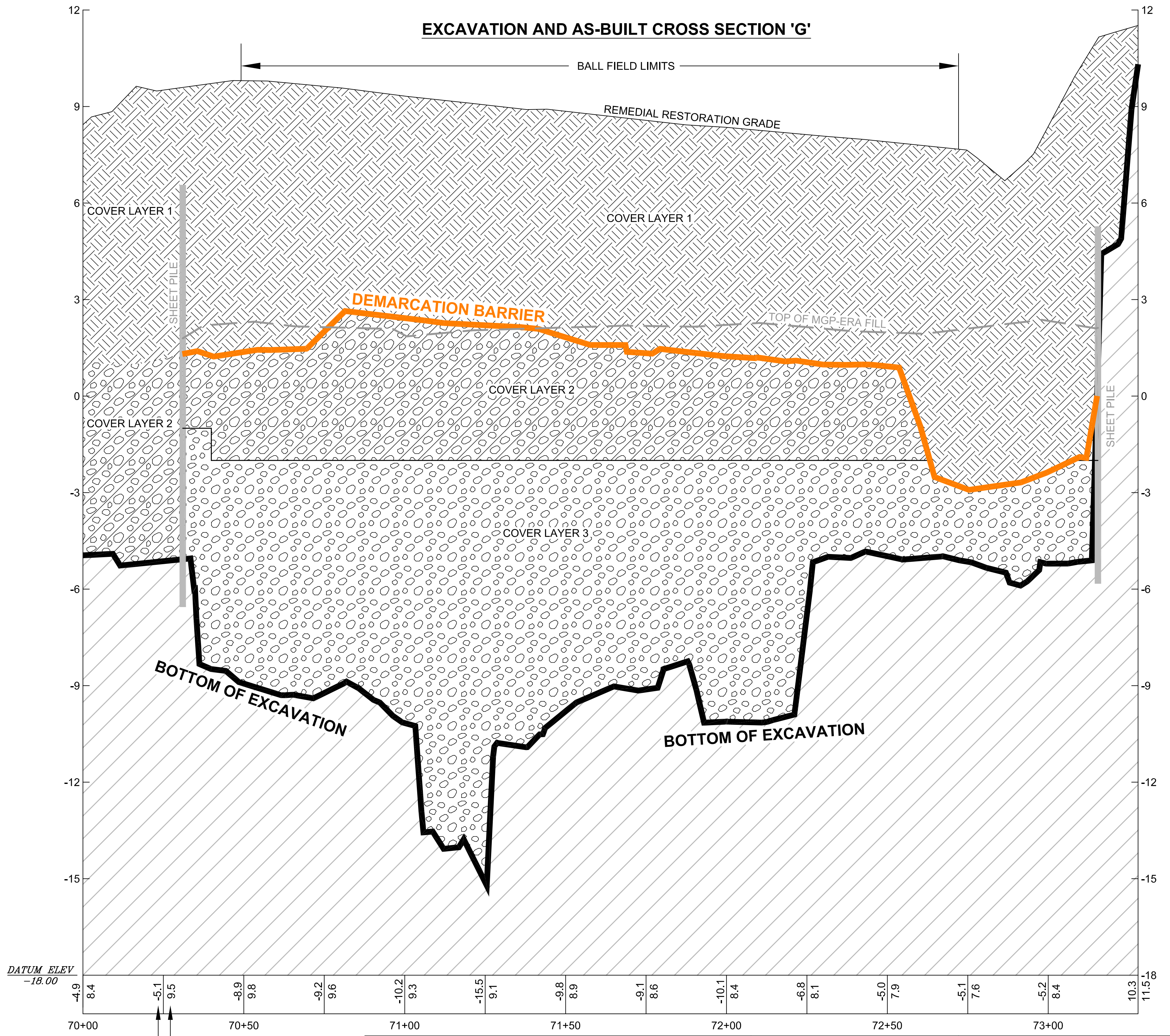




CROSS SECTION LOCATION MAP

0 80 160

SCALE, FEET



REMEDIAL RESTORATION GRADE — EXCAVATION GRADE

COVER LAYER LEGEND

▨ **LAYER 1** - IMPORTED CLEAN FILL

▨ **LAYER 2** - REUSED URBAN FILL AND/OR IMPORTED RECYCLED CONCRETE AGGREGATE

▨ **LAYER 3** - REUSED SUBSURFACE SOIL AND/OR REUSED URBAN FILL

SCALE: Horiz. 1" = 30'
Vert. 1" = 3'

NOTES:

SHEETS 1,2 AND 3 OF 3: SITE AS-BUILT MAP, OU-1 REMEDIAL ACTION, STARLIGHT PARK - EAST 173rd STREET, BRONX, NEW YORK, PREPARED BY KENNON SURVEYING SERVICES, INC., WARREN, NJ, DATE: 6-24-08

1. ALL SHEET PILES WERE REMOVED.

SITE MANAGEMENT PLAN
EAST 173RD STREET WORKS
BRONX, NEW YORK

CONSOLIDATED EDISON COMPANY
OF NEW YORK, INC.

PROJECT 013943-3-1103

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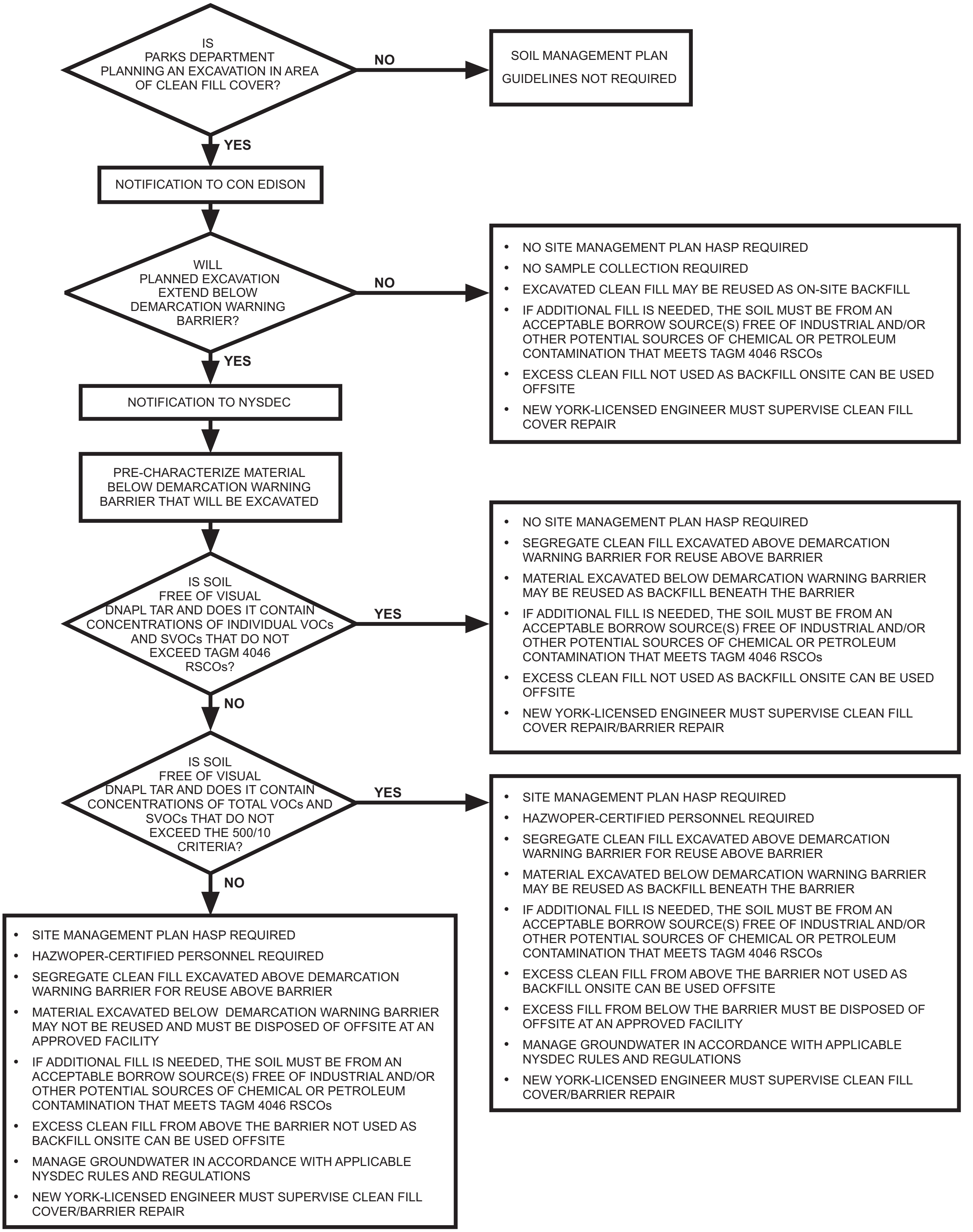
EXCAVATION CROSS SECTIONS D,E,F AND G

March 2010

Figure 5



IS PARKS DEPARTMENT PLANNING AN EXCAVATION IN AREA OF CLEAN FILL COVER?

SOIL MANAGEMENT PLAN GUIDELINES NOT REQUIRED

NOTIFICATION TO CON EDISON

WILL PLANNED EXCAVATION EXTEND BELOW DEMARCATION WARNING BARRIER?

- NO SITE MANAGEMENT PLAN HASP REQUIRED
- NO SAMPLE COLLECTION REQUIRED
- EXCAVATED CLEAN FILL MAY BE REUSED AS ON-SITE BACKFILL
- IF ADDITIONAL FILL IS NEEDED, THE SOIL MUST BE FROM AN ACCEPTABLE BORROW SOURCE(S) FREE OF INDUSTRIAL AND/OR OTHER POTENTIAL SOURCES OF CHEMICAL OR PETROLEUM CONTAMINATION THAT MEETS TAGM 4046 RSCOs
- EXCESS CLEAN FILL NOT USED AS BACKFILL ONSITE CAN BE USED OFFSITE
- NEW YORK-LICENSED ENGINEER MUST SUPERVISE CLEAN FILL COVER REPAIR

NOTIFICATION TO NYSDEC

PRE-CHARACTERIZE MATERIAL BELOW DEMARCATION WARNING BARRIER THAT WILL BE EXCAVATED

IS SOIL FREE OF VISUAL DNAPL TAR AND DOES IT CONTAIN CONCENTRATIONS OF INDIVIDUAL VOCs AND SVOCs THAT DO NOT EXCEED TAGM 4046 RSCOs?

- NO SITE MANAGEMENT PLAN HASP REQUIRED
- SEGREGATE CLEAN FILL EXCAVATED ABOVE DEMARCATION WARNING BARRIER FOR REUSE ABOVE BARRIER
- MATERIAL EXCAVATED BELOW DEMARCATION WARNING BARRIER MAY BE REUSED AS BACKFILL BENEATH THE BARRIER
- IF ADDITIONAL FILL IS NEEDED, THE SOIL MUST BE FROM AN ACCEPTABLE BORROW SOURCE(S) FREE OF INDUSTRIAL AND/OR OTHER POTENTIAL SOURCES OF CHEMICAL OR PETROLEUM CONTAMINATION THAT MEETS TAGM 4046 RSCOs
- EXCESS CLEAN FILL NOT USED AS BACKFILL ONSITE CAN BE USED OFFSITE
- NEW YORK-LICENSED ENGINEER MUST SUPERVISE CLEAN FILL COVER REPAIR/BARRIER REPAIR

IS SOIL FREE OF VISUAL DNAPL TAR AND DOES IT CONTAIN CONCENTRATIONS OF TOTAL VOCs AND SVOCs THAT DO NOT EXCEED THE 500/10 CRITERIA?

- SITE MANAGEMENT PLAN HASP REQUIRED
- HAZWOPER-CERTIFIED PERSONNEL REQUIRED
- SEGREGATE CLEAN FILL EXCAVATED ABOVE DEMARCATION WARNING BARRIER FOR REUSE ABOVE BARRIER
- MATERIAL EXCAVATED BELOW DEMARCATION WARNING BARRIER MAY BE REUSED AS BACKFILL BENEATH THE BARRIER
- IF ADDITIONAL FILL IS NEEDED, THE SOIL MUST BE FROM AN ACCEPTABLE BORROW SOURCE(S) FREE OF INDUSTRIAL AND/OR OTHER POTENTIAL SOURCES OF CHEMICAL OR PETROLEUM CONTAMINATION THAT MEETS TAGM 4046 RSCOs
- EXCESS CLEAN FILL FROM ABOVE THE BARRIER NOT USED AS BACKFILL ONSITE CAN BE USED OFFSITE
- EXCESS FILL FROM BELOW THE BARRIER MUST BE DISPOSED OF OFFSITE AT AN APPROVED FACILITY
- MANAGE GROUNDWATER IN ACCORDANCE WITH APPLICABLE NYSDEC RULES AND REGULATIONS
- NEW YORK-LICENSED ENGINEER MUST SUPERVISE CLEAN FILL COVER/BARRIER REPAIR

- SITE MANAGEMENT PLAN HASP REQUIRED
- HAZWOPER-CERTIFIED PERSONNEL REQUIRED
- SEGREGATE CLEAN FILL EXCAVATED ABOVE DEMARCATION WARNING BARRIER FOR REUSE ABOVE BARRIER
- MATERIAL EXCAVATED BELOW DEMARCATION WARNING BARRIER MAY NOT BE REUSED AND MUST BE DISPOSED OF OFFSITE AT AN APPROVED FACILITY
- IF ADDITIONAL FILL IS NEEDED, THE SOIL MUST BE FROM AN ACCEPTABLE BORROW SOURCE(S) FREE OF INDUSTRIAL AND/OR OTHER POTENTIAL SOURCES OF CHEMICAL OR PETROLEUM CONTAMINATION THAT MEETS TAGM 4046 RSCOs
- EXCESS CLEAN FILL FROM ABOVE THE BARRIER NOT USED AS BACKFILL ONSITE CAN BE USED OFFSITE
- MANAGE GROUNDWATER IN ACCORDANCE WITH APPLICABLE NYSDEC RULES AND REGULATIONS
- NEW YORK-LICENSED ENGINEER MUST SUPERVISE CLEAN FILL COVER/BARRIER REPAIR

SITE MANAGEMENT PLAN
EAST 173RD STREET WORKS
BRONX, NEW YORK

CONSOLIDATED EDISON COMPANY
OF NEW YORK, INC.

GEI Consultants

Project 013943-3-1103

SOIL MANAGEMENT PLAN DECISION GUIDELINES

March 2010

Figure 6

GEI\CON_ED\E 173rd\013943\SMP\E173-DECISION.CDR

Exhibit

Starlight Park
Bronx, New York
NYSDEC VCA Index No. 02-0003-02-08
Site No. V00522-2

ANNUAL INSPECTION AND CERTIFICATION CHECKLIST

Date: ______________________________

Inspector (Professional Engineer): ______________________________

Weather Conditions: ______________________________

Inspection (Annually)

1. Inspection of entire clean fill cover system completed. (Including visual inspection and survey.) ☐ Yes ☐ No

Engineered Control

2. Are there any animal burrows greater than 6 inches relative to the surrounding grade noted within the limits of the clean fill cover? ☐ Yes* ☐ No

   Describe: ______________________________

If yes, describe location, diameter, and depth. Burrow holes shall be repaired following the cover system design criteria and using similar materials as the system in place. Certification of the repair will be made by a New York-Licensed Professional Engineer.

3. Are there any areas of settlement and/or erosion and/or unauthorized excavations or protrusions greater than 6 inches within the area of the clean fill cover system relative to the as-built surface grade of the cover? ☐ Yes* ☐ No

   Describe: ______________________________

If yes, describe location, size, and amount of settlement. Repair engineering control deficiencies using cover system design criteria and using similar materials as the system in place. Certification of the repair will be made by a New York-Licensed Professional Engineer.

Park-Wide Inspection

4. Are the monitoring wells damaged or missing? ☐ Yes* ☐ No

   Describe: ______________________________

5. Are the Park cover materials (e.g., buildings, pavement) in the area of the clean fill cover system damaged? ☐ Yes ☐ No

   Describe: ______________________________

6. Have irrigation or drinking water wells been installed in the Park? ☐ Yes* ☐ No

   Describe: ______________________________

Land Use Changes

7. Is the current land use of the area within the limits of the clean cover fill system being used as a public park? ☐ Yes* ☐ No

If no, describe: ______________________________

8. If applicable, is an environmental easement on file in the Land Division of Records of the New York City Registrar's office? ☐ Applicable ☐ Not Applicable

If applicable, confirm easement and any amendments are properly recorded.

Provide the following information for the recorded easement.

Book Number: ______________________________
Page Number: ______________________________
Date easement was filed in Registrar's office: ______________________________

Have any amendments and/or additional filings been recorded that may modify or supersede the easement? ☐ Yes ☐ No

If yes, explain: ______________________________

Authorized Excavations

9. Where any authorized excavations conducted at the site during the last year? ☐ Yes ☐ No

Provide a brief description of the authorized excavation to include the specific location and date of the work as well as the authorized work plan or notification date.

Corrective Actions

Description and scheduled date of any required corrective action (animal burrow repair, erosion repair, settlement repair, unauthorized excavation repair).

*For items that are checked, notify Consolidated Edison of New York, Inc. within 24 hours.

Inspector’s Signature: ______________________________ Date: _____________

Reviewed by : _____________________________ Date: _____________

Submit Inspection Reports to: Site Plan Attached

Consolidated Edison of New York, Inc.
Mr. Richard Rienzo, P.E.
31-01 Avenue/Building 138, Floor
Long Island City, New York 11105-2048

Appendix A

Health and Safety Plan

GEI Consultants

Geotechnical
Environmental
Water Resources
Ecological

Sample Health and Safety Plan
East 173rd Street Works Former MGP Site

Starlight Park, Bronx, New York
VCA Index No. D2-0003-02-08
Site #: V00552

Prepared for:
Consolidated Edison Company
of New York, Inc.
31-01 20th Avenue
Astoria, NY 11105

Prepared by:
GEI Consultants, Inc.
1 Greenwood Avenue Suite 210
Montclair, NJ 07042
(973) 509-9650

March 16, 2010
Project 013943-3-1103

Table of Contents

Tables

Figures

Attachments

H:\WPROC\Project\CON-ED\East 173rd Street\RAR\March 2010 SMP\Apppendix A - HASP\HASP E173 SMP 0310.doc

Abbreviations and Acronyms

ACGIH	American Conference of Government Industrial Hygienists
ANSI	American National Standards Institute
APR	Air-Purifying Respirator
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CAMP	Community Air Monitoring Plan
CFR	Code of Federal Regulation
CHSS	Corporate Health and Safety Specialist
CMS	Chip Measuring System
DNAPL	Dense Non-Aqueous Phase Liquid
DOT	Department of Transportation
EH&S	Environmental, Health and Safety
EPA	United States Environmental Protection Agency
FSP	Field Sampling Plan
HASP	Health and Safety Plan
IDW	Investigation-derived waste
MGP	Manufactured Gas Plant
MOTs	Materials of Trade
MSDSs	Material Safety Data Sheets
NYCDEP	New York City Department of Environmental Protection
NYSASP	New York State Analytical Services Protocol
NYSDEC	New York State Department of Environmental Conservation
NYSDEP	New York State Department of Environmental Protection
NYSDOH	New York State Department of Health
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAHs	Polycyclic Aromatic Hydrocarbons
PE	Performance Evaluation
PEC	Project Emergency Coordinator
PEL	Permissible Exposure Limit
PID	Photoionization Detector
PPE	Personal Protective Equipment
RPD	Relative Percent Difference
SCBA	Self-Contained Breathing Apparatus
SMP	Site Management Plan
SSO	Site Safety Officer
SVOCs	Semivolatile Organic Compounds
TVOC	Total Volatile Organic Compounds
UFPO	Underground Facilities Protection Organization
USGS	United States Geological Survey
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds

Health and Safety Plan Summary

Emergency Contacts

Emergency contacts will be established prior to commencement of any Site work conducted in accordance with the Site Management Plan (SMP)

Emergency Procedures

Emergency procedures are described in Section 6.

Site-Specific Hazards and Training

Site Specific Hazards are described in Section 2.

The Site Safety Officer will be responsible for providing Site-specific training to all personnel that work at the Site. This training will cover 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.
- Acute effects of compounds at the Site.
- Decontamination procedures.

Personnel will be required to sign and date the Site-Specific Training Form provided in Attachment A prior to working on Site.

General Health and Safety Requirements

Personnel will be required to sign and date the Plan Acceptance Form provided in Attachment A prior to working on-Site.

Personnel Protective Equipment

Level D protection will be worn for initial entry on Site and for all activities except as noted in Section 3. Level D protection will consist of:

- Standard work clothes

- Steel-toe safety boots
- Safety glasses or goggles must be worn when splash hazard is present
- Nitrile outer gloves and PVC or nitrile inner gloves must be worn during all sampling activities
- Hard hat (must be worn during all sampling activities)

Level C protection, unless otherwise specified in Section 3, will consist of Level D equipment and the following additional equipment:

- Full-face or half-face air-purifying respirator (APR)
- Combination dust/organic vapor cartridges
- Tyvek coveralls
- PVC or nitrile inner and nitrile outer gloves

Level B protection will consist of the following equipment:

- Hard hat
- Positive Pressure Self-Contained Breathing Apparatus (SCBA) or positive pressure air line and respirator with escape SCBA
- PE-coated Tyvek coverall
- Nitrile outer and PVC or nitrile inner gloves
- Safety Boots
- Nitrile boot covering
- 5-minute escape SCBA

Air Monitoring

A summary of the action levels and restrictions is presented in Table 1. Air monitoring equipment calibration and maintenance procedures are provided in Attachment B.

1. Introduction

1.1 Purpose and Policy

The purpose of this Site Management Health and Safety Plan (HASP) is to establish personnel protection standards and mandatory safety practices and procedures. This plan assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may arise while conducting intrusive activities that extend beneath the clean fill cover and demarcation warning barrier installed at the Site as part of Remedial Action construction activities. This HASP must be followed for all excavation activities conducted below the clean fill cover and warning/demarcation barrier in areas that have been pre-characterized and found to contain concentrations of individual volatile organic compounds (VOCs) or semivolatile organic compounds (SVOCs) that exceed TAGM 4046 RSCOs and/or that contain visual dense non-aqueous phase liquid (DNAPL) tar. This safety plan will also be followed by personnel conducting on-Site subsurface soil pre-characterization and groundwater sampling.

The provisions of the safety plan are mandatory for all on-Site personnel. Any supplemental plans used by subcontractors shall conform to this plan as a minimum. All personnel who engage in project activities must be familiar with this plan, comply with its requirements, and sign the Plan Acceptance Form (Attachment A), prior to working on the Site. The Plan Acceptance Form must be submitted to the Project Contractor Health and Safety Officer. The Plan may be amended to include health and safety requirements or procedures specific to a planned excavation below the clean fill cover system and demarcation warning barrier.

1.2 Site Description

The East 173rd Street Works former manufactured gas plant (MGP) Site (Site) is located between the Sheridan Expressway and the Bronx River in the neighborhood of West Farms, Borough of the Bronx, New York. The location of the Site is illustrated in Figure 1 of the Site Management Plan (SMP) dated June 24, 2005, taken from a portion of the United States Geological Survey (USGS) Topographic map of the Central Park, New York, the New Jersey Quadrangle, and the Flushing, New York Quadrangle.

The former MGP Site occupied a single parcel of land that is currently owned by the City of New York, and is operated by the New York City Department of Parks and Recreation (Parks Department). The Site is located within Starlight Park, a part of the Bronx River Park. The park is zoned R7-1, a general residential district. The current and intended future use of the Site is a city park. The former MGP Site is located in the middle portion of Starlight Park and was approximately 3 acres in size. The former MGP property boundary and former MGP structures are shown in Figure 2 of the SMP. Starlight Park is approximately 7.3 acres in size, and is currently designated by the Bronx Assessor's Office as Block 03019 Lot 0100.

1.3 Scope of Work

The objective of the proposed work will be communicated to NYSDEC and Con Edison in accordance with Section 4 of the SMP.

1.4 Project Team Organization

The positions of principal personnel associated with any Site work conducted in accordance with the SMP are to be assigned prior the commencement of Site work. These positions are: Project Manager, H&S Officer, Project Engineer, Site Safety Officer.

All Project Contractor personnel must be appropriately trained in first aid and hazardous waste safety procedures, including the operating and fitting of personal protective equipment, and are experienced with the field operations planned for this Site.

2. Risk Analysis

2.1 Chemical Hazards

Potential contaminants, which may be encountered while conducting intrusive activities at the Site, include VOCs, polycyclic aromatic hydrocarbons (PAHs), cyanide, and metals. Some relevant properties of these compounds are shown in Table 2.1.

Of the listed volatile chemicals, benzene has the lowest Permissible Exposure Limit (PEL) as set by Occupational Safety and Health Administration (OSHA) and hence sets the action limit for monitoring with a Photoionization Detector (PID). PAHs could pose significant health threats if ingested or inhaled as a dust. On-Site personnel will make efforts to avoid activities that could generate potentially contaminated dust, and work upwind of soils and groundwater during excavation activities. The metals potentially present in the Site soils are unlikely to become airborne because of their low vapor pressures and moist conditions under which they are expected to be encountered.

In addition to the compounds detected on Site, some of the solvents used in decontamination of equipment are potentially hazardous to human health if they are not used properly. Material Safety Data Sheets for substances that will be used on Site and a select number of Site contaminants are included in Attachment C.

2.2 Radiation Hazards

No radiation hazards are known or expected at the Site.

2.3 Physical Hazards

2.3.1 Slip, Trip and Fall

The most common hazards that will be encountered during excavation and drilling operations are slip, trip, and fall hazards. In order to prevent these from happening:

- Wear work boots in good condition with non-slip soles.
- Maintain good visibility of the work area.
- Use special caution when walking on uneven or debris-ridden ground surfaces.

2.3.2 Explosion

No explosion hazards are expected for any intrusive activities that extend beneath this clean fill cover system. However, explosion hazards should be assessed on a work-specific basis at this Site.

2.3.3 Heat Stress

The use of Level C protective equipment, or greater, may create heat stress. Monitoring of personnel wearing personal protective clothing should commence when the ambient temperature is 72° F or above. Table 2.2 presents the suggested frequency for such monitoring. Monitoring frequency should increase as ambient temperature increases or as slow recovery rates are observed. Refer to the Table 2.3 to assist in assessing when the risk for heat related illness is likely. To use this table, the ambient temperature and relative humidity must be obtained (a regional weather report should suffice). Heat stress monitoring should be performed by the Site Safety Officer (SSO), who shall be able to recognize symptoms related to heat stress. To monitor the workers, be familiar with the following heat-related disorders and their symptoms:

- **Prickly Heat** (Heat rash).Painful, itchy red rash. Occurs during sweating, on skin covered by clothing.
- **Heat Cramps -** Painful spasm of arm, leg, or abdominal muscles, during or after work.
- **Heat Exhaustion** - Headache, nausea, dizziness. Cool, clammy, moist skin. Heavy sweating. Weak, fast pulse. Shallow respiration, normal temperature.
- **Heat Fatigue -** Weariness, irritability, loss of skill for fine or precision work. Decreased ability to concentrate. No loss of temperature control.
- **Heat Syncope** (Heat Collapse) - Fainting while standing in a hot environment.
- **Heat Stroke -** Headache, nausea, weakness, hot dry skin, fever, rapid strong pulse, rapid deep respirations, loss of consciousness, convulsions, coma. **This is a life threatening condition.**

Do not permit a worker to wear a semi-permeable or impermeable garment when they are showing signs or symptoms of heat-related illness.

To monitor the worker, measure:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.

- If the heart rate exceeds 100 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.
- If the heart rate still exceeds 100 beats per minute at the next rest period, shorten the following work cycle by one-third. A worker cannot return to work after a rest period until their heart rate is below 100 beats per minute.
- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).
- If oral temperature exceeds 99.6° F (37.6° C), shorten the next work cycle by one-third without changing the rest period. A worker cannot return to work after a rest period until their oral temperature is below 99.6° F.
- If oral temperature still exceeds 99.6° F (37.6° C) at the beginning of the next rest period, shorten the following cycle by one-third.
- Do <u>not</u> permit a worker to wear a semi-permeable or impermeable garment when oral temperature exceeds 100.6° F (38.1° C).

Prevention of Heat Stress - Proper training and preventative measures will aid in averting loss of worker productivity and serious illness. Heat stress prevention is particularly important because once a person suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat related illness. To avoid heat stress the following steps should be taken:

- Adjust work schedules.
- Mandate work slowdowns as needed.
- Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.
- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
- Maintain worker's body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, i.e., eight fluid ounces (0.23 liters) of water must be ingested for approximately every eight ounces (0.23 kg) of weight lost. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful:
- Maintain water temperature 50o to 60oF (10o to 16.6oC).
- Provide small disposal cups that hold about four ounces (0.1 liter).

- Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or dilute drinks) before beginning work.
- Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.
- Train workers to recognize the symptoms of heat related illness.

2.3.4 Cold-Related Illness

If work on this project begins in the winter months, thermal injury due to cold exposure can become a problem for field personnel. Systemic cold exposure is referred to as hypothermia. Local cold exposure is generally called frostbite.

Hypothermia - Hypothermia is defined as a decrease in the patient core temperature below 96°F. The body temperature is normally maintained by a combination of central (brain and spinal cord) and peripheral (skin and muscle) activity. Interference with any of these mechanisms can result in hypothermia, even in the absence of what normally is considered a "cold" ambient temperature. Symptoms of hypothermia include: shivering, apathy, listlessness, sleepiness, and unconsciousness.

Frostbite - Frostbite is both a general and medical term given to areas of local cold injury. Unlike systemic hypothermia, frostbite rarely occurs unless the ambient temperatures are less than freezing and usually less than 20°F. Symptoms of frostbite are: a sudden blanching or whitening of the skin; the skin has a waxy or white appearance and is firm to the touch; tissues are cold, pale, and solid.

Prevention of Cold-Related Illness - To prevent cold-related illness:

- Educate workers to recognize the symptoms of frostbite and hypothermia
- Identify and limit known risk factors:
- Assure the availability of enclosed, heated environment on or adjacent to the Site.
- Assure the availability of dry changes of clothing.
- Assure the availability of warm drinks.
- Start (oral) temperature recording at the job Site:
    - At the Field Team Leader's discretion when suspicion is based on changes in a worker's performance or mental status.
    - At a worker's request.

  - As a screening measure, two times per shift, under unusually hazardous conditions (e.g., wind-chill less than 20°F, or wind-chill less than 30°F with precipitation).
  - As a screening measure whenever any one worker on the Site develops hypothermia.

Any person developing moderate hypothermia (a core temperature of 92°F) cannot return to work for 48 hours.

2.4 Task Hazard Analysis

2.4.1 Excavation and Soil Boring

Excavation and drilling activities associated with these tasks are inherently dangerous. Special attention should be given to establishing the location of any underground utilities prior to excavating or drilling. Prior to beginning any intrusive investigation work in the area of the clean fill cover system, the Underground Facilities Protection Organization (UFPO) will be contacted for a utility mark-out. All areas subject to intrusive activities must also be cleared by the Parks Department (or current Site owner) for the location of any underground utilities that may be installed within the limits of the clean cover fill system.

Chemical exposure may also occur as drill cuttings or stockpiled soils are handled, and split spoon or grab samples are collected. Activities will be conducted in Level D, but personnel should be prepared to upgrade to Level C when pockets of contaminants are brought to the surface and breathing zone air becomes contaminated.

2.4.2 Groundwater Sampling

Groundwater sample collection involves the transfer of potentially contaminated water to drums and/or sample vials. Care shall be taken to avoid contact of sample water with skin. Well development and groundwater sampling shall be performed with PVC or nitrile inner gloves, outer nitrile gloves, and standard Level D protection.

2.4.3 Site Survey

Any Site survey activities will be conducted in standard Level D protection.

3. Personnel Protection and Monitoring

3.1 Medical Surveillance

All on-Site personnel that will conduct excavation or drilling below clean fill cover and demarcation barrier must certify that they are participating in a medical surveillance program that complies with OSHA regulations for hazardous waste operations (i.e., 29 CFR 1910.120 and 29 CFR 1926.65).

3.2 OSHA Training

All on-Site personnel who will be actively involved in pre-characterization activities, intrusive activities beneath the clean fill cover and demarcation barrier, or groundwater sampling must have completed hazardous waste operations-related training, as required by OSHA Regulations 29 CFR 1910.120. Personnel who completed this training more than 12 months prior to the start of the project must have completed an 8-hour refresher course within the past 12 months.

Documentation of OSHA training for project personnel must be provided to Con Edison prior to starting work.

3.3 Site-Specific Training

The Site Safety Officer 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. This training will be conducted prior to starting fieldwork, and will 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.
- Requirements of this HASP.
- Work practices by which the employee can minimize risk from hazards. This may include a specific review of heavy equipment safety, safety during inclement weather, changes in common escape rendezvous point, Site security measures, or other Site-specific issues that need to be addressed before work begins.
- Safe use of engineering controls and equipment on the Site.
- Acute effects of accessible compounds at the Site.
- Decontamination procedures.

Upon completion of Site-specific training, workers will sign the Site-Specific-Training Form provided in Attachment A. A representative from Con Edison will be present during the Site-specific training. A copy of the completed Site-Specific Training Form will be provided to Con Edison.

3.4 Monitoring Requirements

Air monitoring of the worker-breathing zone will be conducted continuously during all intrusive activities. Organic vapors (total VOCs and benzene) will be monitored with a PID such as the RaeSystems MiniRae 2000 equipped with a 10.6 eV lamp. Background PID levels will be taken initially upwind from planned Site activities. If PID readings for total VOCs are greater than 1 ppm (sustained for 15 minutes in the workers' breathing zone), the PID will be calibrated to measure the gas of interest (i.e., benzene). In the absence of benzene, Level C personal protection (including half-mask APRs) will be used when total VOCs sustained in the breathing zone exceed 25 ppm. If benzene is presented at concentrations (sustained in the breathing zone) between l and 5 ppm, a half-mask APR will be used; between 5 and 25 ppm, a full-face APR will be used. Level B personal protection will be used when benzene exceeds 25 ppm.

In addition, monitoring during intrusive activities will incorporate the use of cyanide color detector tubes taken at least once every half hour. Cyanide color detector tube readings of 5 mg/m^3 or greater shall be cause for employee retreat and/or upgrade to Level B personal protective equipment as determined by the Site Safety Officer.

Should visible dust emissions occur in potentially impacted areas, real time aerosol monitoring or upgrading to Level C may be warranted for affected personnel.

3.5 Summary of Action levels and Restrictions

Conditions for Level D:
All areas

- PID readings for total VOCs < 25 ppm and absence of benzene (sustained for 15 minutes in breathing zone), and
- Hydrogen cyanide readings < 5 mg/m^3

Conditions for Level C:
All areas

- PID readings for total VOCs > 25 ppm (sustained for 15 minutes in breathing zone), or benzene >1 ppm and < 25 ppm (sustained for 15 minutes in breathing zone), or

- Any visible fugitive dust emissions from Site activities that disturb contaminated soil.

Conditions for Level B (or retreat):
All areas

- Benzene (sustained for 15 minutes in breathing zone) > 25 ppm, or
- Hydrogen cyanide readings > 5 mg/m^3

3.5.1 Level D

Level D protection will be worn for initial entry on Site and initially for all activities. Level D protection will consist of:

- Standard work clothes
- Steel-toe safety boots
- Safety glasses (goggles must be worn when splash hazard is present)
- Nitrile outer gloves and PVC or nitrile inner gloves must be worn during all activities requiring contact with soils.
- Hard hat (must be worn during all Site activities)

3.5.2 Level C

The level of personal protection will be upgraded to Level C if the concentration of volatile organic compounds, which can be detected with a PID in the breathing zone, equals or exceeds the specified action limits and the contaminants of concern have characteristic warning properties appropriate for air purifying respirators (e.g. taste, odor).

Level C protection will consist of the following equipment:

- Full-face or half-face air-purifying respirator
- Combination HEPA filter/organic vapor cartridges
- Tyvek coverall (coated Tyvek coveralls if liquid contamination is encountered)
- Steel-toe safety boots
- Nitrile outer gloves and PVC or nitrile inner gloves must be worn during all activities requiring contact with soils.
- Hard hat (must be worn during all Site activities)

Cartridges will be disposed at the end of each day’s use.

3.5.3 Level B (Retreat)

If the concentration of volatile organics, which can be detected with a PID, equals or exceeds the specified action levels, all field personnel associated with the project will immediately retreat to a location up-wind of the source of contamination. At this point, the Site Safety Officer must consult with the Con Edison to discuss appropriate actions.

3.5.4 OSHA Requirements for Personal Protective Equipment

All personal protective equipment used during the course of this field investigation must meet the following OSHA standards:

Type of Protection	Regulation	Source
Eye and Face	29 CFR 1910.133 29 CFR 1926.102	ANSI Z87.1-1968
Respiratory	29 CFR 1910.134 29 CFR 1926.103	ANSI Z88.1-1980
Head	29 CFR 1910.135 29 CFR 1926.100	ANSI Z89.1-1969
Foot	29 CFR 1910.136 29 CFR 1926.96	ANSI Z41.1-1967

ANSI = American National Standards Institute

Both the respirator and cartridges specified for use in Level C protection must be fit-tested prior to use in accordance with OSHA regulations (29 CFR 1910.1025; 29 CFR 1910.134).

Based on performance criteria of air purifying respirators, they cannot be worn under the following conditions:

- Oxygen deficiency;
- IDLH concentrations;
- High relative humidity; and
- If contaminant levels exceed designated use concentrations.

4. Work Zones and Decontamination

4.1 Site Work Zones

To reduce the spread of materials by workers from the contaminated areas to the clean areas, work 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 Hot Zone

Hot zones will be established at the Site for all pre-characterization drilling and excavation activities; unprotected onlookers should be located 50 feet upwind of drilling, excavation, or soil sampling activities. In the event that volatile organics are detected in the breathing zone as discussed in Section 3, all personnel within the hot zone must don Level C protection. Hot zones will also be established during any activity when Level C protection is established as a result of conditions discussed in Section 3.

All personnel within the hot zone will be required to use the specified level of protection. No food, drink, or smoking will be allowed in the hot or warm zones. Contact lenses and cosmetics are not permitted on Site.

4.1.2 Warm Zone

A warm zone will be established and utilized during the pre-characterization drilling and/or excavation activities. This zone will be established between the hot zone and the cold zone, and will include the personnel and equipment necessary for decontamination of equipment and personnel (discussed below). Personnel and equipment in the hot zone must pass through this zone before entering the cold zone. This zone should always be located upwind of the hot zone.

4.1.3 Cold Zone

The cold 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 zone. No equipment or personnel will be permitted to enter the cold zone from the hot zone without passing through the personnel or equipment decontamination station. Eating, smoking, and drinking will be allowed only in this area.

4.2 Decontamination

Generally, any water used in decontamination procedures will be placed in containers and stored on Site. Disposal procedures that may be required by Site-specific conditions are described in the Site Management Field Sampling Plan.

4.2.1 Decontamination of Personnel

Decontamination of personnel will be necessary if Level C or Level B protection is used. At a minimum, a boot wash may be necessary if Level D protection is used. However, disposable gloves used during sampling activities should be removed and bagged; personnel should 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.

The following OSHA-specified procedures include steps necessary for complete decontamination prior to entry into the cold 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 Site Safety Officer 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 Boots, 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 Simple Green/water solution. Necessary equipment includes:

- Wash tub (30 gallon or large enough for person to stand in);
- Simple Green/water solution; and
- Long-handle soft-bristle scrub brushes.

Station 3 - Suit, Safety Boots, and Outer Glove Rinse

Rinse off Simple Green/water solution using copious amounts of water. Repeat as many times as necessary. Necessary equipment includes:

- Wash tub (30 gallon or large enough for person to stand in);
- Spray unit;
- Water; and
- 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:

- Plastic bag.

Station 5 - Canister, Air Tank, or Mask Change

If a worker leaves the hot zone to change a canister, mask or air tank, this is the last step in the decontamination procedures. The worker's canisters or tanks are exchanged, new outer glove donned, and joints taped. Worker returns to duty. Otherwise, the worker proceeds to Station 6. Necessary equipment includes:

- Canisters, air tanks, or mask;
- Tape; and
- Gloves.

Station 6 - Removal of Chemically Resistant Suit

With assistance of helper, remove suit. Deposit in container with plastic liner. Necessary equipment includes:

- Container with plastic liner.

Station 7 - Inner-Glove Wash

Wash inner gloves with Simple Green/water solution that will not harm skin. Repeat as many times as necessary. Necessary equipment includes:

- Simple Green/water solution;
- Wash tub; and
- Long-handle, soft-bristle brushes.

Station 8 - Inner-Glove Rinse

Rinse inner-gloves with water. Repeat as many times as necessary. Necessary equipment includes:

- Water; and
- 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:

- Plastic bags;
- Sanitizing solution; and
- Cotton.

Station 10 - Inner-Glove Removal

Remove inner gloves and deposit in container with plastic liner. Necessary equipment includes:

- Container with plastic liner.

Station 11 - Field Wash

Wash hands and face. Necessary equipment includes:

- Water;
- Soap;
- Tables;
- Wash basins or buckets; and
- Clean towels.

Station 12 - Redress

If re-entering Hot Zone put on clean field clothes (e.g., Tyvek, gloves, etc.). Necessary equipment includes:

- Table; and
- Clothing.

4.2.2 Decontamination of Field Equipment

Field Equipment decontamination procedures are described in the project Site Management Field Sampling Plan. All sampling equipment will be decontaminated with a "Simple Green" solution.

4.3 Investigation-Derived Waste

Investigation-derived waste (IDW) generated during Site work may consist of: (1) liquids generated by the cleaning of sampling and drilling equipment, development of monitoring wells, and purging of monitoring wells prior to groundwater sampling; (2) soils generated during pre-characterization activities and intrusive excavation activities; and (3) solid waste consisting of sampling equipment (e.g., tubing) and personal protective equipment (e.g., gloves). IDW generated during the Site work will be managed in accordance with the Con Edison guidance document titled *Handling of Investigation Derived Waste at Manufactured Gas Plants*, dated December 30, 2002 (see Attachment D).

Decontamination Fluids. Steam-cleaning and decontamination fluids will be collected in 55-gallon drums or polyethylene tank. The drums or tank will be labeled as investigation derived wastewater and temporarily stored on wooden pallets in a plastic-lined containment area pending characterization and proper disposal by Con Edison.

Pre-characterization Drill Cuttings. Visibly impacted drill cuttings will be contained in 55-gallon drums or a covered roll-off container. The drums or roll-off container will be labeled as investigation derived waste soils and temporarily stored in a plastic-lined containment area pending characterization and proper disposal by Con Edison. Drums would be placed on wooden pallets within the containment area.

Development and Purge Water. All development and purge water will be contained in 55-gallon drums or polyethylene tank. The drums /tank will be labeled as investigation derived wastewater and temporarily stored in a plastic-lined containment area pending characterization and proper disposal by Con Edison. Drums would be placed on wooden pallets within the containment area.

Personal Protective Equipment. All personal protective equipment (PPE) will be placed in 55-gallon drums for proper disposal by Con Edison. Drums will be placed on wooden pallets within the containment area.

Soil Excavated Below the Demarcation Warning Barrier. May be reused as on-Site backfill material provided the soil contains no visual evidence of DNAPL tar, has concentrations of total VOCs that do not exceed 10 ppm, has concentrations of total SVOCs that do not exceed 500 ppm, and is placed beneath the demarcation-warning barrier. Soil or fill that contains evidence of DNAPL tar, and/or does not meet the 500 ppm total SVOC/10 ppm total VOC criteria, must be transported off Site for disposal at a permitted facility. Specific handling requirements will be established prior to the start of any soil excavation activities.

Dedicated Sampling Equipment. All dedicated groundwater sampling equipment (dedicated disposable polyethylene bailer and dedicated polypropylene line) will be placed in 55-gallon drums for disposal by Con Edison. Drums will be placed on wooden pallets within the containment area.

5. Sample Shipment

5.1 Environmental Samples

Samples collected in this study will be classified as environmental samples. In general, environmental samples are collected from soils or wells and are not expected to be grossly contaminated with high levels of hazardous materials.

Sample containers must have a completed sample identification tag and the outside container must be marked "Environmental Sample." The sample tag will be legibly written and completed with an indelible pencil or waterproof ink. The information will also be recorded in a 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); and
- Any other pertinent information.

Environmental samples will be packaged and shipped according to the following procedure:

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 metal picnic cooler which has been lined with a large polyethylene bag;
3. Pack cooler with ice to maintain temperature of 4 degrees C;
4. Pack with enough noncombustible, absorbent, cushioning material to minimize the possibility of the container breaking;
5. Seal large bag; and
6. Seal or close outside container.

The appropriate side of the container must be marked "This End Up" and arrows should be drawn accordingly. No DOT marking labeling is required. No DOT shipping papers are required. There are no DOT restrictions on mode of transportation.

5.2 Hazardous Samples

Personnel who must complete a Hazardous Goods Airway Bill must first be DOT trained and certified every two years. 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. Hazardous samples shipped using Federal Express will comply with the International Air Transport Association’s Dangerous Goods Regulations. 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 1-pound net weight. If sampling for volatile organic analysis (VOA), 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 ___" or "Net Volume ___" (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 carrier before packing to ascertain local packaging requirements and not to leave area before the carrier vehicle (aircraft, truck) is on its way.

5.3 Shipping Papers

A blank Project Contractor shipping paper should be filled out and maintained within the driver's reach, whenever a Project Contractor employee carries hazardous materials in a vehicle in quantities above those allowed for Materials of Trade (MOTs). Such materials may include more than 8 gallons of the following:

- Gasoline (for use in a generator) UN1203, Guide #27;
- Methanol (for use in decontamination procedures) UN 1230, Guide #28;
- Nitric Acid (for use in decontamination procedures) UN 1760, Guide #60; and
- Hydrochloric Acid (for use in decontamination procedures) UN 1789, Guide #60.

Other materials may include the following:

- 220 pounds of compressed Gas [Air, Compressed] (calibration gas for the PID, or Grade D breathing air for Level B work) UN 1002, Class 2.2; and

- Other hazardous materials as defined by the DOT.

Appropriate material safety data sheets (MSDSs) should be maintained with the shipping papers and/or the pocket DOT Emergency Response Guidebook.

6. Accident Prevention and Contingency Plan

6.1 Accident Prevention

6.1.1 Site-Specific Training

All field personnel will receive health and safety training prior to the initiation of any pre-characterization activities or intrusive activities beneath the clean fill cover and demarcation barrier, or groundwater sampling. The Site-specific training form provided in Attachment A must be signed, dated, and returned to the Project Contractor Site Safety Officer. 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 meeting 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; and
- Emergency procedures.

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.

- Brakes, hydraulic lines, light signals, fire extinguishers, fluid levels, steering, tires, horn, and other safety devices will be checked at the beginning of each shift.

- Large construction motor vehicles will not be backed up unless:

    - The vehicle has a reverse signal alarm audible above the surrounding noise level; or
    - The vehicle is backed up only when an observer signals that it is safe to do so.

- Heavy equipment or motor vehicle cable will be kept free of all nonessential items, and all loose items will be secured.

- Large construction motor vehicles and heavy equipment will be provided with necessary safety equipment (such as seat belts, roll-over protection, emergency shut-off in case of roll-over, backup warning lights and audible alarms).

- Blades and buckets will be lowered to the ground and parking brakes will be set before shutting off any heavy equipment or vehicles.

6.2 Spill Control Plan

All personnel must take every precaution to minimize the potential for spills during Site operations. Any spill shall be reported immediately to the Con Edison emergency contacts that will be identified prior to staring any fieldwork. Spill control apparatus (sorbent materials) will be located on Site. All materials used for the clean up of spills will be containerized and labeled separately from other wastes, unless otherwise directed by Con Edison.

6.3 Contingency Plan

6.3.1 Emergency Procedures

In the event that an emergency develops on Site, the procedures delineated herein are to be immediately followed. Emergency conditions are considered to exist if:

- Any member of the field crew is involved in an accident or experiences any adverse effects or symptoms of exposure while on Site.

- A condition is discovered that suggests the existence of a situation more hazardous than anticipated.

General emergency procedures, and specific procedures for personal injury, chemical exposure and radiation exposure, are described below.

6.3.2 Chemical Exposure

If a member of the field crew demonstrates symptoms of chemical exposure, the procedures outlined below should be followed:

- Another team member (buddy) should remove the individual from the immediate area of contamination. The buddy should communicate to the Field Team Leader (via voice and hand signals) of the chemical exposure. The Field Team Leader should contact the appropriate emergency response agency.

- Precautions should be taken to avoid exposure of other individuals to the chemical.

- If the chemical is on the individual's clothing, the chemical should be neutralized or removed if it is safe to do so.

- If the chemical has contacted the skin, the skin should be washed with copious amounts of water.

- In case of eye contact, emergency eyewash should be used. Eyes should be washed for at least 15 minutes.

- All chemical exposure incidents must be reported in writing to the Office Health and Safety Representative. The Site Safety Officer or Field Team Leader is responsible for completing the accident report.

6.3.3 Personal Injury

In case of personal injury at the Site, the following procedures should be followed:

- Another team member (buddy) should signal the Field Team Leader that an injury has occurred.

- A field team member trained in first aid can administer treatment to an injured worker.

- The victim should then be transported to the nearest hospital or medical center. If necessary, an ambulance should be called to transport the victim.

- For less severe cases, the individual can be taken to the Site dispensary.

- The Field Team Leader or Site Safety Officer is responsible for making certain that an Accident Report Form is completed. This form is to be submitted to the Office Health and Safety Representative. Follow-up action should be taken to correct the situation that caused the accident.

- Any incident (near miss, property damage, first aid, medical treatment, etc.) must be reported.

A first-aid kit and blood-born pathogens kit will be kept on Site during the field activities.

6.3.4 Evacuation Procedures

- The Field Team Leader will initiate evacuation procedure by signaling to leave the Site.
- All personnel in the work area should evacuate the area and meet in the common designated area.
- All personnel suspected to be in or near the contract work area should be accounted for and the whereabouts or missing persons determined immediately.
- Further instruction will then be given by the Field Team Leader.

6.3.5 Procedures Implemented in the Event of a Major Fire, Explosion, or On-Site Health Emergency Crisis

- Notify the paramedics and/or fire department, as necessary;
- Signal the evacuation procedure previously outlined and implement the entire procedure;
- Isolate the area;
- Stay upwind of any fire;
- Keep the area surrounding the problem source clear after the incident occurs;
- Complete accident report for and distribute to appropriate personnel.

6.4 Community Air Monitoring Plan

Real-time air monitoring for volatile compounds and particulates at the perimeter of the work zone will be performed during intrusive activities. Monitoring will be conducted in accordance with the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan (CAMP).

Real-time sampling methods will be used to determine ambient air concentrations upwind and downwind of the intrusive activity. This will include the use of real-time continuous monitoring devices for total volatile organic compounds (TVOC) and respirable particulate matter (PM_{10}).

The following target compounds and corresponding action levels are based on the NYSDOH Generic CAMP.

Target Compounds	**Alert Level (*)**
TVOCs (15-minute average concentration)	3.7 ppm greater than background**

Target Compounds	**Response Level**
TVOCs (15-minute average concentration)	5.0 ppm greater than background**
Respirable Particulate Matter (PM-10)	100 $\mu g/m^3$ greater than background**

Target Compounds	**Action Level (***)**
TVOCs (15-minute average concentration)	25 ppm greater than background**
Respirable Particulate Matter (PM-10)	150 $\mu g/m^3$ greater than background**

ppm - parts per million
$\mu g/m^3$ - micrograms per meter cubed
TVOCs – total Volatile Organic Compounds
* Alert Level is an internally established level at 75% of NYSDOH Response Level
** Background is defined as the current upwind fifteen-minute average concentration.
*** Action Level Exceedance Requires Work Stoppage and Mitigation of the condition causing the Exceedance

Tripod mounted stations will be used for minimally intrusive work such as park construction, installation/abandonment of monitoring wells, and during shallow invasive work which will violate the demarcation barrier. Instruments will be positioned along the Work Zone perimeter to monitor the air based on a particular day's ground intrusive activities at up to three locations. Real-time monitors will continuously gather data during periods of intrusive activity during working hours. The equipment will be manually read on a predetermined periodic cycle during the work activity. The readings will be collected at a minimum of 15-minute intervals during periods of intrusive activities. Wind direction will be determined by using a wind sock or flagging placed on a pole at the Site.

Each air monitoring station would include the following:

1. Station Tripod and enclosure
2. An organic vapor analyzer
3. A particulate monitor

Each monitoring station will continuously measure and record TVOCs and PM-10. All TVOC and PM-10 will be stored in dataloggers located within each monitoring station. Data from each piece of equipment will be downloaded daily at the completion of intrusive activities and stored on a central computer system. The location of each station, the work zone, and the wind direction will be noted daily. At each monitoring station location, the 15-minute average value of TVOC and PM-10 will be recorded. The 15-minute average value of TVOC and PM-10 data from the upwind and downwind station will be compared and resultant downwind concentration will be calculated and recorded.

6.4.1 Contingency Plan

The air-monitoring contingency plan identifies potential site control measures that may be implemented in response to elevated levels of target compounds or odor. A tiered warning alert and response action must be implemented during the air-monitoring program. Tiered warning alerts are defined as follows.

- **Green Condition.** Normal or ambient air-conditions where all target concentrations are less than the Response Levels for respirable particulate matter or TVOC.
- **Preliminary Yellow Alert.** Concentration of TVOC is equal to or greater than the Alert Level, but less than the Response Level.
- **Yellow Alert.** Concentration of at least one target is equal to or greater than Response Level, but less than the Action Level.
- **Red Alert.** Concentration of at least one target is equal to or greater than the Action Level.

The response plan will rely on real-time data generated from the fixed-station monitoring, portable equipment monitoring, and meteorological monitoring. These data sources will be evaluated together in order to make appropriate decisions concerning site conditions and potential control measures.

An explanation of the notification system, specific conditions, and response actions for TVOCs and PM-10 are presented below.

6.4.2 VOCs

6.4.2.1 Green Condition

Green site conditions will be in effect when the total VOC concentration is less than 75 percent of the total VOC action level of 5.0 ppm. Specifically, green site conditions will apply when the total VOC concentration measured at each fixed station is less than 3.7 ppm (Alert Level).

6.4.2.2 Preliminary Yellow Alert

Preliminary Yellow Alert will be in effect if the TVOC concentration measured at a station is greater than or equal to the Alert Level (3.7 ppm) but less than the Response Level (5.0 ppm). The Contractor and Con Edison will be notified by the Air Monitoring Consultant of elevated measurements and a Preliminary Yellow Alert.

At this time, the upwind and downwind concentrations will be compared to determine if the Preliminary Yellow Alert is due to site activities. If downwind TVOC concentrations are greater than upwind concentrations, then it will be assumed that the Preliminary Yellow Alert is due to site activities.

If the above condition is true, then a Preliminary Yellow Alert will be verified. Under a verified Preliminary Yellow Alert, a contingency meeting attended by Air Monitoring Consultant, the Contractor, Con Edison, and NYSDEC will be held. The Contractor, Con Edison, and NYSDEC will determine appropriate response actions. This meeting will be held within 60 minutes of the Preliminary Yellow Alert verification. The site will remain in Preliminary Yellow Alert as long as the TVOC concentration is between 3.7 ppm (Alert Level) and 5.0 ppm (Response Level), based on 15-minute averages.

The site will return to a Green Condition if the following condition is true.

- The 15-minute average concentrations for TVOCs at each of the monitoring stations are less than 3.7 ppm (Alert Level).

6.4.2.3 Yellow Alert

Yellow Alert will be in effect if average TVOC concentrations increase to greater than the Response Level of 5.0 ppm. Yellow Alert will remain in effect if one of the following conditions is true.

- The average TVOC concentration, measured over a 15-minute period, is greater than or equal to 5.0 ppm (Response Level)

Under Yellow Alert, construction activities will be temporarily halted. A meeting attended by Air Monitoring Consultant, the Contractor, Con Edison, and NYSDEC will be held within 60 minutes of the Yellow Alert. The Contractor, Con Edison, and NYSDEC will determine appropriate response actions. Possible Yellow Alert corrective measures/actions are listed in **subsection 6.4.5.** After appropriate corrective measures/actions are taken, work activities may resume provided that the TVOC concentration at the Site perimeter is no more than 5.0 ppm above background for the 15-minute average.

If average TVOC concentrations fall below the Response Level, then the site will be returned to Preliminary Yellow Alert, at which time work activities may resume. The Preliminary Yellow Alert site condition will remain in effect as long as the following condition is true.

- The 15-minute average concentration for TVOCs is greater than 3.7 ppm (Alert Level) and less than 5.0 ppm (Response Level).

The site will return to a Green Condition site condition if the following condition is true.

- The 15-minute average concentrations for TVOCs at each of the monitoring stations are less than 3.7 ppm (Alert Level).

6.4.2.4 Red Alert

Red Alert will be in effect if average TVOC concentrations increase to greater than the Action Level of 25.0 ppm. Red Alert will remain in effect if one of the following conditions is true.

- The average TVOC concentration, measured over a 15-minute period, is greater than 25 ppm (Action Level).

Under Red Alert, all construction activities will be halted. A meeting attended by Air Monitoring Consultant, the Contractor, Con Edison, and NYSDEC will be held within 60 minutes of the Response Level notification. The Contractor, Con Edison, and NYSDEC will determine appropriate response actions. Possible Red Alert corrective measures/actions are listed in **subsection 6.4.5**. After appropriate corrective measures/actions are taken, work activities may resume provided that the TVOC concentration at the Site perimeter is no more than 5.0 ppm above background for the 15-minute average.

If average TVOC concentrations fall below the Action Level, then the site will be returned to an Yellow Alert. If average TVOC concentrations fall below the Response Level, then the site will be returned to Preliminary Yellow Alert, at which time work activities may resume. The Preliminary Yellow Alert site condition will remain in effect as long as the following condition is true.

- The 15-minute average concentration for TVOCs is greater than 3.7 ppm (Alert Level) and less than 5.0 ppm (Response Level).

The site will return to a Green Condition if the following condition is true.

- The 15-minute average concentrations for TVOCs at each of the monitoring stations are less than 3.7 ppm (Alert Level).

6.4.3 Respirable Particulate Matter (PM_{10})

6.4.3.1 Green Condition

Green site conditions will be in effect when the downwind 15-minute average PM-10 concentration is less than 100 μg/m^3 above the current average upwind conditions (Alert Level).

6.4.3.2 Yellow Alert

A Yellow Alert will be in effect if the average 15-minute PM-10 concentration at a station is greater than 100 μg/m^3 and related to site activities. The Contractor, Con Edison, and NYSDEC will be notified by the Air Monitoring Consultant of elevated measurements and a possible Yellow Alert. The upwind and downwind PM-10 concentrations will be compared to determine if the elevated PM-10 concentrations are due to site activities. If downwind PM-10 concentrations are 100 ug/m^{3}greater than upwind concentrations (Response Level), then it will be assumed that the Yellow Alert is due to site activities.

The Yellow Alert will remain in effect as long as the average PM-10 concentration is greater than or equal to 100 μg/m^3 above upwind conditions (Response Level), and less than or equal to 150 μg/m^3(Action Level). Under a verified Yellow Alert, dust suppression techniques must be implemented by the Contractor and/or Con Edison contractors. At this point, routine monitoring continues and 15-minute averages continue to be evaluated. Work may continue with dust suppression techniques provided that downwind PM-10 levels do not exceed 150 ug/m^3 above the upwind level (Action Level) and provided that no visible dust is migrating offsite from the work area. A contingency meeting attended by Air Monitoring Consultant, the Contractor, Con Edison, and NYSDEC will be held within 60 minutes of the verified Yellow Alert if the condition is not mitigated by dust suppression techniques. Possible response actions for dust control are listed in subsection 6.4.5.

6.4.3.3 Red Alert

Red Alert will be in effect if the average 15-minute PM-10 concentration exceeds 150 μg/m^3 above the current average upwind concentration (Action Level). Under Red Alert, work must be stopped and a meeting attended by Air Monitoring Consultant, the Contractor, Con Edison, and NYSDEC will be held within 60 minutes of the Response Level notification. The Contractor, Con Edison, and NYSDEC will determine appropriate response actions. Possible Red Alert response actions for PM-10 are listed in Section 6.4.5. Work may resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 concentration to within 150 ug/m^3 of the upwind level and in preventing visible dust migration.

Specific PM-10 target concentrations for Green Condition, Preliminary Yellow Alert, Yellow Alert, and Red Alert are summarized in Table 2.

6.4.4 Visible Dust

In addition to measured PM_{10} levels, the CAMP requires monitoring of visible dust conditions. If visible airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM_{10} levels do not exceed 150 $\mu g/m^3$ above the upwind level and provided that no visible dust is migrating from the work area.

6.4.5 Response Actions

The table below lists possible response actions to be taken by the Contractor in the event of a Yellow or Red Alert. The bulleted response actions specified under each alert can be implemented in any order that is most appropriate under the existing site conditions.

Alert Level	Response Action
Yellow	▪ Establish trend of data and determine if evaluation/wait period is warranted ▪ Temporarily stop work ▪ Temporarily relocate work to an area with potentially lower emission levels ▪ Apply water to area of activity or haul roads to minimize dust levels ▪ Reschedule work activities ▪ Cover all or part of the excavation area ▪ Apply VOC emission suppressant foam over open excavation areas ▪ Slow the pace of construction activities ▪ Change construction process or equipment that minimize air emissions ▪ Install additional barrier fence
Red	▪ Apply yellow alert controls ▪ Encapsulate construction area causing alert conditions and treat air exhaust

7. Site Safety Plan

This Site Safety Plan section of the HASP is sufficiently detailed to be used as a stand-alone document. This plan establishes policies and procedures to protect workers and the public from the potential hazards posed by the intrusive activities that extend beneath the clean fill cover and the demarcation-warning barrier installed on the Site. Reading of the Site Safety Plan is required of all on-Site personnel. The plan identifies measures to minimize accidents and injuries that may result from project activities or during adverse weather conditions.

7.1 General Information

7.1.1 Site Description

7.1.1.1 Location and Access

The East 173rd Street Works Site is located between the Sheridan Expressway and the Bronx River in the West Farms section of the Borough of the Bronx, Bronx County, New York. The location of the site is illustrated in Figure 1 of the Site Management Plan. The former grounds of the MGP at the Site occupied a single parcel of land that is currently owned by the City of New York and operated by the New York City Parks and Recreation (Parks Department). The Site is located within Starlight Park, a part of the City of New York’s Bronx River Park. Starlight Park is zoned R7-1, a general residential district. The current and intended future use of the Site is a New York City-owned public park. The former MGP was located in the middle portion of Starlight Park and occupied an area of approximately 3 acres. The boundaries and former structures of this MGP are shown on Figure 2 of the Site Management Plan. Starlight Park is approximately 7.3 acres in size, and is currently designated by the Bronx Assessor’s Office as Block 0319, Lot 0100.

7.1.1.2 Buried Utilities

All underground utilities, including electric lines, gas lines, and communication lines will be identified prior to initiation of drilling and other subsurface work. The underground utility clearance program that will be performed at the Site will include the following.

- All on-Site underground utilities in the vicinity of proposed subsurface intrusive locations will be located in conjunction with Parks Department (or current property owner) personnel.

- A private locating company will be contracted by the contractor to identify underground structures and utilities at the Site.

- Any off-Site underground utilities in the vicinity of proposed on Site activities will be located and marked by a representative of the Underground Facilities Protective Organization (UFPO): (800) 272-4480. New York State law requires that UFPO be notified at least three working days, and not more than ten working days, before subsurface work is conducted. Sewer and water will be marked out by the New York City Department of Environmental Protection (NYCDEP).

7.1.1.3 Topography

Land surface topography of the Site is relatively flat and is approximately 15 feet above mean sea level.

7.1.1.4 Surrounding Population

The surrounding area is commercial to the west and residential beyond the Bronx River to the East.

7.1.1.5 Perimeter Control

Safety cones with highly visible caution tape will be used to secure the work area. All excavations shall be properly barricaded.

7.1.1.6 Emergency Response Capabilities

The New York City Fire Department will respond to incidents involving actual or imminent fire, explosion, or hazardous material spills emergencies. The NYC Fire Department Emergency Medical Services Group will respond to medical emergencies on Site, and provide transportation to the hospital. Jacobi Medical Center Emergency Room is fully equipped to deal with injuries and chemical exposures scenarios described previously. Hospital emergency capabilities should be confirmed prior to initiating work.

7.2 Project Objectives

This plan is written to cover operations to be performed during the potential intrusive activities that extend beneath the clean fill cover and demarcation warning barrier installed at this Site, and on-Site groundwater sampling activities. These operations may include:

- Air monitoring
- Subsurface soil sampling
- Soil excavation and sampling
- Soil borings

- Groundwater sampling
- Contaminated soil/material, load out, and transport activities
- Other work as applicable

7.3 Authorized Site Personnel

Prior to mobilizing to the Site, all project subcontractors will identify those individuals in their employ who will be working on the Site, their safety training dates, and the status of their medical surveillance program. All personnel arriving or departing the Site are required to log in and out with a designated record keeper. All personnel and activities on Site must be authorized by the Project Manager or by his designee.

7.4 Control of Site Access

The activities at the Site will be secured by a temporary freestanding fence and/or safety cones with caution tape. The project area (i.e., proposed excavation locations) will be submitted prior to commencement of Site work.

- The Project Manager will be responsible for ensuring control of access to all work areas and restricted zones on Site. Boundaries have been delineated for the different areas.

- A worker and visitor log (log in, log out) will be maintained on Site during field operations.

If Site conditions develop that require changes in the established boundaries, the Site Safety Officer (SSO) and the Project Manager or their designees will be notified immediately. The field boundaries will be re-marked, and a meeting will be held for Site personnel to inform them (on an as-needed basis) of the changes, the reasons that caused them to be made, and any new health and safety practices that might be necessary as a result of the altered Site conditions. If necessary, to ensure health and safety, the Site HASP maps/figures will be revised (as applicable) to show the new configuration of controlled areas. In addition to the above-mentioned Site access control measures, applicable work area protection requirements detailed in Con Edison's Environmental, Health and Safety (EH&S) Work Plan Guide (32.0 Work Area Protection) will be performed (see Attachment D).

7.5 Chemical Safety and Handling

All hazardous chemicals must be stored at the Site in containers that are in good condition with proper labeling. Personnel handling the chemicals must use proper PPE and have knowledge of the chemical's physical properties and hazards. An inventory of all chemicals used and stored at the Site will be maintained and available upon request. Applicable chemical safety and handling requirements detailed in Con Edison's EH&S Work Plan Guide (5.0 Chemical Safety and Handling) will be performed (see Attachment D). All MSDSs for chemicals used at the Site will be submitted and approved by Con Edison prior to use.

7.6 Evaluation of Potential Chemical Hazards

MGP waste contaminants include ferrocyanides from purifier wastes, SVOCs, VOCs and PAHs and heavy metals from tars.

The potential primary hazards of each contaminant are identified as follows. Note that the matrices specified for each contaminant are not necessarily exclusive but are based on the best existing information of the Site. This Site Safety Plan is intended to be sufficiently stringent to ensure worker protection from all of the potential contaminants listed, regardless of matrix.

CONTAMINANT:	**Volatile Organic Compounds (VOCs, potentially including benzene, toluene, ethylbenzene, and xylenes, i.e., BTEX)**			
Possible Sources:	Fuels, Oils and Other Petroleum Products			
Form:	Gas ☐	Liquid ☒	Solid (adsorbed) ☒	Other ____Vapor____
Characteristic:	Corrosive ☐	Ignitable ☒	Radioactive ☐	Volatile ☒
	Toxic ☒	Reactive ☐	Other _________	Unknown ☐
Matrix:	Soils ☒	Debris ☐	Groundwater ☒	Other Airborne Vapor

CONTAMINANT:	**Polycyclic Aromatic Hydrocarbons (PAHs), including naphthalene**			
Possible Sources:	MGP Tars, Petroleum Products, Products of Incomplete Combustion			
Form:	Gas ☐	Liquid ☒	Solid (adsorbed) ☒	Other _____________
Characteristic:	Corrosive ☐	Ignitable ☒*	Radioactive ☐	Volatile ☐
	Toxic ☒	Reactive ☐	Other _________	Unknown ☐
Matrix:	Soils ☒	Debris ☐	Groundwater ☐	Other _____________

*No free phase MGP tar was observed and all samples of MGP-impacted soils were not ignitable.

CONTAMINANT:	**Cyanide Compounds (primarily ferrocyanides of low toxicity)**			
Possible Sources:	Purifier Waste Disposal			
Form:	Gas ☐	Liquid ☐	Solid (adsorbed) ☒	Other _____________
Characteristic:	Corrosive ☐	Ignitable ☐	Radioactive ☐	Volatile ☐
	Toxic ☒	Reactive ☐	Other _________	Unknown ☐
Matrix:	Soils ☒	Debris ☒	Groundwater ☐	Other_____________

CONTAMINANT:	**TAL Metals**			
Possible Sources:	Site Debris			
Form:	Gas ☐	Liquid ☐	Solid (adsorbed) ☒	Other _____________
Characteristic:	Corrosive ☐	Ignitable ☐	Radioactive ☐	Volatile ☐
	Toxic ☒	Reactive ☐	Other _________	Unknown ☐

Matrix:	Soils	☒	Debris	☐	Groundwater	☐	Other ______________

MSDSs (as available) and/or Occupational Health Guidelines for contaminants potentially found at the Site (and/or for products that are potentially the source of contamination), and for decontamination chemicals that may be used on Site, are included in Attachment C.

The potential exposure routes associated with the contaminants that will potentially be encountered by workers during intrusive activities are listed below.

Substances Involved	Primary Exposure Routes
VOCs	Vapor inhalation, skin or eye contact
PAHs	Inhalation of fugitive dust, ingestion
Ferrocyanides	Inhalation of fugitive dust, ingestion
TAL Metals	Inhalation of fugitive dust, ingestion

7.7 Levels of Protection for Site Workers

This subsection stipulates PPE requirements for different tasks during the Site investigations. The designated levels of protection have been based on an evaluation of potential hazards and risks associated with work during the project.

7.7.1 Levels of Protection Required

PPE required for each level of protection is as follows.

Safety Equipment	Level A	Level B	Level C	Level D
Hard hats with splash shields or safety glasses			•	•
Steel-toe safety boots		•	•	•
Chemical-resistant gloves as appropriate for work being performed and materials handled			•	•
Half- or full-face respirators with organic/HEPA cartridges as approved by the SSO			•	
Tyvek™ coverall			•	
Chemical-resistant clothing (e.g., PE coated Tyvek)		•		
Pressure-demand, full-face SCBA or pressure-demand supplied air respirator with escape SCBA	•	•		
Inner and outer chemical-resistant gloves	•	•		
Nitrile Boot Covering	•	•		
Two-way radio	•	•		
Hard hat	•	•		
Fully encapsulating chemical-resistant suit	•			

PPE requirements for field activities are as follows.

Activity	Level of Protection	Backup Protection
Test Boring and Soil Sampling	D	C
Monitoring Well Sampling	D	C
Air Monitoring	D	C
Excavation Beneath Clean Fill Cover and Demarcation Barrier	D	C
Waste Management/Handling	D	C

The SSO will closely monitor the work schedules listed in the project logbook to be sure that all workers entering the Site have had their safety briefing and that the amount of PPE kept on Site is sufficient for all of the workers present at any time. Additional PPE recommendations are listed in Attachment D (Con Edison's EH&S Work Plan Guide, 24.0 PPE).

7.7.2 Ambient Air Monitoring and Protection Limits

In accordance with NYSDEC and NYSDOH requirements, a Community CAMP will be implemented at the Site during intrusive activities that extend beneath the clean fill cover and demarcation warning barrier installed at the Site. The objective of the CAMP is to provide a measure of protection for the downwind community (i.e., off-Site receptors, including residences and businesses and on-Site workers not involved with the intrusive activities) from potential airborne contaminant releases as a direct results of intrusive activities. Two air-monitoring stations will be set up on Site. VOCs and respirable particulates (PM-10) will be monitored at the downwind perimeter of the immediate work area on a continuous basis. Wind direction will be determined using a wind sock(s) and/or flagging poles installed on Site. Upwind concentrations will also be measured continuously to establish background conditions. VOC vapors will be monitored using a PID. Particulate dust will be monitored using a MiniRAM™ PM-10 particulate meter. The equipment will be calibrated at least daily. Fifteen-minute running average concentrations will be collected from each of the two air monitoring stations during work activities. The VOC Monitoring, Response Levels, and Actions are presented as follows.

CAMP
Air Monitoring Response Levels and Actions

VOCs	
Response Level	**Actions**
>5 ppm above background for 15-minute average	▪ Temporarily halt work activities ▪ Continue monitoring ▪ If VOC levels decrease (per instantaneous readings) below 5 ppm over background, work activities can resume

CAMP
Air Monitoring Response Levels and Actions

Response Level	**Actions**
VOCs	
Persistent levels >5 ppm over background <25 ppm	▪ Halt work activities ▪ Identify source of vapors ▪ Corrective action to abate emissions ▪ Continue monitoring ▪ Resume work activities if VOC levels 200 feet downwind of the property boundary or half the distance to the nearest potential receptor is <5 ppm for a 15-minute average ▪ If VOC levels are >25 ppm at the perimeter of the work area, activities must be shutdown
Particulate	
>100 mcg/m^3 above background for 15-minute average or visual dust observed leaving the Site	▪ Apply dust suppression ▪ Continue monitoring ▪ Continue work if downwind PM-10 particulate levels are <150 mcg/m^3 above upwind levels and no visual dust leaving Site
>150 mcg/m^3 above background for 15-minute average	▪ Stop work ▪ Re-evaluate activities ▪ Continue monitoring ▪ Continue work if downwind PM-10 particulate levels are <150 mcg/m3 above upwind levels and no visual dust leaving Site

Sources:

New York State Department of Health Community Air Monitoring Plan, June 20, 2000.

New York State Department of Environmental Conservation Division Technical and Administrative Guidance Memorandum - Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites, October 27, 1989.

During excavating and materials handling operations, the air in work areas will also be sampled periodically for the presence of contaminants. A portable PID will be utilized to periodically monitor the levels of organic vapors in the ambient air, a Mini RAM^{TM} PM-10 (or equivalent) particle detector will be used to count inhalable particles (0.1-10 micrometer range) of dust during the field work, and a Draeger MiniWard continuous cyanide detector and Chip Measuring System (CMS) electronic Draeger tubes will be used to monitor for hydrogen cyanide during field work. PID, MiniRAM, and cyanide readings will be taken hourly during excavation or more frequently if air quality measurements approach action levels as defined herein. Measurements will be monitored from the breathing zone (4 to 5 feet above ground level) at worker locations to determine working conditions (and whether there is a need to change levels of worker protection).

In order to make a conservative assessment of when different levels of respiratory protection are needed during the fieldwork, it will be assumed that the organic vapors detected by the air monitoring instruments consist of the most toxic volatile compounds expected to be found on the Site. Preliminary evaluation of the risks expected at the Site indicates that the most toxic volatiles that are probably present are VOCs (particularly BTEX). Based on data published by the OSHA and the American Conference of Government Industrial Hygienists (ACGIH), and Con Edison’s experience with MGP wastes, the following PPE will be employed when the given concentrations of organic vapor are detected in the breathing zone for a sustained 15 minutes.

Compound of Concern	Level D	Level C	Level B
Benzene	M<1 ppm	1 ppm<M<25 ppm	M>25 ppm
BTEX and other photoionizable Total VOCs	M <25 ppm	M >25 ppm	*

Where: M = concentration of organic vapor measured in the field
*Decision to employ Level B protection based on measured benzene concentration

The PPE requirements may be modified based on compound-specific monitoring results information, with the written approval of the Corporate Health and Safety Specialist (CHSS).

Respiratory protection from dusts will be required when inhalable particulate concentrations from potentially contaminated sources exceed 150 µg/m^3.

Hydrogen cyanide gas will be monitored in the work zone continually using hand held meter. Due to potential interference from sulfurs, hydrogen sulfide gas will also be monitored for comparison to the hydrogen cyanide gas levels detected. Hydrogen cyanide gas detections will also be confirmed with CMS Draeger tubes due to this interference Measurements will be monitored from the breathing zone (4 to 5 feet above ground level) at worker locations to determine working conditions (and determine work actions). The cyanide response levels are presented below.

Hydrogen Cyanide Gas	
Note: No air purifying respiratory protection is available for hydrogen cyanide gas	
>1 ppm for 15-minute average using continuous meter	▪ Run CMS Draeger tube ▪ Continue monitoring ▪ Continue work if CMS (Chip Measurement System) Draeger tube for hydrogen cyanide reads <2 ppm
>2 ppm on CMS Draeger tube	▪ Stop work and move (with continuous monitoring meter) at least 25 feet up-wind from excavation or until continuous monitoring device registers <1 ppm ▪ Run CMS Draeger tube and Re-evaluate activities ▪ Continue monitoring ▪ Allow area to ventilate and continue to monitor while returning to the work zone. Do not move into an area when readings are >1 ppm without confirming with additional CMS Draeger tube ▪ May resume work if Draeger tube for cyanide reads <2 ppm

Odors or dusts derived from Site contaminants may cause nausea in some Site workers, even though the contaminants are at levels well below the safety limits as defined above. Workers may use dust masks or respirators to mitigate nuisance odors with the approval of the SSO.

Whenever practical, work areas should be positioned upwind of organic vapor and dust sources to reduce the potential for worker exposure.

7.7.3 Odor Monitoring and Action Limits

During excavation, odors will be monitored at the downwind fence line by personnel trained in making odor observation and evaluation. The intensity of any perceived odor will be measured on the 8-point n-butanol intensity scale as described in ASTM Method E-544 "Standard Practice for Referencing Suprathreshold Odor Intensity."

Research conducted by Odor Science and Engineering, Inc. (OS&E) at 1350 Blue Hills Avenue, Bloomfield, Connecticut and by Dr. William Cain at Yale University in New Haven, Connecticut, has shown that complaints of nuisance odors typically occur when the intensity of any odor is perceived to be at a level of 3.5 or higher on the 8-point n-butanol scale. Accordingly, whenever an odor intensity of 2.5 on the n-butanol scale is perceived at the Site downwind fence line by the odor monitor, a warning will be given to the Site manager and SSO. No increase in Site excavation rate would be permitted following this warning, although no control actions would be required.

If the odor intensity at the downwind fence line reaches an intensity level of 3.5 on the n-butanol scale, the Site manager would be informed to initiate appropriate control actions such as applying an odor neutralizer or covering the excavated material. BioSolve®, which is non-reactive, biodegradable and non-hazardous, will be used to control odors. A spray unit will be used to apply the odor neutralizer. BioSolve® could be applied to solid or liquid surfaces. A MSDS for BioSolve® is included in Attachment C.

Should the odor intensity at the downwind fence line continue to increase, the Project Manager would then stop excavation activities and cover the excavation until weather conditions changed sufficiently to alleviate the problem.

7.8 Hearing Protection

Per OSHA regulation 29 CFR 1926.101, hearing protective devices will be provided to personnel working in areas of high decibel noise. Hearing protective devices will be worn during periods of high decibel noise exposure, as per 29 CFR 1926.52, Table D-2, Permissible Noise Exposures. Noise exposure will not exceed 85 decibels over an eight-hour day.

7.9 The "Buddy" System

The "buddy" system will be employed by Site personnel when working under certain circumstances, such as enclosed spaces. Under the "buddy" system, each Site worker is responsible for monitoring the well-being of another worker. No one works alone when the "buddy" system is implemented. At no time will fewer than two employees be present at the Site if activities are underway.

7.10 Heat Stress Monitoring and Prevention

Wearing personal PPE puts Site workers at risk of developing heat stress that may result in health effects ranging from fatigue to serious illness to death. Heat stress is caused by the interplay of a variety of factors, including ambient conditions, workload, clothing, and the physical characteristics of each worker. The major symptoms of heat stress are listed below.

- ***Heat Rash*** may result from prolonged exposure to heat or humid air.

- ***Heat Cramps*** are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include: muscle spasms; and pain in the hands, feet, and abdomen.

- ***Heat Exhaustion*** occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include: pale, cool, moist skin; heavy sweating; dizziness; nausea, and fainting.

- ***Heat Fatigue* -** Weariness, irritability, loss of skill for fine or precision work. Decreased ability to concentrate. No loss of temperature control.

- ***Heat Syncope*** (Heat Collapse) - Fainting while standing in a hot environment.

- ***Heat Stroke*** is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are: red, hot, usually dry skin; lack of or reduced perspiration; nausea; dizziness and confusion; strong, rapid pulse; and coma.

When the temperature in the work area is continuously at or above 72°F (22.2°C) for more than one hour, all workers wearing protective clothing (Level A, B, or C) will be monitored for heat stress during rest periods according to one of the following procedures.

- Take pulse over a 30-second period as early as possible in the rest period. If the heart rate exceeds 100 beats per minute at the beginning of the rest period, shorten the next work cycle by one third and keep the rest time the same. If, at the next rest period, the heart rate still exceeds 100 beats per minute, shorten the following work period again by one third. Continue the process as necessary.

- Take body temperature orally using a clinical thermometer kept under the tongue for three minutes. Take temperature at the end of each work cycle before drinking anything. If the temperature exceeds 99.6°F (37.6°C), shorten the next work period by one third without changing the rest period. If the temperature still exceeds 99.6°F at the beginning of the next rest period, shorten the following work cycle by one third. No worker will be permitted to wear a semi-permeable or impermeable garment if their temperature exceeds 100.6°F (38.1°C).

7.11 Effects of Cold Exposure and Their Prevention

Persons working outdoors in temperatures at or below freezing may be frostbitten. Extreme cold for even a short time may cause severe injury to exposed body surfaces, or result in profound generalized cooling, causing death. Areas of the body that have high surface area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible.

Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. For instance, 10 degrees Fahrenheit with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at -18°F.

As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is perspiration soaked.

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of damage. Frostbite of the extremities can be categorized into:

- **Frost nip or incipient frostbite**: characterized by sudden blanching or whitening of the skin

- **Superficial frostbite**: skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient

- **Deep frostbite**: tissues are cold, pale, and solid; extremely serious injury

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in the following five stages.

- Shivering
- Apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F
- Unconsciousness, glassy stare, slow pulse, and slow respiratory rate
- Freezing of the extremities
- Death

Standard reference books should be consulted for specific first-aid treatments. Medical help must be obtained for the more serious conditions. These effects of cold exposure shall be prevented by the wearing of appropriate clothing and by providing a warm "refuge" area where workers may warm up as necessary to prevent cold effects.

7.12 Indicators of Toxic Exposure

The following indicators of toxic exposure are generally observable by others and should be reported to the SSO if observed in a worker or personally experienced.

- Changes in complexion or skin discoloration
- Lack of coordination
- Changes in demeanor
- Excessive salivation, pupillary response
- Changes in speech pattern

The following symptoms of toxic exposure are generally non-observable by others, and should be reported to the SSO if experienced.

- Headaches
- Dizziness
- Blurred vision
- Nausea
- Cramps
- Irritation of eyes, skin, throat, or respiratory tract

The action to be taken by the SSO in response to any of these symptoms will be guided by the considerations covered in the Contingency Plan (subsection 6.3).

7.13 Precautions for Working in Confined Spaces

If any work in confined spaces is required, it will be performed in accordance with 29 CFR 1910.146 and this HASP will be amended to address the work, as applicable. Confined space work will not be performed without first notifying and receiving written approval from the CHSS.

7.14 Fire Prevention

Special attention will be paid to fire prevention to avoid uncontrolled fires. The following fire prevention rules will be followed at the Site.

- Smoking will be prohibited in all areas except those clearly designated and labeled as such by the PEC as smoking areas.

- All tanks, containers, and pumping equipment associated with the storage or handling of combustible or flammable liquids will be UL-listed for their intended use and in good condition.

- No sources of ignition will be permitted in areas where flammable or combustible liquids are stored. “NO SMOKING” signs will be placed in these areas.

- All lighting used in areas where flammable or combustible liquids are stored or used will be UL-listed.

- Delivery and storage of combustible or flammable liquids will be in keeping with state and federal Department of Transportation (DOT) regulations.

- Precaution will be taken while performing hot-work activities to prevent ignition of MGP tars or impacted materials. However, based on sampling performed to date, the MGP materials at this site are not ignitable.

- Good housekeeping standards will be maintained including the removal of waste, rubbish, and rags daily.

In addition to the above-mentioned fire protection measures, applicable fire protection requirements detailed in Con Edison’s EH&S Work Plan Guide (11.0 Fire Protection and Prevention) will be followed (see Attachment D).

7.15 Communication Procedures

Communication procedures will be established for all on-Site personnel.

7.16 Decontamination Procedures

Decontamination areas will be established for personnel decontamination and equipment decontamination.

7.16.1 Personnel Decontamination Station

A personnel decontamination station where workers can drop equipment and remove PPE will be set up at the boundary of the restricted zones within active Site work areas. It will be equipped with basins for water and detergent, and trash bag(s) or cans for containing disposable PPE and discarded materials. Once personnel have decontaminated at this station and taken off their PPE, they will proceed to a sink where they will wash themselves wherever they have potentially been exposed to any contaminants (e.g., hands, face, etc.)

Decontamination of personnel will be necessary if Level C or Level B protection is used. Decontamination will not be necessary if only Level D protection is used. However, disposable gloves used during sampling activities should be removed and bagged; personnel should be encouraged to remove clothing and shower as soon as it is practical 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.

The following specific decontamination procedure will be used as necessary by Site workers wearing PPE from Level C through Level B. Modification can be made to the decontamination process by the SSO depending upon the extent of contamination.

- Step 1 - Equipment drop (SCBA, tools, monitoring equipment, etc.) Decontaminate as appropriate (per SSO’s instructions).

- Step 2 - Boot wash/rinse (wash with Simple Green, rinse with fresh water spray). Wash outer gloves, remove and save for later use, or remove and discard outer gloves and place in trash bag/can provided in the decontamination area.

- Step 3 - Hardhat removal, wash if visibly contaminated (use same wash as in Step 2).

- Step 4 - Remove boots. If Tyvek™ (or equivalent) suit was worn and is visibly contaminated, remove and place in trash bag/can provided in the decontamination area or decontaminate (wash) and store for reuse. Contaminated washable coveralls should be removed and bagged for washing.

- Step 5 - Respirator and/or eye protection removal (as applicable). Wash (per Step 2) to remove visible contamination.

- Step 6 - Glove removal.

- Step 7 - Wash potentially exposed skin (use water and soap at indoor sink).

- Step 8 - Disinfect respirator per manufacturer's recommendations.

Contaminated PPE (gloves, suits, etc.) will be decontaminated and stored for reuse or placed in plastic bags (or other appropriate container) and disposed of in an approved facility. Decontamination wastewater and used cleaning fluids will be collected and disposed of in accordance with all applicable state and federal regulations.

7.16.2 Heavy Equipment Decontamination

Heavy equipment decontamination will be performed within the limits of the on-Site decontamination pads. A steam generator and brushes will be used to clean excavating equipment and other tools. No heavy equipment will be permitted to leave the Site unless it has been thoroughly decontaminated.

Wastewater from the heavy equipment and personnel decontamination areas will be collected and disposed of in accordance with all applicable state and federal regulations (Note: method of disposal is subject to client approval).

7.16.3 Sampling Equipment Decontamination

Sampling equipment will be decontaminated in accordance with the Site Management Field Sampling Plan.

7.16.4 Decontamination Equipment Requirements

The following equipment shall be in sufficient supply to implement project decontamination procedures.

- Plastic trash barrels
- Liners for trash barrels
- Wash basins
- Simple Green
- Hand pump sprayers
- Long handle soft bristle brushes
- Large sponges
- Cleaning wipes for respirators
- Bench or stool(s)
- Acetone
- Nitric acid
- Steam generator

- Paper towels
- Plastic trash bags
- Other

Subcontractors performing decontamination procedures are responsible for ensuring that the above materials, as required for their operation, are in sufficient supply.

7.17 Location of Buried Utilities

The Site may be underlain by shallow, buried utilities. Thus, it will be necessary for the contractor to exercise a high degree of caution in determining the correct and safe location of each excavation/drilling area. All underground utilities (electric, gas, telephone, and cable) will be marked by the New York One Call Center before initiation of intrusive work. The New York Department of Environmental Protection will mark out sewer and water. A private locating company will be contracted by the contractor to identify underground structures and utilities at the Site. The Parks Department (or current Site owner) will also be contacted in order to identify underground utilities.

Utility companies with active lines in the Site area will be asked to mark all of their facilities.

7.18 Engineering Controls and Work Practices

Engineering controls and work practices specified by both OSHA and the United States Environmental Protection Agency (EPA) are directed primarily toward limiting exposure through the application of engineered barriers. These requirements apply to practices on Superfund sites; however, they will be applied to the East 173rd Street Works Site where/when appropriate and practical.

7.19 Excavation

As discussed in subsection 7.17, all utilities will be marked out prior to excavation activities. Site workers will use these data to choose apparently safe locations for drilling/excavating. Drilling/excavating will proceed carefully at shallow depths to avoid rupturing any potentially existing unmarked lines or lines present below the depth of hand digging. Particulate dust monitoring and protection procedures are provided in subsection 7.2 of the Site Management HASP.

7.20 Waste Management

On-Site personnel will inspect the waste storage area and document the conditions everyday. Documentation will be provided to Con Edison. Further details of waste management, sampling and labeling activities are discussed in the Site Management Field Sampling Plan.

7.21 Material Handling

Regulations for handling drums and containers are specified by OSHA 29 CFR 1910.120(j). Potential hazards associated with handling drums include vapor generation, fire, explosions, and possible physical injury. Whenever possible the material will be lifted and moved by mechanical devices rather than manual effort. These mechanical devices will be operated by trained authorized personnel only. Drum and container handling will be performed in accordance with all applicable regulations (see Attachment D, Con Edison EH&S Work Plan Guide – 18.0 Material Handling).

7.22 Mechanical Equipment

All hand and power tools will be maintained and used properly. Any tools damaged must be removed from the Site until they are repaired. Removing any safety controls is prohibited. Electric hand tools must be double insulated or grounded with a ground-fault circuit interrupter (see Attachment D for Con Edison EH&S Work Plan Guide – 19.0 Mechanical Equipment)

7.23 Vehicle Management

All vehicles used to transport personnel, equipment or for soil hauling must be maintained and operated in a safe manner to protect workers and the public. Only properly trained and licensed personnel may operate vehicles (see Attachment D for Con Edison EH&S Work Plan Guide – 28.0 Vehicle Management).

7.24 Drilling and Earth-Moving Equipment Safety

Drilling and earth-moving equipment operators will be responsible for operating their assigned pieces of equipment according to the requirements outlined in 29 CFR 1926, Subpart O. Any pieces of equipment not satisfying the requirements of this section or otherwise unsafe to operate will not be used. The SSO will be apprised of the unsatisfactory condition of equipment as soon as possible. The equipment will be placed out-of-service and tagged to identify its safety failing until the equipment can be repaired, or decontaminated and demobilized from the Site.

7.25 Sanitation for Temporary Work Sites

Sanitary facilities (i.e., portable toilets) will be available at the Site.

7.26 Illumination

Illumination requirements identified by OSHA are directed to work efforts inside buildings and/or during non-daylight hours. Illumination will meet or exceeds requirements specified in 29 CFR 1926.56, Illumination.

7.27 Site-Specific Safety Rules

The following site-specific rules and regulations will be enforced during Site activities.

- No smoking, drinking, or eating within restricted zones.

- Proper respiratory protection is required to be worn at all times within zones where toxic vapor/gas levels have been determined to be above recommended safety limits. Copies of fit tests and medical clearance forms for each worker will be present on Site.

- All rest, refreshment, and sanitary facility use will take place in “clean areas” outside of restricted and decontamination zones.

- Those in contact with contaminated soils or other materials that are thought to be contaminated must go through decontamination upon egress from the restricted area (based on the level of contamination) and before they may enter “clean” areas or non-restricted areas. Decontamination procedures are detailed in subsection 4.2.

- The SSO has full authority over start-up and shutdown of operations from a safety standpoint. He will determine whether conditions are too extreme for work, and he will establish the working hours at the Site.

7.28 Conditions Reportable to the SSO

Any of the following conditions, or potential conditions, shall be immediately reported to the SSO:

- Fire and/or explosion
- Spill or release of potentially hazardous material
- Severe weather (e.g., electrical storm, tornado, etc.)
- Physical or chemical injuries, or hazards potentially causing injury to workers or the public
- Any other condition, potential event, or hazard posing a potential risk to human health or the environment

7.29 Emergency Evacuation Procedures

7.29.1 Site Evacuation Procedures

The SSO will act as the Project Emergency Coordinator (PEC) in the event of an emergency. If an emergency occurs that requires the evacuation of an area to ensure personnel safety, including (but not limited to) fire, explosion, severe weather, hazardous waste/materials spills, or a significant release of gas into the atmosphere, a horn will be sounded on the Site by the nearest person aware of the event. The horn will sound continuously for approximately 15 seconds, signaling that immediate evacuation of all personnel from the area is necessary as a result of some existing or impending danger. In areas where only two or three people are working side by side, and the need to evacuate can be communicated verbally by the nearest person aware of the event, the air horn will not be necessary.

All heavy equipment in the area will be shut down. Under no circumstances will incoming visitors (other than emergency response personnel) be allowed to enter any area where an emergency is occurring. Visitors or observers and all non-essential personnel present in the area of an emergency will be instructed to evacuate the area immediately.

Contractor and subcontractor emergency coordinators and/or health and safety officers (as designated) will be responsible for ensuring that emergency response requirements specific to their own operations are carried out. These parties will report their activities to the PEC. However, the PEC has final authority regarding all emergency response activities.

All non-essential personnel shall evacuate the emergency areas and notify personnel in adjacent affected areas to evacuate. The evacuated workers will assemble at the primary assembly to be determined prior to commencement of Site work, where the PEC will give directions for implementing necessary actions. In the event that the primary assembly area is involved, unapproachable, or unsafe due to the event, evacuated workers shall assemble at the alternate assembly area, also to be determined prior to the start of work. The PEC will telephone for backup assistance.

Personnel are to avoid encountering smoke/gas plumes as practicable during evacuation and assembling.

The PEC will take charge of all emergency response activities and dictate the procedures that will be followed until emergency personnel arrive. The PEC will assess the seriousness of the situation, and direct whatever efforts are necessary until the emergency response units arrive.

After initiating emergency response procedures, the PEC will assign appropriate personnel to check and attempt to ensure that access roads are not obstructed. If traffic control is necessary, as in the event of a fire or explosion, personnel designated by the PEC will take over these duties until emergency units arrive. Appropriate reflective warning vests will be worn by personnel involved with traffic control. Vests, flares, flashlights, and traffic cones (or equivalent) as may be appropriate for traffic control will be kept available on Site by the PEC.

The PEC will remain at the Site to provide any assistance requested by emergency-response squads as they arrive to deal with the situation. The PEC will have the authority to shut down any part or all of the project after an emergency until he deems it safe to continue operations. He will dictate any changes in project safety practices, which are made necessary by the emergency that has occurred, or are required for preventing further emergencies.

7.29.2 Off-Site Evacuation Procedures

If the PEC deems that humans outside of the Site are at risk, he will notify the appropriate agencies and departments of the need or potential need to institute off-Site evacuation procedures. The PEC will provide, at a minimum, the following information.

- His or her name and telephone number
- Name and address of facility
- Time and type of incident (i.e., release, fire, etc.)
- Name and quantity of materials or material involved, to the extent this information is known
- The extent of injuries, if any

The possible hazards to human health or the environment, and cleanup procedures

Tables

TABLE 1
SUMMARY OF ACTION LEVELS AND RESTRICTIONS

Conditions for Level D:

All areas

- PID readings for total VOCs < 25 ppm and absence of benzene (sustained for 15 minutes in breathing zone)
- Hydrogen Cyanide readings < 5 mg/m^3

Conditions for Level C:

All areas

- PID readings for total VOCs > 25 ppm (sustained for 15 minutes in breathing zone), or benzene > 1 ppm and < 25 ppm (sustained for 15 minutes in breathing zone), or
- Any visible fugitive dust emissions from site activities that disturb contaminated soil.

Conditions for Level B (or retreat):

All areas

- Benzene (sustained for 15 minutes in breathing zone) > 25 ppm, or
- Hydrogen Cyanide readings > 5 mg/m^3

TABLE 2.1
RELEVANT PROPERTIES OF VOLATILES AND SEMIVOLATILES KNOWN OR SUSPECTED

Compound (Synonym)	OSHA PEL(1) (ppm)	IDLH (ppm)	LEL (%)	Odor Threshold(2) (ppm)	Odor Character	Vapor Pressure (mm Hg)	Physical State	Detectable w/ 10.6 eV lamp PID (I.P. eV)
Benzene	1 5 [STEL]	500 [Ca]	1.2	119	Aromatic, sweet	75	Flammable Liquid	Yes (9.24)
o-,m-, p- Xylenes	100 150 [STEL]	900	0.9	20	Aromatic	7,9,9	Flammable Liquid vapor	Yes (8.4-8.6)
Toluene	200 300 [CEIL]	500	1.1	37	Sweet, pungent Benzene-like	20	Flammable Liquid vapor	Yes (8.82)
Ethyl Benzene	100 125 [TLV-STEL]	800	0.8	0.6	Oily Solvent	10	Flammable Liquid	Yes (8.76)

(1)	29 CFR 1910, June 30, 1993 (8-hour Time weighted average unless otherwise specified.)
(2)	ACGIH 1989 Highest reported value of acceptable odor threshold range.
[IDLH]	Immediately dangerous to life or health.
[CA]	Suspect carcinogen - Minimize all possible exposures.
[STEL]	15 minute Short Term Exposure Limit
[SKIN]	Designates that skin is an important possible route of exposure.
[CEIL]	Ceiling Limit - not to de exceeded at any time during a work day.
[TLV]	Threshold Limit Value.

TABLE 2.1 (CONTINUED)
RELEVANT PROPERTIES OF VOLATILES AND SEMIVOLATILES KNOWN OR SUSPECTED

Compound (Synonym)	OSHA PEL(1) (ppm)	IDLH (ppm)	LEL (%)	Odor Threshold(2) (ppm)	Odor Character	Vapor Pressure (mm Hg)	Physical State	Detectable w/ 10.6 eV lamp PID (I.P.)
Naphthalene	10 15 [TLV-STEL]	250	0.9	0.64	Mothballs/ Tar/ Creosote	0.08	Combustible Solid	Yes (8.12)
Polynuclear Aromatic Hydrocarbons (PAH's)	0.2 mg/m^3	80 mg/m^3 [Ca]	varies	varies	varies	very low	Combustible Solid	No (?)
Hydrogen Cyanide	5.0 mg/m^3 [STEL] [SKIN]	50	5.6	5	Bitter almond	630	Flammable Liquid	No (13.6) (Draeger Tube)
Arochlor 1254 PCB, Chlorodiphenyl w/ 54% Chlorine	0.5 mg/m^3	5.0 mg/m^3 [SKIN] [CA]	NA	NA	mild, hydrocarbon	0.00006	Nonflammable liquid (Solid Below 50°F	NA

(1)	29 CFR 1910, June 30, 1993 (8-hour Time weighted average unless otherwise specified.)
(2)	ACGIH 1989 Highest reported value of acceptable odor threshold range.
[IDLH]	Immediately dangerous to life or health.
[CA]	Suspect carcinogen - Minimize all possible exposures.
[STEL]	15 minute Short Term Exposure Limit
[SKIN]	Designates that skin is an important possible route of exposure.
[TLV]	Threshold Limit Value

TABLE 2.2
SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING FOR FIT AND ACCLIMATED WORKERS[a]

Adjusted Temperature[b]	Normal Work Ensemble[c]	Impermeable Ensemble
90°F or above (32.2°C) or above	After each 45 min. of work	After each 15 min. of work
87.5°F (30.8°-32.2°C)	After each 60 min. of work	After each 30 min. of work
82.5°-87.5°F (28.1°-30.8°C)	After each 90 min. of work	After each 60 min. of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 min. of work	After each 90 min. of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 min. of work	After each 120 min. of work

[a] For work levels of 250 kilocalories/hour.

[b] Calculate the adjusted air temperature (ta adj) by using this equation: ta adj ^{o}F = ta ^{o}F + (13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

[c] A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Table 2.3 - HEAT INDEX

ENVIRONMENTAL TEMPERATURE (Fahrenheit)

RELATIVE HUMIDITY	70	75	80	85	90	95	100	105	110	115	120
					APPARENT TEMPERATURE*						
0%	64	69	73	78	83	87	91	95	99	103	107
10%	65	70	75	80	85	90	95	100	105	111	116
20%	66	72	77	82	87	93	99	105	112	120	**130**
30%	67	73	78	84	90	96	104	113	123	**135**	**148**
40%	68	74	79	86	93	101	110	123	**137**	**151**	
50%	69	75	81	88	96	107	120	**135**	**150**		
60%	70	76	82	90	100	114	**132**	**149**			
70%	70	77	85	93	106	124	**144**				
80%	71	78	86	97	113	**136**					
90%	71	79	88	102	122						
100%	72	80	91	108							

*Combined Index of Heat and Humidity...what it "feels like" to the body
Source: National Oceanic and Atmospheric Administration

How to use Heat Index:
1. Across top locate Environmental Temperature
2. Down left side locate Relative Humidity
3. Follow across and down to find Apparent Temperature
4. Determine Heat Stress Risk on chart at right

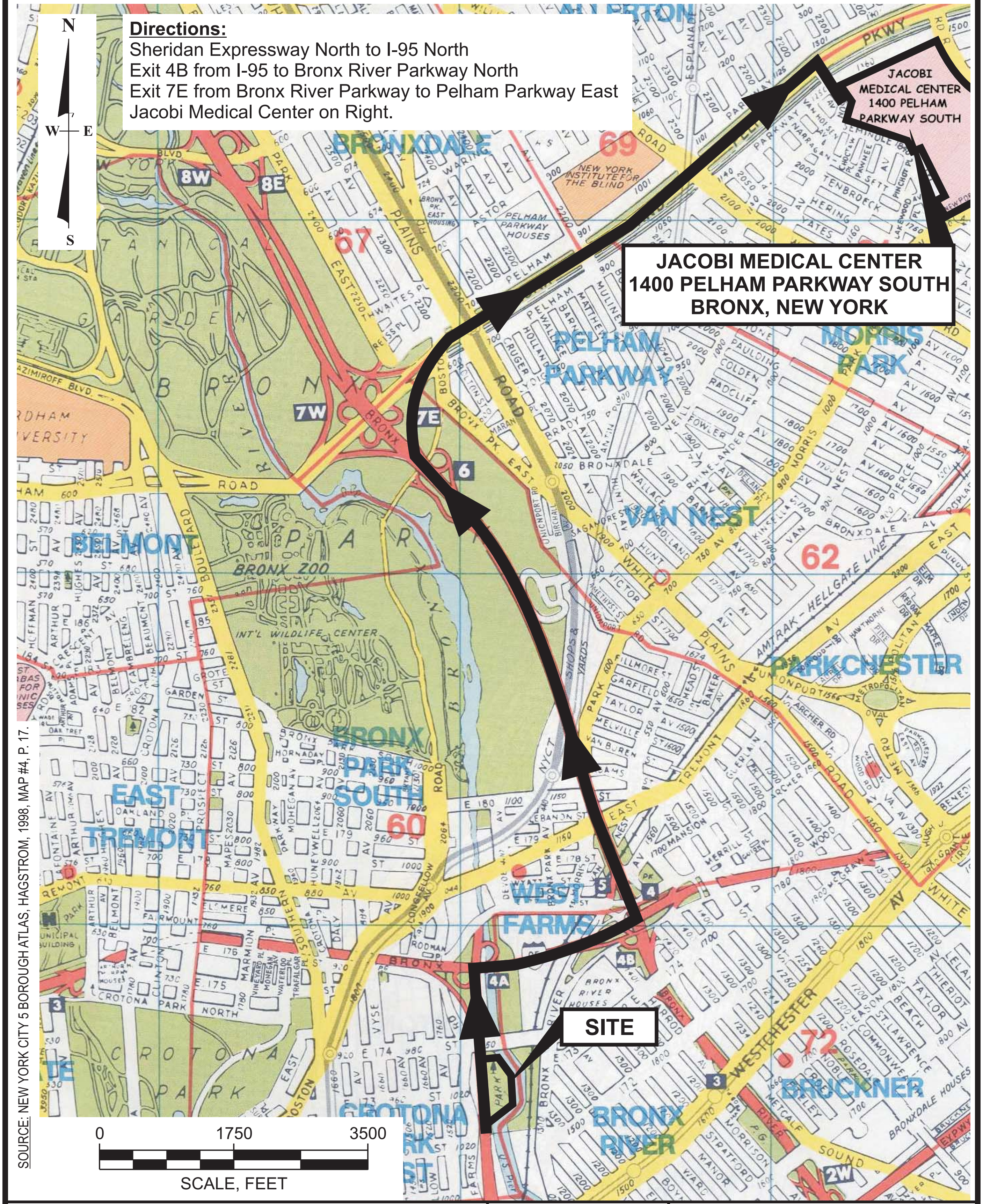
Note: Exposure to full sunshine can increase Heat Index values by up to 15 degrees F.

Apparent Temperature	Heat Stress Risk with Physical Activity and/or Prolonged Exposure
90-105	Heat Cramps or Heat Exhaustion Possible
105-130	Heat Cramps or Heat Exhaustion Likely, Heat Stroke Possible
>130	Heatstroke Highly Likely

GEI Consultants

Figure

Directions:
Sheridan Expressway North to I-95 North
Exit 4B from I-95 to Bronx River Parkway North
Exit 7E from Bronx River Parkway to Pelham Parkway East
Jacobi Medical Center on Right.



SOURCE: NEW YORK CITY 5 BOROUGH ATLAS, HAGSTROM, 1998, MAP #4, P. 17.

EAST 173RD STREET WORKS
BRONX, NEW YORK

CONSOLIDATED EDISON COMPANY
OF NEW YORK, INC.

GEI Consultants

HOSPITAL ROUTE MAP

Project 013943

March 2010

Figure 1

CON_ED\013943\E173\FIGS\E173-HOSPITAL ROUTE.CDR

Attachment A

Forms for Health and Safety-Related Activities

Note: The OSHA Job Safety and Health Protection Poster must be posted prominently during field activities. The following page is an example of the poster to be used in the field. The actual poster must be an 11 inch by 17-inch size version of this page. The OSHA 300 Log of injuries and illnesses is maintained in the home office of each Project Contractor employee.

You Have a Right to a Safe and Healthful Workplace.

IT'S THE LAW!

- You have the right to notify your employer or OSHA about workplace hazards. You may ask OSHA to keep your name confidential.
- You have the right to request an OSHA inspection if you believe that there are unsafe and unhealthful conditions in your workplace. You or your representative may participate in the inspection.
- You can file a complaint with OSHA within 30 days of discrimination by your employer for making safety and health complaints or for exercising your rights under the *OSH Act*.
- You have a right to see OSHA citations issued to your employer. Your employer must post the citations at or near the place of the alleged violation.
- Your employer must correct workplace hazards by the date indicated on the citation and must certify that these hazards have been reduced or eliminated.
- You have the right to copies of your medical records or records of your exposure to toxic and harmful substances or conditions.
- Your employer must post this notice in your workplace.

The *Occupational Safety and Health Act of 1970 (OSH Act),* P.L. 91-596, assures safe and healthful working conditions for working men and women throughout the Nation. The Occupational Safety and Health Administration, in the U.S. Department of Labor, has the primary responsibility for administering the *OSH Act*. The rights listed here may vary depending on the particular circumstances. To file a complaint, report an emergency, or seek OSHA advice, assistance, or products, call 1-800-321-OSHA or your nearest OSHA office: • Atlanta (404) 562-2300 • Boston (617) 565-9860 • Chicago (312) 353-2220 • Dallas (214) 767-4731 • Denver (303) 844-1600 • Kansas City (816) 426-5861 • New York (212) 337-2378 • Philadelphia (215) 861-4900 • San Francisco (415) 975-4310 • Seattle (206) 553-5930. Teletypewriter (TTY) number is 1-877-889-5627. To file a complaint online or obtain more information on OSHA federal and state programs, visit OSHA's website at **www.osha.gov**. If your workplace is in a state operating under an OSHA-approved plan, your employer must post the required state equivalent of this poster.

1-800-321-OSHA

www.osha.gov

U.S. Department of Labor • Occupational Safety and Health Administration • OSHA 3165

OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year ______

U.S. Department of Labor
Occupational Safety and Health Administration

You must record information about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an injury and illness incident report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Form approved OMB no. 1218-0176

Establishment name ____________________

City ____________ **State** ________

Identify the person				**Describe the case**		**Classify the case**											
						CHECK ONLY ONE box for each case based on the most serious outcome for that case:				Enter the number of days the injured or ill worker was:		Check the "injury" column or choose one type of illness:					
(A) Case No.	(B) Employee's Name	(C) Job Title (e.g., Welder)	(D) Date of injury or onset of illness (mo./day)	(E) Where the event occurred (e.g. Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g. Second degree burns on right forearm from acetylene torch)	Death	Days away from work	Remained at work		**Away From Work (days)**	On job transfer or restriction (days)	(M)					
								Job transfer or restriction	Other record-able cases			Injury	Skin Disorder	Respiratory Condition	Poisoning	Hearing Loss	All other illnesses
						(G)	(H)	(I)	(J)	(K)	(L)	(1)	(2)	(3)	(4)	(5)	(6)
					Page totals	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
												Injury	Skin Disorder	Respiratory Condition	Poisoning	Hearing Loss	All other illnesses
												(1)	(2)	(3)	(4)	(5)	(6)

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instruction, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.

PROJECT CONTRACTOR ACCIDENT REPORT FORM

(Page 1 of 2)

Project Name:____________________________________

Injured or ill employee

1. Name ___________________________ Social Security #__________________
   (First) (Middle) (Last)
2. Home Address ____
   (No. and Street) (City or Town) (State and Zip)
3. Age _____ 4. Sex: Male ( ) Female ( )
5. Occupation ____
   (Specific job title, <u>not</u> the specific activity employee was performing at time of injury)
6. Department ____
   (Enter name of department in which injured person is employed, even though they may have been temporarily working in another department at the time of injury)

Employer

7. Name ____
8. Mailing Address ____
   (No. and Street) (City or Town) (State and Zip)
9. Location (if different from mailing address):__________________________________
   ____

THE ACCIDENT OR EXPOSURE TO OCCUPATIONAL ILLNESS

10. Place of accident or exposure ____
    (No. and Street) (City or Town) (State and Zip)
11. Was place of accident or exposure on employer's premises? __(Yes/No)
12. What was the employee doing when injured?_________________________________

____
(Be specific - was employee using tools or equipment or handling material?)

____

13. How did the accident occur? ____

____
(Describe fully the events that resulted in the injury or occupational illness. Tell what happened and how. Name objects and substances involved.

____
Give details on all factors that led to accident. Use separate sheet if needed)

14. Time of accident: ________________
15. Date of injury or initial diagnosis of occupational illness ______________
    (Date)

PROJECT CONTRACTOR ACCIDENT REPORT FORM

(Page 2 of 2)

16. WITNESS TO ACCIDENT	____________________ (Name)	________________ (Affiliation)	_______________ (Phone No.)
	____________________ (Name)	________________ (Affiliation)	_______________ (Phone No.)
	____________________ (Name)	________________ (Affiliation)	_______________ (Phone No.)

Occupational injury or occupational illness

17. Describe the injury or illness in detail; indicate part of body affected.

____

____

18. Name the object or substance which directly injured the employee. (For example, object that struck employee; the vapor or poison inhaled or swallowed; the chemical or radiation that irritated the skin; or in cases of strains, hernias, etc., the object the employee was lifting, pulling, etc.)

____

____

19. Did the accident result in employee fatality? ________ (Yes or No)
20. Number of lost workdays ____/restricted workdays _____ resulting from injury or illness?

Other

21. Did you see a physician for treatment? ________ (Yes or No) ________ (Date)
22. Name and address of physician ____

____
(No. and Street) (City or Town) (State and Zip)

23. If hospitalized, name and address of hospital ________________________________

____
(No. and Street) (City or Town) (State and Zip)

Date of report ____________________ Prepared by ______________________

Official position ____________________________

Project Health And Safety Plan
And Work Plan Acceptance Form
(For The Project Contractor Employees Only)

I have read and agree to abide by the contents of the Work Plan and Health and Safety Plan for the following project:

____________________________	______________________________
(Project Title)	(Project Number)

Furthermore, I have read and am familiar with the work plan or proposal which describes the field work to be conducted and the procedures to be utilized in the conduct of this work.

Name (print)	Signature	Date
____________________________	_____________________________	______________
____________________________	_____________________________	______________
____________________________	_____________________________	______________
____________________________	_____________________________	______________
____________________________	_____________________________	______________
____________________________	_____________________________	______________
____________________________	_____________________________	______________
____________________________	_____________________________	______________
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____________________________	_____________________________	______________
____________________________	_____________________________	______________

Place in project Health and Safety File as soon as possible

Site-Specific Health and Safety Training

(FOR ALL PROJECT CONTRACTOR AND SUBCONTRACT EMPLOYEES ON SITE)

I hereby confirm that site-specific health and safety training has been conducted by the site health and safety officer which included:

- 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
- Decontamination procedures

For the following project:

____________________________	______________________________
(Project Title)	(Project Number)

Name (print)	Signature	Date

Place in project Health and Safety File as soon as possible

Attachment B

Air Monitoring Equipment Calibration and Maintenance

AIR MONITORING EQUIPMENT CALIBRATION AND MAINTENANCE

All monitoring instruments must be calibrated and maintained periodically. Calibration and on-site maintenance records will be kept in the field log book. 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 MicroTip HL-2000 (or equivalent) photoionization detector (PID) must be calibrated at least once each day. Combustible gas/oxygen meters (explosimeters) such as the MSA Model 360 monitor must be calibrated at least once a week. The specific instructions for calibration and maintenance provided for each instrument should be followed.

Attachment C

Material Safety Data Sheets

Occupational Health Guideline for Cyanide

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

APPLICABILITY

The general guidelines contained in this document apply to all cyanides. Physical and chemical properties of two specific compounds are provided for illustrative purposes.

SUBSTANCE IDENTIFICATION

Potassium cyanide

- Formula: KCN
- Synonyms: None
- Appearance and odor: White solid with a faint almond odor.

Sodium cyanide

- Formula: NaCN
- Synonyms: None
- Appearance and odor: White solid with a faint almond odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for cyanide is 5 milligrams of cyanide per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be changed to a ceiling of 5 milligrams cyanide per cubic meter of air averaged over a 10-minute period. The NIOSH Criteria Document for Hydrogen Cyanide and Cyanide Salts should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Cyanide can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. Sufficient cyanide may be absorbed through the skin, especially if there are cuts to cause fatal poisoning.

- **Effects of overexposure**

1. Short-term Exposure: Inhalation or ingestion of cyanide salts may be rapidly fatal. Larger doses by inhalation or swallowing may cause the person to rapidly lose consciousness, stop breathing, and die. In some cases, there are convulsions. At lower levels of exposure, the earlier symptoms include weakness, headache, confusion, nausea, and vomiting. These symptoms may be followed by unconsciousness and death. Occasionally, convulsions occur. Milder forms of intoxication may result only in weakness, dizziness, headache, and nausea. The dust of cyanide salts is irritating to the eyes. In the presence of tears, it may cause the symptoms of poisoning described above. The dust of cyanide salts may produce irritation of the nose and skin. Strong solutions of cyanide salts are corrosive and may produce ulcers.

2. Long-term Exposure: Effects from chronic exposure to cyanide are non-specific and rare.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to cyanide.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to cyanide at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of fainting spells, such as occur in various types of cardiovascular and nervous disorders.

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Public Health Service   Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

and those unusually susceptible to effects of anoxia or with anemia would be expected to be at increased risk from exposure. Examination of the cardiovascular, nervous, and upper respiratory systems, and thyroid should be stressed. The skin should be examined for evidence of chronic disorders.

—Skin disease: Cyanide is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—14" x 17" chest roentgenogram: Cyanide causes human lung damage. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Cyanide is a respiratory irritant. Persons with impaired pulmonary function may be at increased risk from exposure. Periodic surveillance is indicated.

2. *Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis.

3. *First Aid Kits:* First aid kits should be readily available in workplaces where there is a potential for the release of cyanide. These kits should contain a minimum of 48 ampules, each of 0.3 ml amyl nitrate, and complete instructions for use. In addition, 2 physician's kits should be immediately available to trained medical personnel. These kits should contain the above quantity of amyl nitrate as well as sterile sodium nitrite solution (3%) and sterile sodium thiosulfate solution (25%). All of the above drugs should be replaced at least biannually to ensure their potency.

- **Summary of toxicology**

The dust of cyanide salts, a source of cyanide ion, is an asphyxiant due to an inhibitory action on metabolic enzyme systems and can be rapidly fatal. Cyanide exerts this effect because it inactivates certain enzymes by forming very stable complexes with the metal in them. Cytochrome oxidase is probably the most important of these, since it occupies a fundamental position in the respiratory process and is involved in the ultimate electron transfer to molecular oxygen. Since cytochrome oxidase is present in practically all cells that function under aerobic conditions, and since the cyanide ion diffuses easily to all parts of the body, it is capable of suddenly bringing to a halt practically all cellular respiration. In the presence of even weak acids, hydrocyanic acid (HCN) gas is liberated from cyanide salts; a few inhalations of higher concentrations of HCN may be followed by almost instantaneous collapse and cessation of respiration; 270 ppm HCN is immediately fatal to humans, 181 ppm is fatal after 10 minutes, 135 ppm after 30 minutes, and 110 ppm may be fatal in 1 hour. The ingestion by humans of 50 to 100 mg of sodium or potassium cyanide may also be fatal. At lower levels of exposure to HCN, the earliest symptoms of intoxication may include weakness, headache, confusion, and occasionally nausea and vomiting; respiratory rate and depth is usually increased initially and at later stages becomes slow and gasping; if cyanosis is present, it usually indicates that respiration has either ceased or has been very inadequate for a few minutes. Humans tolerate 45 to 54 ppm for ½ to 1 hour without immediate or delayed effects, while 18 to 36 ppm may result in some symptoms after an exposure of several hours. Sodium cyanide dust is irritating to the eyes; in the presence of tears it may liberate HCN, which can be absorbed and cause systemic intoxication. Skin contact with dust may be irritating; strong solutions on the skin produce ulcers which are slow in healing. Cyanide is one of the few toxic materials for which an antidote exists; it functions as follows: First, amyl nitrite (inhalation) and sodium nitrite (intravenously) are administered to form methemoglobin, which binds firmly with free cyanide ions. This traps any circulating cyanide ions. The formation of 10 to 20% methemoglobin usually does not involve appreciable risk, yet provides a large amount of cyanide-binding substance. Second, sodium thiosulfate is administered intravenously to increase the rate of conversion of cyanide to the less toxic thiocyanate. Methylene blue should not be administered, because it is a poor methemoglobin former and, moreover, promotes the conversion of methemoglobin back to hemoglobin.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data—Potassium cyanide**

1. Molecular weight: 65.1
2. Boiling point (760 mm Hg): Data not available
3. Specific gravity (water = 1): 1.55
4. Vapor density (air = 1 at boiling point of potassium cyanide): Not applicable
5. Melting point: 635 C (1175 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): 71.6
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Sodium cyanide**

1. Molecular weight: 49
2. Boiling point (760 mm Hg): 1500 C (2732 F) (extrapolated)
3. Specific gravity (water = 1): 1.6
4. Vapor density (air = 1 at boiling point of sodium cyanide): Not applicable
5. Melting point: 560 C (1040 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): 58
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Reactivity**

1. Conditions contributing to instability: None. Hazardous if kept in closed containers. It may form toxic concentrations of hydrogen cyanide gas when in prolonged contact with air in a closed area.
2. Incompatibilities: Contact with strong oxidizers such as nitrates and chlorates may cause fires and

explosions. Contact with acids and acid salts causes immediate formation of toxic and flammable hydrogen cyanide gas.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen cyanide and carbon monoxide) may be released when cyanide decomposes.

4. Special precautions: Cyanide may react with carbon dioxide in ordinary air to form toxic hydrogen cyanide gas.

- **Flammability**

1. Not combustible

- **Warning properties**

1. Odor Threshold: No quantitative information is available concerning the odor threshold of sodium or potassium cyanide. HCN, however, is evolved from these substances in the presence of moisture. The Manufacturing Chemists Association states that "although HCN has a characteristic odor, its toxic action at hazardous concentrations is so rapid that it is of no value as a warning property."

2. Eye Irritation Level: Cyanide (as CN) is not known to be an eye irritant. However, according to Grant, HCN can produce eye irritation after chronic exposures.

3. Evaluation of Warning Properties: Although cyanide (as CN) has a negligible vapor pressure, in the presence of moisture HCN can be given off. HCN does not have adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of cyanide. Each measurement should consist of a ten (10) minute sample or series of consecutive samples totalling ten (10) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- **Method**

Sampling and analyses may be performed by collection of cyanide with a cellulose membrane filter and an impinger containing sodium hydroxide, followed by analysis by direct potentiometry. An analytical method for cyanide is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with cyanide or liquids containing cyanide.
- If employees' clothing has had any possibility of being contaminated with cyanide, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing which has had any possibility of being contaminated with cyanide should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of cyanide from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the cyanide, the person performing the operation should be informed of cyanide's hazardous properties.
- Where there is any possibility of exposure of an employee's body to cyanide or liquids containing cyanide, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with cyanide should be removed immediately and not reworn until the cyanide is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of cyanide or liquids containing cyanide contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to cyanide or liquids containing cyanide, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with cyanide should be immediately washed or showered with soap or mild detergent and water to remove any cyanide.
- Workers subject to skin contact with cyanide should wash with soap or mild detergent and water any areas of the body which may have contacted cyanide at the end of each work day.
- Eating and smoking should not be permitted in areas where cyanide or liquids containing cyanide are handled, processed, or stored.
- Employees who handle cyanide or liquids containing cyanide should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to cyanide may occur and control methods which may be effective in each case:

Operation	Controls
Use as fumigants and pesticides in greenhouses, ships, mills, and warehouses; use of cyanogen chloride as a warning agent in fumigant gases	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in metal treatment in nitriding, tempering, and case hardening steel; coloring of metals by chemical or electrolytic process; cleaning and coating metals; welding and cutting of heat-resistant metals; liberation during ore extraction and metal purification	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use of calcium cyanamid in fertilizer on soil; during chemical synthesis for manufacture of intermediates in pharmaceuticals, dyes, vitamins, plastics, and sequestering agents; preparation of nitriles, carbylamines, cyano fatty acids, and inorganic cyanides	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in cellulose technology; paper manufacture; in dyeing; as cement stabilizers; use in photography as fixatives, and in blueprinting and process engraving; liberation in blast furance gases or in handling of illuminating gas	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

- **Eye Exposure**

If cyanide gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with cyanides.

- **Skin Exposure**

If cyanide gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If cyanide penetrates through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention immediately.

- **Breathing**

If a person breathes in large amounts of cyanide, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

- **Swallowing**

When cyanide has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.
- If cyanide is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. Collect spilled material in the most convenient and safe manner for reclamation, or for treatment in a cyanide disposal system.

- Waste disposal method:

After treatment as in above, cyanide may be disposed of in a secured sanitary landfill.

REFERENCES

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RESPIRATORY PROTECTION FOR CYANIDE

Condition	Minimum Respiratory Protection* Required Above 5 mg/m^3
Particulate Concentration	
50 mg/m^3 or less	Any supplied-air respirator. Any self-contained breathing apparatus.
Greater than 50 mg/m^3 or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against hydrogen cyanide and particulates. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

[illegible] Agency

Region 5
230 S. Dearborn Street
Chicago, IL 60604

Michigan, Minnesota,
Ohio, Wisconsin

EPA Facts About Ferric Ferrocyanide

What Is Ferric Ferrocyanide?

Ferric ferrocyanide is an intense blue pigment known by many names, including Prussian Blue, Berlin Blue, Chinese Blue, Hamburg Blue, Mineral Blue, Paris Blue, Iron Blue, and others. Ferric ferrocyanide is a compound manufactured from iron cyanide salts.

Ferric ferrocyanide is a major component of the blue residue found at manufactured gas sites. Until the 1950s gas for cooking and lighting in homes was made by passing steam over red hot coke under pressure. Cyanide contaminants in the manufactured gas were removed by passing the gas through a bed of woodchips and iron filings. This process generated ferric ferrocyanide, locally known as gas wash.

Ferric ferrocyanide has been used commercially as a pigment in printing inks, paints, leather cloth, carbon paper, typewriter ribbons, plastics, paper dye, laundry bluing, fertilizers, and cosmetics such as eye shadow. Ferric ferrocyanide has also been used as an anticaking agent in products such as road salt. Medically, ferric ferrocyanide has been used to treat radiation exposure and metal poisoning.

This fact sheet summarizes readily available information about ferric ferrocyanide. For more information, please contact U.S. EPA directly at the appropriate toll-free number:

MI, IN, MN, OH, WI Residents	Residents of Illinois
1-800-621-8431	1-800-572-2515
Monday - Friday	Monday - Friday
9 a.m. - 4:30 p.m.	9 a.m. - 4:30 p.m.
Central Time	Central Time

How are People Exposed to Ferric Ferrocyanide?

People are exposed to ferric ferrocyanide during its manufacture and use, and through contact with products into which the dye has been incorporated. People also may be exposed to ferric ferrocyanide through its medical uses and through contact with waste products from manufactured gas sites.

What Potential Health Threats are Associated With Ferric Ferrocyanide?

Ferric ferrocyanide is a very stable compound that does not dissolve in water or oil. Therefore, it is not readily absorbed through the skin or in the digestive tract. In ferric ferrocyanide the cyanide is strongly bound to the rest of the molecule and therefore acts very differently than free cyanide.

Based on studies of related compounds, ferric ferrocyanide probably has a low toxicity when taken orally in high doses. Ferric and ferrocyanides (which are less chemically stable than ferric ferrocyanide) have LD 50 values for rats above 1 gram (g)/kilogram (kg). This means, on average, one-half of the rats fed greater than 1 g of the compound per kg of body weight will die. Tests of ferric and ferrocyanides have also been performed on mice and dogs, with similer results. These compounds are considered 100 to 5,000 times less toxic than free cyanide.

In people, low doses of ferric ferrocyanides have been given as medication and in clinical tests without harmful affects. In one case, a 52-year-old man ingested a large dose (more than one ounce) of ferrocyanide, which caused serious kidney problems, but he survived. There is no indication that skin irritation due to ferrocynides, including ferric ferrocyanide, is a concern.

Although ferric ferrocyanide probably has a low toxicity, care should be used in its presence. Under extreme conditions, highly toxic decomposition products including free cyanide, can form. In addition, when ferric ferrocyanide is found in manufactured gas plant ste, there may be low levels of other hazardous contaminants.

Occupational Health Guideline for Coal Tar Pitch Volatiles

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

Anthracene

- Formula: $C_{14}H_{10}$
- Synonyms: None
- Appearance and odor: Pale green solid with a faint aromatic odor.

Phenanthrene

- Formula: $C_{14}H_{10}$
- Synonyms: None
- Appearance and odor: Colorless solid with a faint aromatic odor.

Pyrene

- Formula: $C_{16}H_{10}$
- Synonyms: None
- Appearance: Bright yellow solid

Carbazole

- Formula: $C_{12}H_9N$
- Synonyms: None
- Appearance and odor: Colorless solid with a faint aromatic odor.

Benzo(a)pyrene

- Formula: $C_{20}H_{12}$
- Synonyms: BaP, 3,4-benzopyrene
- Appearance and odor: Colorless solid with a faint aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for coal tar pitch volatiles is 0.2 milligram of coal tar pitch volatiles per cubic meter of air (mg/m³) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit for coal tar products be reduced to 0.1 mg/m³ (cyclohexane-extractable fraction) averaged over a work shift of up to 10 hours per day, 40 hours per week, and that coal tar products be regulated as occupational carcinogens. The NIOSH Criteria Document for Coal Tar Products and NIOSH Criteria Document for Coke Oven Emissions should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Coal tar pitch volatiles can affect the body if they are inhaled or if they come in contact with the eyes or skin.

- **Effects of overexposure**

Repeated exposure to coal tar pitch volatiles has been associated with an increased risk of developing bronchitis and cancer of the lungs, skin, bladder, and kidneys. Pregnant women may be especially susceptible to exposure effects associated with coal tar pitch volatiles. Repeated exposure to these materials may also cause sunlight to have a more severe effect on a person's skin. In addition, this type of exposure may cause an allergic skin rash.

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to coal tar pitch volatiles.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to coal tar pitch volatiles at potentially hazardous levels:

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

September 1978

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1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the oral cavity, respiratory tract, bladder, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders, for premalignant and malignant lesions, and evidence of hyperpigmentation or photosensitivity.

—Urinalysis: Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer. A urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment, as well as a test for red blood cells.

—Urinary cytology: Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer. Employees having 5 or more years of exposure or who are 45 years of age or older should have a urinary cytology examination.

—Sputum cytology: Coal tar pitch volatiles are associated with an excess of lung cancer. Employees having 10 or more years of exposure or who are 45 years of age or older should have a sputum cytology examination.

—14" x 17" chest roentgenogram: Coal tar pitch volatiles are associated with an excess of lung cancer. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Coal tar pitch volatiles are reported to cause an excess of bronchitis. Periodic surveillance is indicated.

—A complete blood count: Due to the possibility of benzene exposure associated with coal tar pitch volatiles, a complete blood count is considered necessary to search for leukemia and aplastic anemia.

—Skin disease: Coal tar pitch volatiles are defatting agents and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of these agents.

2. *Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis, and semi-annually for employees 45 years of age or older or with 10 or more years' exposure to coal tar pitch volatiles.

- **Summary of toxicology**

Coal tar pitch volatiles (CTPV) are products of the destructive distillation of bituminous coal and contain polynuclear aromatic hydrocarbons (PNA's). These hydrocarbons sublime readily, thereby increasing the amounts of carcinogenic compounds in working areas. Epidemiologic evidence suggests that workers intimately exposed to the products of combustion or distillation of bituminous coal are at increased risk of cancer at many sites. These include cancer of the respiratory tract, kidney, bladder, and skin. In a study of coke oven workers, the level of exposure to CTPV and the length of time exposed were related to the development of c[illegible]er. Coke oven workers with the highest risk of [illegible]er were those employed exclusively at topside jobs for 5 or more years, for whom the increased risk of dying from lung cancer was 10-fold; all coke oven workers had a 7-½-fold increase in risk of dying from kidney cancer. Although the causative agent or agents of the cancer in coke oven workers is unidentified, it is suspected that several PNA's in the CTPV generated during the coking process are involved. Certain industrial populations exposed to coal tar products have a demonstrated risk of skin cancer. Substances containing PNA's which may produce skin cancer also produce contact dermatitis; examples are coal tar, pitch, and cutting oils. Although allergic dermatitis is readily induced by PNA's in guinea pigs, it is only rarely reported in humans from occupational contact with PNA's; these have resulted largely from the therapeutic use of coal tar preparations. Components of pitch and coal tar produce cutaneous photosensitization; skin eruptions are usually limited to areas exposed to the sun or ultraviolet light. Most of the phototoxic agents will induce hypermelanosis of the skin; if chronic photodermatitis is severe and prolonged, leukoderma may occur. Some oils containing PNA's have been associated with changes of follicular and sebaceous glands which commonly take the form of acne. There is evidence that exposures to emissions at coke ovens and gas retorts may be associated with an increased occurrence of chronic bronchitis. Coal tar pitch volatiles may be associated with benzene, an agent suspected of causing leukemia and known to cause aplastic anemia.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data—Anthracene**

1. Molecular weight: 178.2
2. Boiling point (760 mm Hg): 340 C (644 F)
3. Specific gravity (water = 1): 1.24
4. Vapor density (air = 1 at boiling point of anthracene): 6.15
5. Melting point: 217 C (423 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Phenanthrene**

1. Molecular weight: 178.2
2. Boiling point (760 mm Hg): 340 C (644 F)
3. Specific gravity (water = 1): 1.18
4. Vapor density (air = 1 at boiling point of phenanthrene): 6.15
5. Melting point: 100.5 C (213 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Pyrene**

1. Molecular weight: 202.3
2. Boiling point (760 mm Hg): Greater than 360 C (greater than 680 F)

3. Specific gravity (water = 1): 1.28

4. Vapor density (air = 1 at boiling point of pyrene): 6.9

5. Melting point: 150.4 C (303 F)

6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg

7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble

8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Carbazole**

1. Molecular weight: 167.2
2. Boiling point (760 mm Hg): 355 C (671 F)
3. Specific gravity (water = 1): Greater than 1
4. Vapor density (air = 1 at boiling point of carbazole): 5.8
5. Melting point: 246 C (475 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Benzo(a)pyrene**

1. Molecular weight: 252.3
2. Boiling point (760 mm Hg): Greater than 360 C (greater than 680 F)
3. Specific gravity (water = 1): Greater than 1
4. Vapor density (air = 1 at boiling point of benzo(a)pyrene): 8.7
5. Melting point: 179 C (354 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Reactivity**

1. Conditions contributing to instability: None hazardous
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: None
4. Special precautions: None

- **Flammability**

1. Flash point: Anthracene: 121 C (250 F) (closed cup); Others: Data not available
2. Autoignition temperature: Anthracene: 540 C (1004 F); Others: Data not available
3. Flammable limits in air, % by volume: Anthracene: Lower: 0.6; Others: Data not available
4. Extinguishant: Foam, dry chemical, and carbon dioxide

- **Warning properties**

Grant states that "coal tar and its various crude fractions appear principally to cause reddening and squamous eczema of the lid margins, with only small erosions of the corneal epithelium and superficial changes in the stroma, which disappear in a month following exposure. Chronic exposure of workmen to tar fumes and dust has been reported to cause conjunctivitis and discoloration of the cornea in the palpebral fissure, either near the limbus or, in extreme cases, across the whole cornea. Occasionally, epithelioma of the lid margin has been attributed to contact with coal tar."

MONITORING AND MEASUREMENT PROCEDURES

- **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

Coal tar products may be sampled by collection on a glass fiber filter with subsequent ultrasonic extraction and weighing. An analytical method for coal tar pitch volatiles is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 1, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00267-3).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with condensed coal tar pitch volatiles, where skin contact may occur.
- If employees' clothing may have become contaminated with coal tar pitch volatiles, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing contaminated with coal tar pitch volatiles

should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of coal tar pitch volatiles from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the coal tar pitch volatiles, the person performing the operation should be informed of coal tar pitch volatiles's hazardous properties.

- Employees should be provided with and required to use splash-proof safety goggles where condensed coal tar pitch volatiles may contact the eyes.

SANITATION

- Workers subject to skin contact with coal tar pitch volatiles should wash with soap or mild detergent and water any areas of the body which may have contacted coal tar pitch volatiles at the end of each work day.
- Employees who handle coal tar pitch volatiles should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.
- Areas in which exposure to coal tar pitch volatiles may occur should be identified by signs or other appropriate means, and access to these areas should be limited to authorized persons.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to coal tar pitch volatiles may occur and control methods which may be effective in each case:

Operation	Controls
Liberation from extraction and packaging from coal tar fraction of coking	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a binding agent in manufacture of coal briquettes used for fuel; use as a dielectric in the manufacture of battery electrodes, electric-arc furnace electrodes, and electrodes for alumina reduction	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in manufacture of roofing felts and papers and roofing	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use for protective coatings for pipes for underground conduits and drainage; use as a coating on concrete as waterproofing and corrosion-resistant material; use in road paving and sealing	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in manufacture and repair of refractory brick; use in production of foundry cores; use in manufacture of carbon ceramic items	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

- **Eye Exposure**

If condensed coal tar pitch volatiles get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with these chemicals.

- **Skin Exposure**

If condensed coal tar pitch volatiles get on the skin, wash the contaminated skin using soap or mild detergent and water. Be sure to wash the hands before eating or smoking and to wash thoroughly at the close of work.

- **Breathing**

If a person breathes in large amounts of coal tar pitch volatiles, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of releases until cleanup has been completed.
- If coal tar pitch volatiles are released in hazardous concentrations, the following steps should be taken:

1. Ventilate area of spill.

2. Collect released material in the most convenient and safe manner for reclamation or for disposal in sealed containers in a secured sanitary landfill.

- Waste disposal method:

Coal tar pitch volatiles may be disposed of in sealed containers in a secured sanitary landfill.

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RESPIRATORY PROTECTION FOR COAL TAR PITCH VOLATILES

Condition	Minimum Respiratory Protection* Required Above 0.2 mg/m³
Particulate and Vapor Concentration	
2 mg/m³ or less	A chemical cartridge respirator with an organic vapor cartridge(s) and with a fume or high-efficiency filter. Any supplied-air respirator. Any self-contained breathing apparatus.
10 mg/m³ or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s) and with a fume or high-efficiency filter. A gas mask with a chin-style or a front- or back-mounted organic vapor canister and with a full facepiece and a fume or high-efficiency filter. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
200 mg/m³ or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode. A powered air-purifying respirator with an organic vapor cartridge and a high-efficiency particulate filter.
400 mg/m³ or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 400 mg/m³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Naphtha (Coal Tar)

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_7H_8 - C_8H_{10}$ (approximately)
- Synonyms: Naphtha, 49 degrees Be-coal tar type; crude solvent coal tar naphtha; high-solvent coal tar naphtha
- Appearance and odor: Reddish-brown, mobile liquid with an aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for coal tar naphtha is 100 parts of coal tar naphtha per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 400 milligrams of coal tar naphtha per cubic meter of air (mg/m³).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Coal tar naphtha can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed.

- **Effects of overexposure**

1. *Short-term Exposure:* Overexposure to coal tar naphtha can cause lightheadedness, drowsiness, and unconsciousness. It also may cause mild irritation of the eyes, nose, and skin.

2. *Long-term Exposure:* Prolonged overexposure to coal tar naphtha may cause irritation of the skin.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to coal tar naphtha.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to coal tar naphtha at potentially hazardous levels:

1. *Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from coal tar naphtha exposure.

—Skin disease: Coal tar naphtha is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: Although coal tar naphtha is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: Although coal tar naphtha is not known as a kidney toxin in humans, the importance o this organ in the elimination of toxic substances justifie special consideration in those with impaired renal function.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of coal tar naphtha might cause exacerbation of symptoms due to its irritant properties.

2. *Periodic Medical Examination:* Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

Coal tar naphtha vapor is narcotic. Rats survived continuous exposure at 3200 ppm for two months; at 1800 ppm some animals showed damage to the liver and kidneys; above 1000 ppm there was evidence of narcotic action. Rats exposed at 567 ppm and 312 ppm for 18 to 20 hours a day for 7 days had some reduction in blood leukocytes, possibly the result of the presence of benzene. There are few if any well documented reports of industrial injury resulting from the inhalation of

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

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naphtha. However, exposure to high concentrations might be expected to cause lightheadedness, drowsiness, and possibly irritation of the eyes, nose, and throat. Repeated or prolonged contact with the liquid may result in drying and cracking skin due to defatting action. Coal tar (naphtha) is a non-uniform mixture of aromatic hydrocarbons and may contain benzene.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 110 (approximately)
2. Boiling point (760 mm Hg): 110 to 190 C (230 to 374 F)
3. Specific gravity (water = 1): 0.97
4. Vapor density (air = 1 at boiling point of coal tar naphtha): 3 (approximately)
5. Melting point: Data not available
6. Vapor pressure at 20 C (68 F): Less than 5 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Greater than 1

- **Reactivity**

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizing agents may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving coal tar naphtha.
4. Special precautions: Coal tar naphtha will attack some forms of plastics, rubber, and coatings.

- **Flammability**

1. Flash point: 38 to 43 C (100 to 109 F) (closed cup)
2. Autoignition temperature: 482 to 510 C (900 to 950 F)
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Dry chemical, foam, carbon dioxide

- **Warning properties**

1. Odor Threshold: Since the odor thresholds of the main constituents of coal tar naphtha are below their permissible exposure limits, the odor threshold of coal tar naphtha is assumed to be below the permissible exposure limit.
2. Eye Irritation Level: According to Grant, Gafafer states that the naphthas cause conjunctival irritation. Two of the main constituents of coal tar naphtha, xylene and toluene, cause noticeable eye irritation at concentrations of 200 and 300 ppm, respectively.
3. Evaluation of Warning Properties: Since the odor threshold of the main constituents of coal tar naphtha are well below their permissible exposure limits, coal tar naphtha is treated as a material with adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- Method

Sampling and analyses may be performed by collection of coal tar naphtha vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure coal tar naphtha may be used. An analytical method for coal tar naphtha is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).
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RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid coal tar naphtha.
- Clothing wet with liquid coal tar naphtha should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of

coal tar naphtha from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the coal tar naphtha, the person performing the operation should be informed of coal tar naphtha's hazardous properties.

- Non-impervious clothing which becomes wet with liquid coal tar naphtha should be removed promptly and not reworn until the coal tar naphtha is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid coal tar naphtha may contact the eyes.

SANITATION

- Skin that becomes wet with liquid coal tar naphtha should be promptly washed or showered with soap or mild detergent and water to remove any coal tar naphtha.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to coal tar naphtha may occur and control methods which may be effective in each case:

Operation	Controls
Use in preparation of coal-tar paints	Process enclosure; general dilution ventilation; personal protective equipment
Use in preparation of coumarone and indene	General dilution ventilation; personal protective equipment
Use as a solvent in rubber industry in manufacture of water-proof cloth, shoe adhesives, and rubber tires	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a solvent, diluent, or thinner in paint, varnish, and lacquer industries	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use in formulations of nitrocellulose and ethylcellulose	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a solvent for polymerized styrol, short-oil phenolic varnishes, urea, resins, melamine, and other synthetic resins; use as a solvent for pesticides as DDT and Gammexane	General dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

- **Eye Exposure**

If coal tar naphtha gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

- **Skin Exposure**

If coal tar naphtha gets on the skin, promptly wash the contaminated skin using soap or mild detergent. If coal tar naphtha soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent. If irritation persists after washing, get medical attention.

- **Breathing**

If a person breathes in large amounts of coal t naphtha, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

- **Swallowing**

If coal tar naphtha has been swallowed, do not induce vomiting. Get medical attention immediately.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.
- If coal tar naphtha is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely

clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber. Coal tar naphtha should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- Waste disposal methods:

Coal tar naphtha may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. By atomizing in a suitable combustion chamber.

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RESPIRATORY PROTECTION FOR NAPHTHA (COAL TAR)

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
5000 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
10,000 ppm or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 10,000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Naphthalene

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_{10}H_8$
- Synonyms: White tar; naphthalin
- Appearance and odor: Colorless to brown solid with the odor of mothballs.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for naphthalene is 10 parts of naphthalene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 50 milligrams of naphthalene per cubic meter of air (mg/m³).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Naphthalene can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.

- **Effects of overexposure**

1. Short-term Exposure: Inhalation or ingestion of naphthalene may cause abdominal cramps, nausea, vomiting, diarrhea, headache, tiredness, confusion, painful urination, and bloody or dark urine. Swallowing large amounts may cause convulsions or coma. Inhalation, ingestion, and possibly skin absorption of naphthalene may cause destruction of red blood cells with anemia, fever, yellow jaundice, bloody urine, kidney and liver damage. Naphthalene, on contact with the eyes, has produced irritation. Naphthalene, on contact with the skin, has produced skin irritation.

2. Long-term Exposure: Repeated skin exposure to naphthalene may cause an allergic rash. Repeated exposure may cause cataracts.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to naphthalene.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to naphthalene at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a deficiency of glucose-6-phosphate dehydrogenase in erythrocytes may be at increased risk from exposure. Examination of the eyes, blood, liver and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—A complete blood count: Naphthalene has been shown to cause red blood cell hemolysis. A complete blood count should be performed, including a red cell count, a white cell count, and a differential count of a stained smear, as well as hemoglobin and hematocrit.

—Urinalysis: Since kidney damage may also occur from exposure to naphthalene, a urinalysis should be performed, including at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

- **Summary of toxicology**

Naphthalene vapor causes hemolysis and eye irritation; it may cause cataracts. Severe intoxication from ingestion of the solid results in characteristic manifestations of marked intravascular hemolysis and its consequences, including potentially fatal hyperkalemia. Initial symptoms include eye irritation, headache, confu-

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

September 1978

naphtha. However, exposure to high concentrations might be expected to cause lightheadedness, drowsiness, and possibly irritation of the eyes, nose, and throat. Repeated or prolonged contact with the liquid may result in drying and cracking skin due to defatting action. Coal tar (naphtha) is a non-uniform mixture of aromatic hydrocarbons and may contain benzene.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 110 (approximately)
2. Boiling point (760 mm Hg): 110 to 190 C (230 to 374 F)
3. Specific gravity (water = 1): 0.97
4. Vapor density (air = 1 at boiling point of coal tar naphtha): 3 (approximately)
5. Melting point: Data not available
6. Vapor pressure at 20 C (68 F): Less than 5 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Greater than 1

- **Reactivity**

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizing agents may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving coal tar naphtha.
4. Special precautions: Coal tar naphtha will attack some forms of plastics, rubber, and coatings.

- **Flammability**

1. Flash point: 38 to 43 C (100 to 109 F) (closed cup)
2. Autoignition temperature: 482 to 510 C (900 to 950 F)
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Dry chemical, foam, carbon dioxide

- **Warning properties**

1. Odor Threshold: Since the odor thresholds of the main constituents of coal tar naphtha are below their permissible exposure limits, the odor threshold of coal tar naphtha is assumed to be below the permissible exposure limit.
2. Eye Irritation Level: According to Grant, Gafafer states that the naphthas cause conjunctival irritation. Two of the main constituents of coal tar naphtha, xylene and toluene, cause noticeable eye irritation at concentrations of 200 and 300 ppm, respectively.
3. Evaluation of Warning Properties: Since the odor threshold of the main constituents of coal tar naphtha are well below their permissible exposure limits, coal tar naphtha is treated as a material with adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

Sampling and analyses may be performed by collection of coal tar naphtha vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure coal tar naphtha may be used. An analytical method for coal tar naphtha is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).
026).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid coal tar naphtha.
- Clothing wet with liquid coal tar naphtha should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with naphthalene or liquids containing naphthalene.
- If employees' clothing may have become contaminated with solid naphthalene, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing contaminated with naphthalene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of naphthalene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the naphthalene, the person performing the operation should be informed of naphthalene's hazardous properties.
- Non-impervious clothing which becomes contaminated with naphthalene should be removed promptly and not reworn until the naphthalene is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where solid naphthalene or liquids containing naphthalene may contact the eyes.

SANITATION

- Skin that becomes contaminated with naphthalene should be promptly washed or showered with soap or mild detergent and water to remove any naphthalene.
- Eating and smoking should not be permitted in areas where solid naphthalene is handled, processed, or stored.
- Employees who handle naphthalene or liquids containing naphthalene should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to naphthalene may occur and control methods which may be effective in each case:

Operation	Controls
Formulation of insecticide and moth repellant as flakes, powder, balls, or cakes	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a fumigant for moth repellant and insecticide	General dilution ventilation; personal protective equipment
Use in manufacture of chemical intermediates for production of pharmaceuticals, resins, dyes, plasticizers, solvents, coatings, insecticides, pigments, rubber chemicals, tanning agents, surfactants, waxes, cable coatings, textile spinning lubricants, rodenticides, and in storage batteries	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Manufacture of naphthalene	Local exhaust ventilation; process enclosure; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

- **Eye Exposure**

If naphthalene or liquids containing naphthalene get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

- **Skin Exposure**

If molten naphthalene gets on the skin, immediately flush the skin with large amounts of water. Get medical attention immediately. If naphthalene or liquids containing naphthalene get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If naphthalene or liquids containing naphthalene penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

- **Breathing**

If a person breathes in large amounts of naphthalene, move the exposed person to fresh air at once.

- **Swallowing**

When naphthalene has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.
- If naphthalene is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. For small quantities, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber.

- Waste disposal methods:

Naphthalene may be disposed of:

1. By making packages of naphthalene in paper or other flammable material and burning in a suitable combustion chamber.
2. By dissolving naphthalene in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber.

ADDITIONAL INFORMATION

To find additional information on naphthalene, look up naphthalene in the following documents:

- Medical Surveillance for Chemical Hazards
- Respiratory Protection for Chemical Hazards
- Personal Protection and Sanitation for Chemical Hazards

These documents are available through the NIOSH Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

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ATTACHMENT C

MATERIAL SAFETY DATA SHEETS

RESPIRATORY PROTECTION FOR NAPHTHALENE

Condition	Minimum Respiratory Protection* Required Above 10 ppm
Particulate and Vapor Concentration	
500 ppm or less	A chemical cartridge respirator with a full facepiece, organic vapor cartridge(s), and dust filter. A gas mask with a chin-style or a front- or back-mounted organic vapor canister and dust filter. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 500 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

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Material Safety Data Sheets Collection:

Sheet No. 316
Benzene

Issued: 11/78 Revision: E, 8/90

Section 1. Material Identification

32

R 1
I 4
S 2*
K 4
*Skin absorption

NFPA
3
2 0
-

HMIS
H 3
F 3
R 0
PPG†
† Sec. 8

Benzene (C_6H_6) Description: Derived by fractional distillation of coal tar, hydrodealkylation of toluene or pyrolysis of gasoline, catalytic reforming of petroleum, and transalkylation of toluene by disproportionation reaction. Used as a fuel; a chemical reagent; a solvent for a large number of materials such as paints, plastics, rubber, inks, oils, and fats; in manufacturing phenol, ethylbenzene (for styrene monomer), nitrobenzene (for aniline), dodecylbenzene (for detergents), cyclohexane (for nylon), chlorobenzene, diphenyl, benzene hexachloride, maleic anhydride, benzene-sulfonic acid, artificial leather, linoleum, oil cloth, varnishes, and lacquers; for printing and lithography; in dry cleaning; in adhesives and coatings; for extraction and rectification; as a degreasing agent; in the tire industry; and in shoe factories. Benzene has been banned as an ingredient in products intended for household use and is no longer used in pesticides.
Other Designations: CAS No. 0071-43-2, benzol, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, nitration benzene, phene, phenyl hydride, pyrobenzol.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

Cautions: Benzene is a confirmed *human carcinogen* by the IARC. *Chronic low-level exposure may cause cancer (leukemia) and bone marrow damage, with injury to blood-forming tissue.* It is also a dangerous fire hazard when exposed to heat or flame.

Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

1989 OSHA PELs
(29 CFR 1910.1000, Table Z-1-A)
8-hr TWA: 1 ppm, 3 mg/m³
15-min STEL: 5 ppm, 15 mg/m³

(29 CFR 1910.1000, Table Z-2)
8-hr TWA: 10 ppm
Acceptable Ceiling Concentration: 25 ppm
Acceptable Maximum Peak: 50 ppm (10 min)†

1989-90 ACGIH
TLV-TWA: 10 ppm, 32 mg/m³

1988 NIOSH RELs
TWA: 0.1 ppm, 0.3 mg/m³
Ceiling: 1 ppm, 3 mg/m³

1985-86 Toxicity Data‡
Man, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted
Man, inhalation, TC_{Lo}: 150 ppm inhaled intermittently over 1 yr in a number of discrete, separate doses affects the blood (other changes) and nutritional and gross metabolism (body temperature increase)
Rabbit, eye: 2 mg administered over 24 hr produces severe irritation

* OSHA 29 CFR 1910.1000, Subpart Z, states that the final benzene standard in 29 CFR 1910.1028 applies to all occupational exposures to benzene except in some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.

Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift.

See NIOSH, *RTECS* (CY1400000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 176 °F (80 °C)
Melting Point: 42 °F (5.5 °C)
Vapor Pressure: 100 mm Hg at 79 °F (26.1 °C)
Vapor Density (Air = 1): 2.7
Evaporation Rate (Ether = 1): 2.8

Molecular Weight: 78.11
Specific Gravity (15 °C/4 °C): 0.8787
Water Solubility: Slightly (0.180 g/100 g of H_2O at 25 °C)
% Volatile by Volume: 100
Viscosity: 0.6468 mPa at 20 °C

Appearance and Odor: A colorless liquid with a characteristic sweet, aromatic odor. The odor recognition threshold (100% of panel) is approximately 5 ppm (unfatigued) in air. Odor *is not* an adequate warning of hazard.

Section 4. Fire and Explosion Data

Flash Point: 12 °F (-11.1 °C), CC	**Autoignition Temperature:** 928 °F (498 °C)	LEL: 1.3% v/v	UEL: 7.1% v/v

Extinguishing Media: Use dry chemical, foam, or carbon dioxide to extinguish benzene fires. Water may be ineffective as an extinguishing agent since it can scatter and spread the fire. Use water spray to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.
Unusual Fire or Explosion Hazards: Benzene is a Class 1B flammable liquid. A concentration exceeding 3250 ppm is considered a potential fire explosion hazard. Benzene vapor is heavier than air and can collect in low lying areas or travel to an ignition source and flash back. Explosive and flammable benzene vapor-air mixtures can easily form at room temperature. Eliminate all ignition sources where benzene is used, handled, or stored.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Structural firefighter's protective clothing provides limited protection. Stay out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Runoff to sewer can create pollution, fire, and explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Benzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Benzene explodes on contact with diborane, permanganic acid, bromine pentafluoride, peroxodisulfuric acid, and peroxomonosulfuric acid. It ignites on contact with dioxygen difluoride, dioxygenyl tetrafluoroborate, iodine heptafluoride, and sodium peroxide + water. Benzene forms sensitive, explosive mixture with iodine pentafluoride, ozone, liquid oxygen, silver perchlorate, nitryl perchlorate, nitric , and arsenic pentafluoride + potassium methoxide (explodes above 30 °C). A vigorous or incandescent reaction occurs with bromine uoride, uranium hexafluoride, and hydrogen + Raney nickel [above 410 °F (210 °C)]. Benzene is incompatible with oxidizing materials.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of benzene can produce toxic gases and vapors such as carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a supected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).
Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. The most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level exposure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.
Medical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.
Target Organs: Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.
Primary Entry Routes: Inhalation, skin contact.
Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).
Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be fatal. Call a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye contact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill and contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined spaces such as sewers, watersheds, and waterways because of explosion danger. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4), 112; and per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
isted as SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[107]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing benzene containers, use nonsparking tools. Keep fire extinguishers readily available.
Engineering Controls: Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and dangers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Designate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, CANCER HAZARD."
Other Precautions: Provide preplacement and periodic medical examinations with emphasis on a history of blood disease or previous exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Benzene (*benzol*)
DOT Hazard Class: Flammable liquid
No.: UN1114
OT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Benzene
IMO Hazard Class: 3.2
ID No.: UN1114
IMO Label: Flammable liquid
IMDG Packaging Group: II

DANGER
BENZENE
CANCER HAZARD
FLAMMABLE–NO SMOKING
AUTHORIZED PERSONNEL ONLY
RESPIRATOR REQUIRED

MSDS Collection **References:** 1, 2, 12, 26, 73, 84-94, 100, 101, 103, 109, 124, 126, 127, 132, 134, 136, 138, 139, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 315
Chloroform

Issued: 11/77 Revision: D, 9/92

Section 1. Material Identification

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Chloroform ($CHCl_3$) Description: Derived by chlorination of methane, hydrochlorination of methanol, or reaction of chlorinated lime with acetone, acetaldehyde, or ethanol. Purified by extraction with concentrated sulfuric acid and rectification. Used in the manufacture of fluorocarbons (mainly FC-22) for refrigerants, in plastics, photographic processing, fire extinguishers, insecticides, and dry cleaning; as a solvent for fats, oils, waxes, rubbers, alkaloids, Gutta-Percha, and resins. Used as an anesthetic since 1847 but abandoned within the last few decades because of cardiac arrest during surgery and delayed death due to liver injury.

Other Designations: CAS No. 67-66-3, Freon-20, methane trichloride, methenyl chloride, R-20 (refrigerant), trichloroform, trichloromethane, TCM. Improperly called 'formyl chloride.'

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Chloroform is considered one of the most dangerous and volatile chlorinated hydrocarbons. It is a central nervous system (CNS) and cardiac depressant, an eye, skin, and respiratory tract irritant, and causes liver and kidney damage from acute and chronic exposure.

R 1
I 3
S 2*
K 2
* Skin absorption

NFPA
0
2 0
-

HMIS
H 3†
F 0
R 0
PPE‡
† Chronic effects
‡ Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Chloroform, ca 99%. Usually contains 0.75% ethanol as a stabilizer. Impurities include bromodichloromethane, vinylidene, and diethyl carbonate.

1991 OSHA PEL
8-hr TWA: 2 ppm (9.78 mg/m^3)

1990 IDLH Level
1000 ppm

1990 NIOSH REL
60 min STEL: 2 ppm (9.78 mg/m^3)

1992-93 ACGIH TLV
TWA: 10 ppm (49 mg/m^3)

1990 DFG (Germany) MAK
TWA: 10 ppm (50 mg/m^3)
Category II: Substances with systemic effects. Half-life = 2 hr
Peak Exposure Limit: 20 ppm, 30 min average value, 4/shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 10 mg/m^3/1 year caused anorexia, nausea, and vomiting.
Rat, oral, TD_{Lo}: 13832 mg/kg given continuously for 2 years caused leukemia.
Rat, oral, LD_{50}: 908 mg/kg caused weight loss or decreased weight gain.
Rat, inhalation, TC_{Lo}: 30 ppm/7 hr administered from the 6 to 15 day of pregnancy caused fetotoxicity or developmental abnormalities of the musculoskeletal system.
Rabbit, eye: 20 mg/24 hr caused moderate irritation.

* See NIOSH, *RTECS* (FS9100000), for additional irritation, mutation, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 143 °F (62 °C)
Freezing Point: -82 °F (-63.5 °C)
Molecular Weight: 119.39
Viscosity: 5.63 mP at 68 °F (20 °C)
Relative Evaporation Rate (BuAc=1): 11.6
Surface Tension: 27.1 dyne/cm at 68 °F (20 °C)
Refraction Index: 1.4422 at 77 °F (25 °C)
Density: 1.49845 at 59 °F (15 °C)
Water Solubility: Nearly insoluble; 0.5% at 77 °F (25 °C)
Other Solubilities: Soluble in ethanol, ethyl ether, benzene, acetone, carbon disulfide, and carbon tetrachloride.
Odor Threshold: 85 to 307 ppm (*range from combined sources*)
Vapor Pressure: 160 mm Hg at 68 °F (20 °C); 200 mm Hg at 77 °F (25 °C)
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.136 lb/ft^3 or 2.183 kg/m^3
Appearance and Odor: Colorless, volatile liquid with a heavy, ethereal odor.

Section 4. Fire and Explosion Data

Flash Point: Nonflammable	**Autoignition Temperature:** Nonflammble	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Nonflammable from standard tests in air but will burn on prolonged exposure to flame or high temperature. To fight fire, use extinguishing agents suitable for surrounding fire. *Do not* scatter material with a high-pressure water stream. **Unusual Fire or Explosion Hazards:** Container may explode in heat of fire. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is *not* effective. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Chloroform is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. It's pH decreases on prolonged exposure to air and light due to hydrochloric acid (HCl) formation. The recommended shelf-life is 2 months for full containers and 2 weeks for partially full containers. **Chemical Incompatibilities:** Incompatible with acetone, alkalis, aluminum, disilane, lithium, magnesium, dinitrogen dioxide, nitrogen tetroxide, perchloric acid, phosphorus pentoxide, potassium, potassium hydroxide, methyl alcohol, potassium *tert*-butoxide, sodium, sodium hydroxide, sodium methylate, sodium-potassium alloy, triisopropylphosphine, calcium hydroxide, and fluorine and any strong oxidizers. **Conditions to Avoid:** Exposure to light, prolonged heat, and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of $CHCl_3$ can produce carbon dioxide and toxic chlorine, HCl, and phosgene gas. $CHCl_3$ decomposes at 437 °F to formic acid, carbon monoxide, and HCl on prolonged heating with water.

Section 6. Health Hazard Data

Carcinogenicity: Chloroform is considered a carcinogen by the IARC (Class-2B, possibly carcinogenic in humans with limited human and sufficient animal evidence),(164) NTP (Class 2, reasonably anticipated to be a carcinogen, limited human and sufficient animal evidence),(169) and NIOSH (Class X, carcinogen defined with no further categorization),(164) DFG (MAK-B, justifiably suspected of having carcinogenic potential),(16 and ACGIH (Class A2, suspected human carcinogen based on limited epidemiologic evidence or demonstration)(163). Carcinogenicity tends to be organ specific primarily to the liver and kidneys. **Summary of Risks:** Chloroform is a CNS depressant, eye, skin, and respiratory tract irritant, and causes damage to the liver and kidneys. Symptoms range from dizziness to cardiac arrythmias resulting in death. Chloroforms' toxicity is due to its easy lipid solubility. Avoid exposure during pregnancy because $CHCl_3$ diffuses readily across the placenta. Alcoholics seem to be affected sooner and more severely than others from chloroform exposure (alcohol may already have damaged the liver). Ethanol, polybrominated biphenols, steroids, and ketones potentiate chloroform's toxicity.

Continue on next page

Section 6. Health Hazard Data

Target Organs: Liver, kidney, heart, eyes, skin. **Primary Entry Routes:** Inhalation, ingestion, skin contact/absorption. **Medical Conditions Aggravated by Long-Term Exposure:** Alcoholism, liver, kidney, or nervous system disorders. **Acute Effects:** Vapor inhalation causes varying degrees of C'S depression depending on concentration and exposure length. Symptoms include headache, nausea, dizziness, drunkenness, progressive v ss, vomiting, thirst, delirium, and disorientation. Exposure to 14,000 to 16,000 ppm has caused rapid unconsciousness. Severe acute exposures mage the liver and kidney (damage is usually not observed for 24 to 48 hr post exposure), respiratory failure, severe cardiac arrythmias (reason fo. iscontinuation of use as an anesthetic), and death. Apparent recovery from heavy exposures may result in delayed death due to liver or kidney failure. Death usually occurs 4 to 5 days post exposure and autopsy shows massive liver necrosis. Vapors cause eye irritation and spasmodic winking. Direct eye contact with the liquid causes immediate burning pain and possible corneal epithelium damage. Skin contact with the liquid produces burning pain, erythema, and vesiculation due to defatting of the skin. Ingestion can cause gastrointestinal irritation, irregular heartbeat, nausea and vomiting, diarrhea (possibly blood-stained), drowsiness, unconsciousness, and state of shock. **Chronic Effects:** Prolonged inhalation of chloroform vapors causes fatigue, digestive disturbances, frequent and burning urination, mental dullness, and CNS and peripheral neuropathies. Liver (fatty degeneration and enlargement with hepatitis seen in dogs) and kidney damage may also occur .

FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water, to dilute. *Do not* induce vomiting because victim may become obtunded. Gastric lavage may be indicated if patient is comatose or at risk of convulsing. **Note to Physicians:** Because effects may be delayed (especially kidney and liver problems), keep victim under observation for 24 to 48 hr. Administration of fluids may help to prevent kidney failure. Obtain blood glucose, urinalysis, liver function tests, chest x-ray, and monitor cardiac function and fluid/electrolyte status. Monitor liver and kidney function for 4 to 5 days after exposure. Disulfiram, its metabolites, and a high carbohydrate diet appear to protect somewhat against chloroform toxicity. *Do not give adrenalin!* Tests may show increased bilirubin, ketosis, lowered blood prothrombin, and fibrogen.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. If possible without risk, move container from spill area. Cleanup personnel should wear fully encapsulating vapor-protective clothing. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for disposal. For large spills, dike far ahead of spill and contain for later disposal or reclamation. Spills in water may need to be trapped at the bottom with sand bag barriers and treated with activated carbon and removed by suction hoses, mechanical lifts, and dredges. Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Rainbow Trout (*Salmo gairdneri*), LC_{50} = 2030 µg/L; bluegill (*Lepomis macrochirus*), LC_{50} = 100,000 µg/L/96 hr; largemouth bass (*Micropterus salmoides*) LC_{50} = 51 ppm/96 hr. **Environmental Degradation:** If released to land, most chloroform evaporates rapidly (due to high vapor pressure) while some may leach to groundwater where it remains for a long time on the bottom. If released to water, chloroform evaporates rapidly with estimated half-lifes of 36 hr (river), 40 hr (pond), 9 to 10 days (lake). In air, chloroform photodegrades with a half-life of 80 days. It can be transported long distances and some may return to earth via rain. **Disposal:** Reclamation is possible through distillation or steam stripping. Chloroform is a candidate for liquid injection, rotary kiln, or fluidized bed incineration with an acid scrubber. Contact your supplier or a licensed contractor for detailed recommenda-ic ow applicable Federal, state, and local regulations.

E. ignations

isted as a RCRA Hazardous Waste (40 CFR 261.33): No. U044
isted as a SARA Extremely Hazardous Substance (40 CFR 355), TPQ: 10,000 lb
isted as a SARA Toxic Chemical (40 CFR 372.65)
isted as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 10 lb (4.54 kg) [* per RCRA, Sec. 3001; CWA, Sec. 311(b)(4), & CWA Sec. 307(a)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

ection 8. Special Protection Data

oggles: Wear chemical safety goggles for concentrations of 5 ppm to 2% and a full facepiece for levels above 2%, per OSHA eye- and face-rotection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek rofessional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/ IOSH-approved respirator. For any detectable concentration use a supplied-air respirator or SCBA with a full facepiece and operated in pressure-emand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *arning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written spiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, spection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of lyvinyl alcohol or Viton (breakthrough times > 1 hr) to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to aintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion to the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-ench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before use. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. actice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

ection 9. Special Precautions and Comments

orage Requirements: Prevent physical damage to containers. Store in lead-lined or mild steel containers of all-welded construction in a cool (< 30), dry, well-ventilated area away from direct light and incompatibles. **Engineering Controls:** To reduce potential health hazards, use sufficient ution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Isolate operations olving chloroform. **Administrative Controls:** It is suggested that chloroform use for extractions in labs should be avoided and replaced because its toxicity and carcinogenic potential. Consider preplacement and periodic medical exams of exposed workers.

Transportation Data (49 CFR 172.101)

T ing Name: Chloroform
d Class: 6.1
N1888
T Packing Group: II
T Label: Poison
cial Provisions (172.102): N36, T14

Packaging Authorizations
a) Exceptions: None
b) Nonbulk Packaging: 173.202
c) Bulk Packaging: 173.243

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 40

***DS Collection* References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 153, 159, 163, 164, 167, 168, 169, 171, 174, 175, 176, 180.

pared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** W Silverman, MD

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Material Safety Data Sheets Collection:

Sheet No. 757
Coal Tar Creosote

Issued: 7/91

Section 1. Material Identification

34

Coal Tar Creosote (molecular formula varies with purity) Description: Three main derivations: by distillation of coal tar produced by high-temperature carbonization of bituminous coal; by mixing strained naphthalene oil, wash oil, and strained or light anthracene oil; as a by-product of conventional coal coking. It typically contains up to 160 chemicals, mainly aromatic compounds such as phenol, pyrol and pyridine. Used mainly as a wood preservative for railroad ties, poles, fence posts, marine pilings, and other lumber for outdoor use; as a water-proofing agent, fuel oil constituent, frothing agent for mineral separation, hop defoliant, and lubricant for die molds; in manufacturing chemicals; and in medicine as an antiseptic, disinfectant, antipyretic, astringent, germicide, and styptic.
Other Designations: CAS No. 8001-58-9, Awpa,® brick oil, Caswell No. 225,® coal tar oil, creosote, creosote oil, creosotum, cresylic creosote, heavy oil, liquid pitch oil, naphthalene oil, Preserv-o-sote,® Sakresote,® tar oil, wash oil.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.
Cautions: Flammable, liquid coal tar creosote is toxic by inhalation, ingestion, and skin contact. The IARC and NTP classify it as *a human carcinogen.*

R 1
I 4
S 4*
K 2
* Skin absorption

NFPA
2
2 0
-

HMIS
H 2
F 2
R 0
PPG†
† Sec. 8

* Skin absorption can occur with phenol, a major component of coal tar creosote.

Section 2. Ingredients and Occupational Exposure Limits

Coal tar creosote, ca 100%

1990 OSHA PEL
8-hr TWA: 0.2 mg/m³*

1987 IDLH Level
700 mg/m³

1990-91 ACGIH TLV
TWA: 0.2 mg/m³*

1990 NIOSH REL
0.1 mg/m³ (cyclohexane extractable portion)

1985-86 Toxicity Data†
Rat, oral, LD_{50}: 725 mg/kg; toxic effects not yet reviewed
Dog, oral, LD_{Lo}: 600 mg/kg; toxic effects not yet reviewed
Rat, TD_{Lo}: 52,416 mg/kg administered during 91 days prior to mating produces reproductive effects on fallopian tubes and ovaries
Mouse, skin, TD_{Lo}: 99 g/kg produces tumors in skin and appendages

* As coal tar pitch volatiles.
† See NIOSH, *RTECS* (GF8615000), for additional mutation, reproductive, tumorigenic, and other toxicity data.

Section 3. Physical Data

Boiling Point: 381 to 752 °F (194 to 400 °C)
Distillation Range: 446 to 554 °F (230 to 290 °C)
Heat of Combustion: -12,500 Btu/lb
Heat of Vaporization: 107 Btu/lb
Molecular Weight: Varies with purity
Density/Specific Gravity: 1.07 to 1.08 at 68 °F (20 °C)
Water Solubility: Slightly soluble

Appearance and Odor: Pure coal tar creosote is colorless, but the industrial product is a yellow to black oily liquid with an aromatic smoky smell and a burning caustic taste.

Section 4. Fire and Explosion Data

Flash Point: 165.2 °F (74 °C), CC	**Autoignition Temperature:** 637 °F (336 °C)	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2), or regular foam. For large fires, use fog or regular foam. Since water is least effective, use it as an extinguishing agent only when the preferred measures are unavailable. However, use water spray to cool fire-exposed containers.
Unusual Fire or Explosion Hazards: Vapors may travel to an ignition source and flash back. Containers may explode in heat of fire. Coal tar creosote presents a vapor explosion hazard indoors, outdoors, and in sewers.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear full protective clothing. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Immediately leave area if you hear a rising sound from venting safety device or notice any fire-caused tank discoloration. Isolate area for 1/2 mile in all directions if fire involves tank, rail car or tank truck. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Fully decontaminate or properly dispose of personal protective clothing.

Section 5. Reactivity Data

Stability/Polymerization: Coal tar creosote is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Creosote oil mixed with chlorosulfonic acid in a closed container causes an increase in temperature and pressure.
Conditions to Avoid: Avoid excessive heat and contact with chlorosulfonic acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of coal tar creosote can produce oxides of carbon and thick, black, acrid smoke.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA list coal tar creosote as a carcinogen.

Summary of Risks: Coal tar creosote is toxic by inhalation, ingestion, and skin contact. It contains a variety of hydrocarbons such as phenol and polycyclic aromatic hydrocarbons such as benzo[a]pyrene, benzanthracene, and phenol derivatives. The range of toxicity depends on the exposure concentration, amount, and duration. Effects may include irritation, burns, and several forms of cancer.

Medical Conditions Aggravated by Long-Term Exposure: Chronic respiratory or skin diseases.

T[illegible] Organs: Eyes, skin, bladder, kidneys, and respiratory system.

P[illegible]y Entry Routes: Inhalation, ingestion, and skin contact.

A[illegible] Effects: Skin contact may cause irritation, burning, itching, redness, pigment changes, dermatitis (a rash of redness and small bumps), or burns. Photosensitization (worsening of rash with exposure to sunlight) may occur. Inhalation may be irritating to the respiratory tract. Eye contact may cause conjunctivitis (inflammation of the eye's lining), keratitis (corneal inflammation), or corneal burns with scarring. Ingestion may result in nausea, vomiting, abdominal pain, rapid pulse, respiratory distress, and shock. Systemic absorption by any route (including skin absorption) may cause trouble breathing, thready (continuous or drawn out) pulse, dizziness, headache, nausea, vomiting, salivation, and convulsions. Exposure to large doses (particularly by ingestion) may be fatal.

Chronic Effects: Dermatitis, skin cancer, and lung cancer.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* let victim rub eyes or keep them tightly closed. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Wash affected area with soap and flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of milk or water. *Do not induce vomiting!*

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Cresol may be detected in urine.

ection 7. Spill, Leak, and Disposal Procedures

pill/Leak: Notify safety personnel. Isolate hazard area, deny entry, and stay upwind of spills. Shut off all ignition sources—no flares, smoking, or ames in hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If possible with no risk, stop leak. Water ray may be used to reduce vapor but it may not prevent ignition in closed spaces. For small spills, take up with earth, sand, vermiculite, or other sorbent, noncombustible material and place in suitable containers for later disposal. For large spills, dike far ahead of liquid spill for later sposal. Follow applicable OSHA regulations (29 CFR 1910.120).

vironmental Degradation: Coal tar creosote is fouling to shoreline. Ecotoxicity values are: TL_{50}, goldfish (*Carassius auratus*), 3.51 ppm/24 hr 0:40) mixture of creosote and coal tar; LD_{50}, bob white quail (*Colinus virginianus*), 1,260 ppm/8 days (60:40) mixture of creosote and coal tar.

sposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

PA Designations

sted as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Material No. U051

ted as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per RCRA, Sec. 3001]

RA Extremely Hazardous Substance (40 CFR 355): Not listed

ted as a SARA Toxic Chemical (40 CFR 372.65)

HA [illegible]ignations

[illegible]al tar pitch volatiles) as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

[illegible] 8. Special Protection Data

ggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since tact lens use in industry is controversial, establish your own policy.

pirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if ssary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an A. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

er: Wear impervious gloves, boots, aprons, and gauntlets to prevent all skin contact. Applying a layer of petroleum jelly or lanolin castor oil nent to the face reduces vapor contact and penetration through skin. Frequent change of protective garments is an additional protective ure.

ilation: Provide general and local exhaust ventilation systems equipped with high-efficiency particulate filters to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by olling it at its source.(103)

y Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

aminated Equipment: Take particular care to avoid any contamination of drains or ventilation ducts. Remove this material from your shoes quipment. Launder contaminated clothing before wearing.

nents: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, ng, using the toilet, or applying cosmetics.

ion 9. Special Precautions and Comments

ge Requirements: Avoid physical damage to containers. Store in a cool, dry, well-ventilated area. Store coal tar creosote as close to area of possible to minimize transporting distance.

eering Controls: Use engineering controls to keep airborne concentrations below the OSHA PEL. Institute a respiratory protection m that includes regular training, maintenance, inspection, and evaluation. Always perform synthesis and purification procedures under a l ventilation hood and make regular operational safety checks. Label doors to rooms where coal tar creosote is produced, used, or stored as ing a carcinogen. Locate emergency equipment at well-marked and clearly identified stations in case emergency escape is necessary.

Precautions: Preplacement and periodic medical examinations of exposed workers emphasizing respiratory, skin, liver, and kidney rs, including comprehensive work and medical history, physical examination, CXR, PFTs, urinalysis, LFT, and sputum cytology as the ng physician considers appropriate. Educate workers about coal tar creosote's carcinogenicity and proper handling procedures to avoid re.

Comments: Caution is in order when handling or sawing old creosote-treated lumber since it retains a considerable portion of creosote for 5 to 30 years.

portation Data (49 CFR 172.101)

hip[illegible]Name: Creosote

[illegible]lass: Flammable liquid

[illegible]36

[illegible]: Flammable liquid

***ollection* References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 139, 140, 142, 143, 146, 148, 153, 159

l by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** Mark Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 409
Cresol (Mixed Isomers)

Issued: 12/78 Revision: B, 3/92

Section 1. Material Identification

Cresol, *mixed isomers* ($CH_3C_6H_4OH$) Description: Derived from coal tar or petroleum. Cresol is marketed by individual isomer and as pure or crude cresol. Pure cresol is a mixture of *ortho*, *meta*, and *para* isomers. Crude cresol (commercial cresol) is prepared by distilling "grey phenic acid" at 356 to 401 °F (180 to 205 °C) and is comprised of 20% *ortho*, 40% *meta*, and 30% *para* isomers, plus small amounts of phenol and xylenols. Each isomer can be prepared synthetically by diazotization of the specific corresponding toluidine. Used in manufacturing synthetic resins, explosives, photographic developers, petroleum, paint, disinfectants, and fumigants; as an ore flotation agent; and in the agriculture industry for herbicides and insecticides.
Other Designations: CAS No. 1319-77-3, Bacillol, cresylic acid, Tekresol, tricresol.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Cresol is severely irritating to mucous membranes, eyes, and skin. Depending on the cresol concentration, extent of exposure, and amount of skin exposed, toxicity may be slight (irritation) or severe (permanent injury or death).

R 1
I 4
S 3*
K 2
* Skin absorption

NFPA
2
3 0

HMIS
H 3
F 2
R 0
PPG†
† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Cresol (*mixed isomers*) National Formulary (NF) grade contains < 5% phenol

1990 OSHA PEL (Skin)
8-hr TWA: 5 ppm (22 mg/m³)

1990 NIOSH REL
TWA: 5 ppm (22 mg/m³)

1990 IDLH Level
250 ppm

1991-92 ACGIH TLV (Skin)
TWA: 5 ppm (22 mg/m³)

1990 DFG (Germany) MAK
TWA: 5 ppm (22 mg/m³) (H)*
Peak Exposure Limit: 10 ppm, 5 min, momentary value/8 per shift

1985-86 Toxicity Data†
Rat, oral, LD_{50}: 1454 mg/kg; toxic effects not yet reviewed
Mouse, inhalation, LC_{50}: 179 mg/m³/2 hr; no toxic effects noted (*o*-)
Rabbit, eye: 103 mg produced severe irritation (*p*-)
Rabbit, skin: 517 mg applied for 24 hr produced severe irritation (*m*-)
Rabbit, skin, LD_{50}: 2000 mg/kg; toxic effects not yet reviewed

* Danger of cutaneous absorption.
† See NIOSH, *RTECS* (GO5950000), for additional toxicity data. For data on specific isomers, see *RTECS* (GO6125000, *meta*; GO6300000, *ortho*; and GO6475000, *para*).

Section 3. Physical Data

Boiling Point Range: 375.8 to 397.4 °F (191 to 203 °C)
Melting Point Range: 51.8 to 95 °F (11 to 35 °C)
Vapor Pressure: 0.25 (*ortho*), 0.15 (*meta*), 0.11 (*para*) mm Hg at 68 °F (20 °C)
Vapor Density (air = 1): 3.72
pH: Saturated solutions are neutral or slightly acidic to litmus
Viscosity: 4.49 to 7.0 cP at 104 °F (40 °C)

Molecular Weight: 108.13
Specific Gravity: 1.030 to 1.038 at 77 °F (25 °C)
Water Solubility: Soluble, 1%
Other Solubilities: Soluble in alcohol, ether, dilute alkalies, glycol and vegetable oils
Refraction Index: 1. 5353 at 75.2 °F (24 °C)
Odor Threshold: Low, 0.012 mg/m³; high, 22 mg/m³

Appearance and Odor: Colorless, yellow, or pinkish liquid turning brown on exposure to air or light with a phenolic odor and pungent taste.

Section 4. Fire and Explosion Data

Flash Point: 178 °F (81.11 °C, *ortho*), 187 °F (86.11 °C, *meta* and *para*), CC	**Autoignition Temperature:** 1110 °F (559 °C, *ortho*), 1038 °F (558 °C, *meta* and *para*)	**LEL:** 1.4% (*ortho*), 1.1% (*meta* and *para*) at 302 °F (150 °C)	**UEL:** None reported

Extinguishing Media: While cresol does not ignite easily, it burns. For small fires, use dry chemical, carbon dioxide (CO_2), water spray, or regular foam. For large fires, use water spray, fog, or regular foam. Do not scatter material with more water than is necessary to put out fire.
Unusual Fire or Explosion Hazards: Container may explode in heat of fire.
Special Fire-fighting Procedures: Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is ineffective for fires involving cresol. Use clothing the manufacturer recommends specifically for use with cresol. If possible without risk, remove container from fire area. Fight fire from maximum distance. Stay away from ends of tanks. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Cresol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Cresol reacts with oxidizing materials and causes a temperature and pressure increase with chlorosulfonic acid, nitric acid, and oleum.
Conditions to Avoid: Ignition sources and contact with incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition of cresol can produce carbon dioxide (CO_2) and toxic cresol fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(142) and OSHA(164) do not list cresol as a carcinogen. **Summary of Risks:** Cresol is corrosive to eyes, skin, and mucous membranes. Degree of toxicity depends on the cresol concentration involved, amount of surface area exposed, and duration of exposure. Ingestion is corrosive to the digestive tract's mucous membranes and can pose serious problems if not treated promptly. Because cresol has a low vapor pressure, it is not volatile enough under normal conditions to present an inhalation hazard. If heated, vapor inhalation is likely. Severe chemical burns and dermatitis are the main hazards in industry. Note that cresol's *ortho* and *para* isomers (if used individually) are in crystal form and thus are a dust inhalation hazard. By all routes of exposure, cresol produces toxic symptoms similar to phenol's. **Medical Conditions Aggravated by Long-Term Exposure:** Skin diseases. **Target Organs:** Eyes, skin, central nervous system (CNS), liver and kidney. **Primary Entry Routes:** Skin and eye contact/absorption. **Acute Effects:** Cresol is absorbed through skin, open wounds, and the mucous membranes of the respiratory and digestive tracts. The rate at which skin absorbs cresol depends more on the size of exposure area than on the concentration of material applied. Cresol is corrosive to the skin causing smarting; tingling; redness; swelling; burns that may be very painful and become white and wrinkled with softening that may become gangrenous; blisters; possible shock as a result

Continue on next page

Section 6. Health Hazard Data, *continued*

of pain; and, in severe cases of absorption, coma and death. Contact with eyes may cause stinging, and burning, watering of eyes, redness and swelling of lids, corneal opaqueness causing blurred vision and possible loss of sight. In rare cases, a pigment disorder called ochronosis occurs characterized by darkening of skin, conjunctiva, and cartilage of the nose and ears. Ingestion leads to burning of lips, mouth, and throat, pain in swallowing, ulceration of the mucous membranes of the mouth, color change of the tongue (white), thirst, throat swelling, cramps, nausea and vomiting (sometimes of coffee grounds-like material due to digestive hemorrhage). In severe cases symptoms might progress to shock, convulsions, coma, and death. If vapor inhalation occurs, symptoms include irritation of mucous membranes of nose, eyes, and mouth, watering of eyes, sneezing, coughing, difficulty breathing, headache, nausea, muscle weakness, and possible pulmonary edema. In most cases of exposure, if death occurs, it is usually caused by respiratory failure. **Chronic Effects:** Repeated exposure to cresol may cause digestive disturbences, liver, kidney, spleen and pancreatic damage, and skin eruptions or dermatitis. Some people can become allergic or hypersensitive to cresol.

FIRST AID: ***Emergency personnel should protect against contamination.***

Eyes: Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* allow victim to rub or keep eyes tightly shut. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing to prevent burns. Rinse with flooding amounts of water for at least 15 min. If clothing is stuck to skin after flushing with water, *do not* remove! Thoroughly wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting with 2 tablespoons of Ipecac (adult dose). After patient vomits, give activated charcoal in 8 oz. of water to drink. **After first aid, get appropriate in-plant, paramedic, or community medical support.**

Note to Physicians: Since effects may be delayed, keep victim under observation. Irrigate eyes and wash skin with a mixture of polyethylene glycol 300 and industrial methylated spirits (PEG 300/IMS, 2:1 by volume). Recommended treatment for ingestion is repeated gastric lavage with large quantities of olive oil.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area (with fixed or portable fan systems for cross-ventilation), deny entry, and stay upwind. Shut off all ignition sources. Spilled liquid can be neutralized with crushed limestone or soda ash. Take up small spills with earth, sand, vermiculite or other absorbent, noncombustible material and place into suitable containers. For large spills, dike far ahead of liquid for later disposal or reclamation. For water spills, you may need to trap cresol at the bottom with sandbag barriers, apply activated charcoal, and then remove trapped material with dredges or lifts. Follow applicable OSHA regulations (29 CFR 1910.120).

Environmental Degradation: When released into the atmosphere, cresol degrades by reacting with photochemically produced hydroxyl radicals during the day (half-life = 8 to 10 hr), and with nitrate radicals at night (half-life = 2 to 5 min). Cresol biodegrades in eutrophic (nutrient-rich) waters.

Ecotoxicity Values: Blue gill, TL_m, 24 mg/L/96 hr (fresh water); shrimp, TL_m, 10 to 100 ppm/48 hr (saltwater).

Soil Absorption/Mobility: Cresol is mobile in soil but biodegradation is probable. Cresols probably leach due to water solubility.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U052*

Listed as a CERCLA Hazardous Substance† (40 CFR 302.4): Reportable Quantity (RQ), 1000 lb (454 kg) [† per RCRA, Sec. 3001 and CWA, Sec. 311(b)(4)]

Listed (*o-cresol only*) as a SARA Extremely Hazardous Substance (40 CFR 355)

Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

* When a spent solvent and classified as a hazardous waste from nonspecific sources, cresol has Hazardous Waste No. F004.

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles or faceshields to protect against droplets or spray, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. At 50 to 500 ppm use a full face gas mask. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes: training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. Rubber is suggested as a material suitable for protection against cresol.

Ventilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103)

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in properly labelled (with trade name) iron or steel containers in cool, dry, well-ventilated location. Protect from light and keep away from incompatibles (Sec. 5). Outside or detached storage is preferred. To prevent static sparks, electrically ground and bond all equipment used in cresol manufacture, use, and storage.

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level.

Administrative Controls: Consider preplacement and periodic examinations of exposed workers that emphasize skin, kidney, liver, and respiratory system.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Cresol
DOT Hazard Class: Corrosive material
ID No.: UN2076
DOT Label: Corrosive
DOT Packaging Exceptions: 173.244
DOT Packaging Requirements: 173.245

IMO Shipping Name: Cresols (*o-*, *m-*, *p-*)
IMO Hazard Class: 6.1
ID No.: UN2076
IMO Label: Poison
IMDG Packaging Group: II

***MSDS Collection* References:** 26, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 140, 153, 159, 162, 163, 164

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** AC Darlington, MPH, MD; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 789
Cyanide

Issued: 11/91

Section 1. Material Identification

36

R	1
I	4
S	2
K	1

Genium
1
4 1
-

HMIS
H 4
F 1
R 1
PPG*
* Sec. 8

Cyanide (CN⁻) Description: Derived by combining a carbon ion with a nitride ion. Used in rat and pest poisons, silver and metal polishes, photographic solutions, fumigating products, and electroplating solutions. Cyanide may also be liberated in burning of plastics, natural fabrics (wool or silk), polyurethane bedding or furniture, acrylic baths, nylon carpets, and melamine resin insulation.

Other Designations: CAS No. 57-12-5, carbon nitride ion, cyanide anion, isocyanide.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Cyanide is severely toxic by all routes of entry and its lethal dose is an estimated 1 µg/ml. Take necessary precautions to avoid all possible exposure to this material.

Section 2. Ingredients and Occupational Exposure Limits

Cyanide, ca 100%

1990 OSHA PEL (Skin)
STEL: 4.7 ppm, 5 mg/m³, as hydrogen cyanide (gas)

1990 IDLH Level
50 mg/m³

1991-92 ACGIH TLV (Skin)
Ceiling: 10 ppm, 11 mg/m³, as hydrogen cyanide (gas)

1990 NIOSH REL (Skin)
STEL: 4.7 ppm, 5 mg/m³ as hydrogen cyanide (gas)

1990 DFG (Germany) MAK (*Danger of cutaneous absorption*)
TWA: 10 ppm, 11mg/m³ as hydrogen cyanide (gas)

1985-86 Toxicity Data*
Mouse, intraperitoneal, LD_{50}: 3 mg/kg; toxic effects not yet reviewed

* See NIOSH, *RTECS* (GS7175000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: Varies with specific CN⁻ compound
Melting Point: Varies with specific CN⁻ compound
Molecular Weight: 26.02
Density: Varies with specific CN⁻ compound
Water Solubility: Varies with specific CN⁻ compound

Appearance and Odor: Varies with specific CN⁻ compound, but usually has an almond odor.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Cyanide is combustible. For small fires, use dry chemical, water spray or foam. *Do not use carbon dioxide* (CO_2)*!* For large fires, use water spray, fog, or regular foam. *Do not scatter* material with more water than needed to extinguish fire.

Unusual Fire or Explosion Hazards: Combustible by chemical reaction with heat, moisture, or acid. Many cyanides readily evolve hydrogen cyanide (HCN), a toxic flammable gas.

Special Fire-fighting Procedures: Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing *is ineffective* for fires involving cyanide. Wear chemical protective clothing that the shipper or manufacturer specifically recommends. If possible without risk, remove container from fire area. Fight fire from maximum distance. Stay away from ends of tanks. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Remove and isolate contaminated clothing at the site.

Section 5. Reactivity Data

Stability/Polymerization: Cyanide is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Cyanide may react violently with hypochlorite solutions at pH 10 to 10.3, is explosive with nitrites if heated above 450 °C, and is incompatible with chlorates, fluorine, magnesium, nitrates, and all inorganic acids.

Conditions to Avoid: Avoid exposure to heat and contact with incompatibles.

Hazardous Products of Decomposition: Thermal oxidative decomposition of cyanide can produce carbon dioxide and toxic, flammable vapors of CN⁻.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list cyanide as a carcinogen.

Summary of Risks: Cyanide is a potent, fast-acting, chemical asphyxiant (material which causes pulse and breathing obstruction) that prevents tissue utilization of oxygen by inhibiting the enzyme involved (cytochrome oxidase). Death can occur within seconds to minutes after inhalation of some cyanide gases, and may take as long as an hour after ingestion of a large amount of a cyanide salt due to a slower absorption. Toxicity is dependent on the form of cyanide the victim is exposed to. Mortality from acute exposures is high, but recovery is generally complete in nonfatal cases.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Continue next page

Section 6. Health Hazard Data, *continued*

Target Organs: Brain, heart, lungs, skin, blood.

Primary Entry Routes: Inhalation, ingestion, skin absorption.

Acute Effects: Inhalation of cyanide gases may cause rapid toxicity where the victim may only have time to utter a warning cry before succumb- unconsciousness caused by asphyxiation. If exposure is small there may be a weak, rapid, irregular heartbeat with bright-pink coloration of due to high oxyhemoglobin content in the veins before person loses consciousness. A telltale sign of inhalation or ingestion is the odor of lmonds on the breath, however up to half the population is genetically unable to detect this smell. Dialated pupils are common in severe poisonings. Contact with broken skin can cause cyanide absorption into the bloodstream. Cyanide ingestion can cause a bitter, burning taste, salivation, nausea, vomiting, anxiety, confusion, vertigo (dizziness), giddiness, sensation of stiffness in the lower jaw, and dyspnea (difficult respiration). In severe cases symptoms could progress to convulsions, paralysis, coma, cardiac arrhythmias, followed by death due to respiratory failure.

Chronic Effects: Chronic skin contact may cause cyanide rash, characterized by itching, and macular (blotches), papular (small, solid, conical, elevation of the skin), and vesicular (blister-like) eruptions. Chronic cyanide inhalation may cause appetite loss, headache, weakness, nausea, dizziness, and symptoms of irritation of the upper respiratory tract and eyes. Other symptoms of chronic exposure include goiter, B12 and folate abnormalities, chest discomfort, epistaxis (nose bleed), poor appetite and sleeping, and functional changes in hearing.

FIRST AID: *Emergency personnel should protect against contamination!*

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Speed is extremely important. Rinse with flooding amounts of water for at least 15 min. Wash exposed area *extremely thoroughly* with soap and water. If irritation and pain persist, consult a physician.

Inhalation: Remove exposed person to fresh air and immediately begin administering 100% oxygen. Avoid mouth-to-mouth resuscitaton during CPR to prevent self-poisonings.

Ingestion: Obtain and prepare the Lilly cyanide antidote kit [Eli Lilly Co. (Stock No. M76)] for use in symptomatic patients. Never give anything by mouth to an unconscious or convulsing person. Do not induce vomiting with Ipecac syrup. Consider gastric lavage. Activated charcoal is said to be ineffective.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: If the victim is unconscious, bradycardia and absence of cyanosis may be key diagnostic signs. Consider administration of amyl nitrite followed by sodium nitrite and sodium thiosulfate (antidote kit). Consider use of 100% oxygen.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate area, deny entry, and stay upwind. Shut off all ignition sources—no flames, flares, or smoking in hazard area. Cleanup personnel should wear fully encapsulating, vapor-protective clothing for spills or leaks without fire. For small dry spills, carefully scoop into clean, dry, suitable container and cover loosely. For small solution spill, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers. For large spills, dike far ahead of solution spills for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): Hazardous Waste No. P030

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity: *An RQ is not being assigned to the general class* [* per Clean W Act, Sec. 307(a)]

remely Hazardous Substance (40 CFR 355): Not listed

is a SARA Toxic Chemical (40 CFR 372.65)

SHA Designations

isted as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

ection 8. Special Protection Data

oggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since ntact lens use in industry is controversial, establish your own policy.

espirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if cessary, wear a NIOSH-approved respirator. Select the respirator based on its suitability provide adequate worker protection for the given orking conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, actor vessels, or storage tanks), wear an SCBA with a full facepiece operated in pressure-demand or other positive-pressure mode. *Warning! -purifying respirators do not protect workers in oxygen-deficient atmospheres.*

her: Wear impervious gloves, boots, aprons, and gauntlets to prevent repeated or prolonged skin contact.

ntilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust ilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)

fety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

ntaminated Equipment: Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. move this material from your shoes and clean personal protective equipment.

mments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, oking, using the toilet, or applying cosmetics. Cyanide detoxifying kits and instructions should be available in use areas. Instruct employees rking in these areas on how and when to use these kits.

ction 9. Special Precautions and Comments

rage Requirements: Avoid physical damage to containers. Store in tightly closed and properly labeled containers in cool, dry, well-ventilated away from heat and incompatibles.

gineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control hazardous airborne taminants and to maintain concentrations at the lowest practical level.

er Precautions: If respirators are used, implement a respiratory protection program that includes regular training, maintenance, inspection, evaluation. Consider preplacement and periodic medical examinations of exposed workers that emphasize the heart, blood, and respiratory em.

Transportation Data (49 CFR 172.101, .102)

T Shipping Name: Cyanide *or* cyanide mixture, dry
T H d Class: Poison B
588
el: Poison
T Packaging Exceptions: 173.364
T Packaging Requirements: 173.370

IMO Shipping Name: Cyanides, inorganic, n.o.s.
IMO Hazard Class: 6.1
ID No.: UN1588
IMO Label: Poison
IMDG Packaging Group: I/II; Stow 'away from' acids

S Collection **References:** 73, 101, 103, 126, 127, 136, 143, 146, 148, 153, 159, 161, 163

ared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MPH, MD; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:
Sheet No. 385
Ethylbenzene

Issued: 8/78 Revision: B, 9/92

Section 1. Material Identification

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Ethylbenzene ($C_6H_5C_2H_5$) Description: Derived by heating benzene and ethylene in presence of aluminum chloride with subsequent distillation, by fractionation directly from the mixed xylene stream in petroleum refining, or dehydrogenation of naphthenes. Used as a solvent, an antiknock agent in gasoline; and as an intermediate in production of synthetic rubber, styrene, cellulose acetate, diethylbenzene, acetophenone, ethyl anthraquinone, propyl oxide, and α-methylbenzol alcohol.
Other Designations: CAS No. 100-41-4, ethylbenzol, EB, phenylethane, NCI-C56393.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
I 3
S 2*
K 4
* Skin absorption

NFPA
3
2 0
-

HMIS
H 2†
F 3
R 0
PPE - Sec. 8
† Chronic effects

Cautions: Ethylbenzene is a skin and mucous membrane irritant considered the most irritating of the benzene series. Inhalation causes acute and chronic central nervous system (CNS) effects. It is highly flammable and forms explosive mixtures with air.

Section 2. Ingredients and Occupational Exposure Limits

Ethylbenzene, ca >99.0%. Impurities include ~ 0.1% *meta & para* xylene, ~ 0.1% cumene, and ~ 0.1% toluene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m³)
15-min STEL: 125 ppm (545 mg/m³)
Action Level: 50 ppm (217 mg/m³)

1990 IDLH Level
2000 ppm

1990 NIOSH REL
TWA: 100 ppm (435 mg/m³)
STEL: 125 ppm (545 mg/m³)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m³)
STEL: 125 ppm (545 mg/m³)

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m³)
Category 1: local irritants
Peak Exposure Limit: 200 ppm, 5 min momentary value, max of 8/shift
Danger of cutaneous absorption

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 100 ppm/8 hr caused eye effects, sleep, and respiratory changes.
Human, lymphocyte: 1 mmol/L induced sister chromatid exchange.
Rat, oral, LD_{50}: 3500 mg/kg; toxic effects not yet reviewed
Rat (female), inhalation, TC_{Lo}: 1000 ppm/7 hr/day, 5 days/wk, for 3 wk prior to mating and daily for 19 days of gestation produced pups with high incidence of extra ribs.(179)

* See NIOSH, *RTECS* (DA0700000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 277 °F (136 °C)
Melting Point: -139 °F (-95 °C)
Surface Tension: 31.5 dyne/cm
Ionization Potential: 8.76 eV
Viscosity: 0.64 cP at 77 °F (25 °C)
Refraction Index: 1.4959 at 68 °F (20 °C)
Relative Evaporation Rate (ether = 1): 0.0106
Bulk Density: 7.21 lb/Gal at 77 °F (25 °C)
Critical Temperature: 651 °F (343.9 °C)
Critical Pressure: 35.6 atm
Molecular Weight: 106.16
Density: 0.863 at 77 °F (25 °C)
Water Solubility: Slightly, 14 mg/100 mL at 59 °F (15 °C)
Other Solubilities: Miscible in alcohol, ether; soluble in carbon tetrachloride, benzene, sulfur dioxide, and many organic solvents; insoluble in ammonia
Odor Threshold: 2.3 ppm
Vapor Pressure: 7.1 mm Hg at 68 °F (20 °C); 10 mmHg at 78.62 °F (25.9 °C); 100 mm Hg 165.38 °F (74.1 °C)
Saturated Vapor Density (Air = 0.075 lb/ft³ or 1.2 kg/m³): 0.0768 lb/ft³ or 1.2298 kg/m³

Appearance and Odor: Colorless, flammable liquid with a pungent odor.

Section 4. Fire and Explosion Data

Flash Point: 64 °F (18 °C) CC	**Autoignition Temperature:** 810 °F (432 °C)	**LEL:** 1.0% v/v	**UEL:** 6.7% v/v

Extinguishing Media: Class 1B Flammable liquid. For small fires, use dry chemical, carbon dioxide, or 'alcohol-resistant' foam. For large fires, use fog or 'alcohol-resistant' foam. Use water only if other agents are unavailable; EB floats on water and may travel to an ignition source and spread fire. **Unusual Fire or Explosion Hazards:** Burning rate = 5.8 mm/min. Vapors may travel to an ignition source and flash back. Container may explode in heat of fire. EB poses a vapor explosion hazard indoors, outdoors, and in sewers. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Cool container sides with water until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Withdraw immediately if you hear rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Ethylbenzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Reacts vigorously with oxidizers.
Conditions to Avoid: Exposure to heat and oxidizers.
Hazardous Products of Decomposition: Thermal oxidative decomposition of EB can produce acrid smoke and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list EB as a carcinogen. **Summary of Risks:** Occupational exposure to EB alone rare since it is usually present together with other solvents. EB is irritating to the eyes, skin, and respiratory tract. Vapor inhalation produces varying degrees of CNS effects depending on concentration. The liquid is absorbed through the skin but vapors are not. 56 to 64% of inhaled ethylbenzene is retained and metabolized. Urinary metabolites following exposure to 23 to 85 ppm for 8 hr are mandelic acid (64%), phenylglyoxylic acid (25%), and methylphenylcarbinol/1-phenyl ethanol (5%). Concurrent exposure to xylene and ethylbenzene causes slower excretion of EB metabolites. Based on the rat LD_{50}, one manufacturer gives 3 to 4 oz. as the lethal dose for a 100 lb person.

Continue on next page

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Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list methyl alcohol as a carcinogen.
Summary of Risks: Methyl alcohol is toxic mainly to the nervous system, particularly optic nerves, where damage can progress to permanent
blindness. Poisoning may also result in metabolic acidosis. Methyl alcohol oxidizes in the body to form formaldehyde and formic acid. These
derivatives are believed responsible for many of methyl alcohol's poisonous and toxic effects. Since it is eliminated slowly from the body, methyl
lcohol is considered a cumulative poison. The fatal ingestion dose is 100 to 250 ml, although death is reported from less than 33 ml.
ledical Conditions Aggravated by Long-Term Exposure: None reported
Target Organs: Eyes, central nervous system, skin, and digestive tract.
Primary Entry Routes: Inhalation, ingestion, skin absorption.
Acute effects: Inhalation can cause irritation of eyes and nose, headache, fatigue, nausea, visual impairment (optic nerve neuropathy or visual
field changes) or complete and possibly permanent blindness, acidosis, convulsions, circulatory collapse, respiratory failure, and death. Ingestion
can cause gastrointestinal (GI) irritation followed by the symptoms described for inhalation and possible kidney impairment. Skin contact results
in a feeling of coldness, dryness, and cracking possibly leading to dermatitis. Methyl alcohol can absorb through skin and may cause headache,
fatigue, and visual disturbances. Eye contact causes irritation and watering of eyes, inflamed lids, and painful sensitization to light.
Chronic Effects: Chronic inhalation or skin absorption may produce visual impairment or complete blindness.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical
facility. Do not let victim rub or keep eyes tightly shut. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Since methyl alcohol is volatile and flammable, carefully dispose of contaminated clothing. Rinse
with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious and alert* person drink 1 to 2
glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Consider administering 10% ethanol in D5W intravenously to maintain ethyl alcohol blood level at 100 mg/dl. Check formic acid
in urine and measure blood pH and plasma bicarbonate. After ingestion, there is typically an 18- to 48-hr latency period before clinical toxicity

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate area, deny entry, and stay upwind. Shut off all ignition sources—no flares, smoking, or flames in
hazard area. Cleanup personnel should wear fully encapsulating, vapor-protective clothing for spills or leaks with no fire. Water spray may reduce
vapor, but not prevent ignition in closed spaces. For small spills, use nonsparking tools to take up with earth, sand, vermiculite, or other absorbent,
noncombustible material and place in suitable containers for later disposal. For large spills, dike far ahead of spill and await disposal. Follow
applicable OSHA regulations (29 CFR 1910.120).
Environmental Degradation: Aquatic toxicity rating: TLm 96, over 1000 ppm.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33): Hazardous Waste No. U154
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
A Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since
contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if
necessary, wear a NIOSH-approved respirator. Select the respirator based on its suitability to provide adequate worker protection for the given
working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills,
reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent all skin contact.
Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs
(Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing.
Remove this material from your shoes and clean personal protective equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking,
smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Avoid physical damage to containers. Store in cool, dry, well-ventilated flammables storage area, away from strong
oxidizers and other incompatibles. To prevent static sparks, electrically ground all equipment used in methyl alcohol storage, manufacture, and
transportation. Use nonsparking tools.
Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control hazardous airborne
contaminants and to maintain concentrations at the lowest practical level.
Other Precautions: Consider preplacement and periodic medical examinations of exposed workers emphasizing neurological, kidney, liver, and
visual function. Practice good personal hygiene and housekeeping procedures. If respirators are used, institute a respiratory protection program
that includes regular training, maintenance, inspection, and evaluation.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Methyl alcohol
DOT Hazard Class: Flammable liquid
ID No.: UN1230
Label: Flammable liquid
Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Methanol
IMO Hazard Class: 3.2
ID No.: UN1230
IMO Label: Flammable Liquid, Poison
IMDG Packaging Group: II

MSDS Collection **References:** 26, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 140, 143, 146, 148, 149, 153, 159, 163
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MD, MPH; **Edited by:** JR Stuart, MS

Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 624

NAPHTHALENE

Issued: November 1987

SECTION 1. MATERIAL IDENTIFICATION

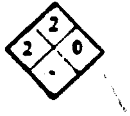
24

Material Name: NAPHTHALENE

Description (Origin/Uses): Used as a moth repellant and in many industrial processes.

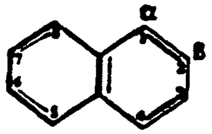
Other Designations: Naphthalin; Naphthene; Tar Camphor; $C_{10}H_8$; NIOSH *RTECS* No. QJ0525000; CAS No. 0091-20-3

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyer's Guide* (Genium ref. 73) for a list of suppliers.



HMIS			
H	2		
F	2	R	1
R	0	I	4
PPG*		S	1
*See sect. 8		K	2

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Naphthalene, CAS No. 0091-20-3 	ca 100	IDLH* Level: 500 ppm **ACGIH TLVs, 1987-88** TLV-TWA: 10 ppm, 50 mg/m³ **OSHA PEL** 8-Hr TWA: 10 ppm, 50 mg/m³ **Toxicity Data**** Child, Oral, LD_{Lo}: 100 mg/kg Man, Unknown, LD_{Lo}: 74 mg/kg Rat, Oral, LD_{50}: 1250 mg/kg

*Immediately dangerous to life and health
**See NIOSH *RTECS* for additional data with references to irritative, mutagenic, reproductive, and tumorigenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point: 424°F (218°C)
Vapor Density (Air = 1): 4.4
por Pressure: 0.087 Torr at 77°F (25°C)
ater Solubility: Insoluble

Specific Gravity (H_2O = 1): 1.162 at 68°F (20°C)
Melting Point: 176°F (80°C)
Molecular Weight: 128 Grams/Mole
% Volatile by Volume: ca 100

Appearance and Odor: White crystalline flakes; strong coal tar odor.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
174°F (79°C) OC; 190°F (88°C) CC	979°F (526°C)	% by Volume	0.9	5.9

Extinguishing Media: Use water spray, dry chemical, or carbon dioxide to fight fires involving naphthalene. **Caution:** Foam or direct water spray applied to molten naphthalene may cause extensive foaming.

Unusual Fire or Explosion Hazards: Naphthalene is a volatile solid that gives off flammable vapor when heated (as in fire situations). This vapor is much denser than air and will collect in enclosed or low-lying areas like sumps. In these areas an explosive air-vapor mixture may form, and extra caution is required to prevent any ignition sources from starting an explosion or fire.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Naphthalene is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

Chemical Incompatibilities: Naphthalene is incompatible with strong oxidizing agents, chromic anhydride, and mixtures of aluminum trichloride and benzoyl chloride.

ditions to Avoid: Ignition sources like open flame, unprotected heaters, excessive heat, lighted tobacco products, and electric sparks st not occur in work areas where naphthalene vapor may become concentrated.

Hazardous Products of Decomposition: Toxic gases like carbon monoxide are produced during fire conditions. Irritating, flammable vapor forms below the melting point because even solid naphthalene has a significant vapor pressure.

SECTION 6. HEALTH HAZARD INFORMATION

Naphthalene is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Renal shutdown (kidney failure), hemolytic effects (breakdown of red blood cells), hematuria (blood in the urine), oliguria (low volume of urine), jaundice, eye damage, and depression of the central nervous system (CNS) are the primary health concerns associated with exposure to naphthalene. The ACGIH TLVs in section 2 are set to prevent eye damage. These recommended exposure limits may not be low enough to prevent blood changes in genetically hypersensitive individuals.
Medical Conditions Aggravated by Long-Term Exposure: Diseases of the blood, liver, and kidneys. Administer medical exams emphasizing these organs. **Target Organs:** Eyes, skin, kidneys, liver, blood (red blood cell effects), and CNS.
Primary Entry: Inhalation, skin contact. **Acute Effects:** Inhalation of naphthalene vapor causes excitement, confusion, headache, nausea, and loss of appetite. **Chronic Effects:** Increased incidence of cataracts.

FIRST AID

Eye Contact: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes to remove particles.
Skin Contact: Immediately wash the affected area with soap and water.
Inhalation: Remove victim to fresh air; restore and/or support his breathing as needed.
Ingestion: Call a poison control center. Never give anything by mouth to someone who is unconscious or convulsing. Administer a gastric lavage followed by saline catharsis. Monitor blood and electrolytic balance. Other sources recommend giving the victim several glasses of water to drink.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all ignition sources immediately. Cleanup personnel need protection against contact and inhalation of vapor (see sect. 8). Contain large spills and collect waste. Use nonsparking tools to place naphthalene into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.
Waste Disposal: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, No. U165
CERCLA Hazardous Substance, Reportable Quantity: 100 lbs (45.4 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Follow the eye- and face-protection guidelines of 29 CFR 1910.133. **Respirator:** Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* (Genium ref. 88) for the maximum-use concentrations and/or the exposure limits cited in section 2. Respirator usage must be in accordance with the OSHA regulations of 29 CFR 1910.134. IDLH or unknown concentrations require an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres.
Other Equipment: Wear impervious gloves, boots, aprons, gauntlets, etc., as required by the specific work environment to prevent skin contact. **Ventilation:** Install and operate general and local maximum explosion-proof ventilation systems of sufficient power to maintain airborne levels of naphthalene below the OSHA PEL standard cited in section 2. **Safety Stations:** Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove and launder contaminated clothing before wearing it again; clean this material from shoes and equipment.
Comments: Practice good personal hygiene; always wash thoroughly after using this material. Keep this material off of your clothing and equipment. Avoid transferring this material from hands to mouth while eating, drinking, or smoking. Do *not* smoke, eat, or drink in any immediate work area. Avoid inhalation of vapor!

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage Segregation: Store naphthalene in a cool, dry, well-ventilated area away from chemical incompatibles (see sect. 5).
Special Handling/Storage: Protect containers from physical damage. All bulk storage facilities must be built with an explosion-proof design. All containers used in shipping/transferring operations must be electrically grounded to prevent static sparks. Use monitoring equipment to measure the extent of vapor present in any storage facility containing naphthalene because of potential fire and explosion hazards.
Comments: All operations with naphthalene must be done carefully to prevent accidental ignition of its flammable/explosive vapor. If the weather is warm, more naphthalene vapor forms and the potential for explosion increases. Do *not* smoke in any use or storage area!

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Naphthalene	**DOT ID No.** UN1334
DOT Hazard Class: ORM-A	**IMO Label:** Flammable Solid
IMO Class: 4.1	**DOT Label:** None

References: 1, 2, 12, [illegible], 84 94, 103 PII

Approvals	
Indust. Hygiene/Safety	
Medical Review	

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Material Safety Data Sheets Collection:

Sheet No. 7
Nitric Acid

Issued: 10/88 Revision: D, 9/92

Section 1. Material Identification

Nitric Acid (HNO_3) Description: A solution of nitrogen dioxide in water commercially available in many concentrations. Derived by oxidation of ammonia by catalytic process (heated platinum catalyst); or by direct synthesis, combining atmospheric nitrogen and oxygen in an electric arc (an expensive process, thus largely abandoned). HNO_3 is usually found in conjunction with nitrogen dioxide, which is considered more hazardous. Used in fertilizer production (ammonium nitrate), in photoengraving, steel etching, explosives (TNT, nitroglycerin, trinitrophenol); manufacture of metallic nitrates, sulfuric acid, aqua regia and oxalic acid, jewelry, various dyes and dyestuffs, pharmaceuticals; as a laboratory reagent, in metallurgy (*mainly* as a pickling agent) and the printing industy.

Other Designations: CAS No. 7697-37-2, aqua fortis, aqua regia, azotic acid, engravers nitrate, hydrogen nitrate, red fuming nitric acid (RFNA), white fuming nitric acid (WFNA).

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for suppliers list.

Cautions: Nitric acid is a corrosive, strong oxidizer that causes irritation or severe burns to the skin, eyes, and respiratory tract. Exposures to high levels of the concentrated acid can be fatal. Increases the flammability of combustibles. Use extreme caution when handling HNO_3.

R 2 I 4 S 4 K 0	HMIS H 3* F 0 R 1 PPE**	*Fuming* nitric acid	NFPA 0 3 1 ox
R 2 I 4 S 4 K 0	HMIS H 3* F 0 R 1 PPE**	*>40%* nitric acid	0 3 0 ox
R 2 I 3 S 3 K 0	HMIS H 3* F 0 R 0 PPE**	*≤40%* nitric acid	0 3 0 –

* Chronic effects ** See Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Nitric acid, various %. Commercially available in nearly all concentrations; most common are 56 and 68%. RFNA (85%), WFNA (97.5%).

1991 OSHA PELs
8-hr TWA: 2 ppm (5 mg/m^3)
15-min STEL: 4 ppm (10 mg/m^3)

1990 IDLH Level
100 ppm

1990 NIOSH REL
8-hr TWA: 2 ppm (5 mg/m^3)
15-min STEL: 4 ppm (10 mg/m^3)

1992-93 ACGIH TLVs
TWA: 2 ppm (5.2 mg/m^3)
STEL: 4 ppm (10 mg/m^3)

1990 DFG (Germany) MAK
2 ppm (5 mg/m^3)
Category I: local irritants
Peak Exposure Limit: 2 ppm
5 min momentary value, 8 per shift

1985-86 Toxicity Data*
Man, unreported route, LD_{Lo}: 110 mg/kg; toxic effects not yet reviewed
Rat, oral, TD_{Lo}: 5275 g/kg administered from 1 to 21 days of pregnancy caused post-implantation mortality and specific developmental abnormalities of the musculoskeletal system.
Rat, inhalation, LC_{50}: 67 ppm (NO_2)/4 hr; toxic effects not yet reviewed

* See NIOSH, *RTECS* [QU5775000 (nitric acid), QU5900000 (RFNA), QU6000000 (WFNA)] , for additional reproductive and toxicity data.

Section 3. Physical Data

Boiling Point: 186.8 °F (86 °C)
Melting Point: -43.6 °F (-42 °C)
Vapor Pressure: 67% HNO_3 = 6.8 mm Hg at 68 °F (20 °C); 95 to 98% = 113 at 100.4 °F (38 °C)
Saturated Vapor Density (Air = 1.2 kg/m³): 1.212 kg/m^3 or 0.0757 lb/ft^3 (67 % HNO_3)
pH: 1

Molecular Weight: 63.02
Density: 1.50269 at 77/39.2 °F (25/4 °C)
Water Solubility: Soluble (releases heat)
Ionization Potential: 11.95 eV

Appearance and Odor: Transparent, clear to yellow, fuming liquid with an acrid, suffocating odor which darkens to a brownish color on aging and exposure to light. "Fuming" nitric acid is red-brown in color.

Section 4. Fire and Explosion Data

Flash Point: Noncombustible	**Autoignition Temperature:** Noncombustible	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: For small fires (< 40% HNO_3), use dry chemical, carbon dioxide (CO_2), water spray, or regular foam. For large fires, use water spray, fog, or regular foam. For small fires (> 40% HNO_3), use water spray, dry chemical, or soda ash. For large fires, flood area with water (*do not* get inside HNO_3 containers). Apply water from as far a distance as possible.

Unusual Fire or Explosion Hazards: HNO_3 is noncombustible but is an oxidizer which increases fire involving combustibles and can initiate an explosion. It releases flammable hydrogen gas in contact with many metals.

Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is not effective for fires involving nitric acid. Acid-resistant clothing is needed. Apply cooling water to sides of containers until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. *Do not* release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Nitric acid decomposes in air and in contact with light and organic matter. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Nitric acid reacts explosively with combustibles, organics or readily oxidizable materials such as wood, turpentine, metal powder and hydrogen sulfide, carbides, cyanides, and alkalies; causes spattering with strong bases; is corrosive to paper, cloth and most metals (except aluminum, gold, platinum, thorium, and tantalum. Will also attack some forms of plastics, rubber, and coatings. There are at least 150 chemicals and chemical combinations which are incompatible with nitric acid. HNO_3 reacts with water to produce heat and toxic corrosive fumes. Refer to *Genium* references 126 and 159 for further detail. **Conditions to Avoid:** Avoid exposure to moisture, heat, and incompatibles.
Hazardous Decomposition Products: Thermal oxidative decomposition of HNO_3 produces nitrogen peroxide and toxic, irritating nitrogen oxides.

Section 6. Health Hazards Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list nitric acid as a carcinogen.
Summary of Risks: Nitric acid is very corrosive to the skin, eyes, digestive and respiratory tract or any tissue it comes in contact with. 58 to 68% (nitric acid) vapors are moderately irritating and can't be tolerated at high concentrations. 95% (nitric acid) vapors cause severe irritation at very low levels and the liquid causes 2nd and 3rd degree burns on short contact with skin or eyes. Vapor inhalation may cause pulmonary edema (fluid in lungs) leading to death. HNO_3 vapor or mist can slowly corrode teeth when chronically exposed. **Medical Conditions Aggravated by Long-Term Exposure:** Chronic respiratory diseases. **Target Organs:** Eyes, skin, respiratory tract, teeth.

Continue on next page

Section 6. Health Hazard Data, continued

Primary Entry Routes: Inhalation, ingestion, skin and eye contact. **Acute Effects:** Inhalation symptoms may take several hours and include throat nd nose irritation, cough, chest pain, difficulty breathing, salivation, giddiness, nausea, muscular weakness, ulceration of nasal mucous membranes, ulmonary edema, and chemical pneumonia. Skin contact is moderately irritating to severely corrosive depending on % of nitric acid. Burns may penetrate deeply, causing ulcers. Skin may be stained yellowish brown. Dilute solutions cause irritation and tend to harden the epithelium (outer skin ayer) without destroying it. HNO_3 liquid causes yellow discoloration of the eyes and severe burns which may result in permanent damage, i.e., sight lo[illegible]estion produces immediate pain and digestive tract burns followed by throat swelling, convulsions, risk of stomach perforation (causing a rigid a[illegible]n) and possible coma. **Chronic Effects:** Repeated inhalation of low concentrations may cause chronic bronchitis, tooth erosion, and/or appetite loss. Repeated exposure to $NO_{(x)}$ such as produced by thermal decomposition of HNO_3 is implicated in chronic lung diseases.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing (*do not force removal if stuck to skin*). Rinse with flooding amounts of water for at least 15 min. Apply a 5% triethanolamine solution to affected area. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute followed by lime milk or milk of magnesia. Do not induce vomiting. *Do not* give sodium bicarbonate or attempt to neutralize the acid.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Observe for several hours since symptoms such as pulmonary edema may be delayed.

Section 7. Spill, Leak, and Disposal Procedures

pill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should wear fully-ncapsulating vapor-protective clothing. Use water spray to cool and disperse vapor. Keep combustibles away from spilled material. For small spills, ke up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in dry containers for disposal. For large spill, flush with ater to containment area and neutralize with agricultural (slaked) lime, sodium bicarbonate, crushed limestone, soda ash, or lime. Report any release excess of 1000 lb. Control runoff and dike for disposal. Follow applicable OSHA regulations (29 CFR 1910.120).

isposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

PA Designations

sted as a SARA Toxic Chemical (40 CFR 372.65)

sted as a SARA Extremely Hazardous Substance (40 CFR 355), TPQ: 1000 lb

sted as a RCRA Hazardous Waste (40 CFR 261.22): No. D001, Characteristic f corrosivity

ted as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable uantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311(b)(4)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Listed as a Process Safety Hazardous Chemical (29 CFR 1910.119), TQ: 500 lb

ction 8. Special Protection Data

ggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow HA re[illegible]ator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability [illegible]quate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For < 50 ppm, [illegible]plied-air respirator operated in a continuous-flow mode. For < 100 ppm, use any supplied-air respirator or SCBA with a full facepiece. For gency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not ct workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: cal certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **r:** Wear acid-proof gloves, boots, aprons, and gauntlets to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems intain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into ork area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench ers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work ng before wearing. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

ion 9. Special Precautions and Comments

ge Requirements: Prevent physical damage to containers. Store in aluminum, stainless steel, or glass containers on a cement floor in a cool, dry, entilated area away from incompatibles (Sec. 5). Dike around storage tanks with large kirbs or stills to retain the acid in event of leakage. Keep lization agents on hand and install a fire hydrant in storage area. (See NFPA Code 43A). **Engineering Controls:** To reduce potential health s, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **istrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the eyes, skin, respiratory tract and Pulmonary function tests (FEV< FVC) are helpful. Educate workers about the hazardous properties of nitric acid.

Transportation Data (49 CFR 172.101)

Shipping Name: *, †, ‡, §, ¥, ψ, ϕ
Hazard Class: 8
: UN1826 (*†), UN1796 (‡§), UN2031 (¥ψ), UN2032 (ϕ)
Packing Group: I (†§¥ϕ), II (*‡ψ)
ackaging Label: Corrosive (*‡¥ψ), Corrosive, Oxidizer (†§),
sive, Oxidizer, Poison (ϕ)
Provisions (172.102): B2, T12, T27 (*); T12, T27 (†); B2,
T27 (‡); T12, T27 (§); B12, B53, T9, T27 (¥); B2, B12, B53,
27(ψ); 2, B9, B32, B74, T38, T43, T45(ϕ)

Packaging Authorizations
a) Exceptions: None
b) Non-bulk Packaging: 173.158 (*†‡§¥ψ), 173.227 (ϕ)
c) Bulk Packaging: 173.242 (*‡ψ), 173.243 (†§¥), 173.244(ϕ)

Quantity limitations
a) Passenger Aircraft or Railcar: Forbidden
b) Cargo Aircraft Only: 30L (*‡ψ), 2.5L (†§¥), Forbidden (ϕ)

Vessel Stowage Requirements
a) Vessel stowage: D
b) Other: 40(*); 40, 66, 89 (†); 40 (‡); 40, 66, 89 (§); 110, 111 (¥); 110, 111 (ψ); 40, 66, 74, 89, 90, 95 (ϕ)

g acid mixtures spent, < 50% HNO_3
g aci[illegible]tures spent, > 50% HNO_3
[illegible]tures, < 50% HNO_3
mixtures, > 50% HNO_3
id other than red fuming, > 70% HNO_3
ψ Nitric acid other than red fuming, < 70% HNO_3
ϕ Nitric acid, red fuming.

***llection* References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 136, 139, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168, 171, 174, 175

by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** W Silverman, MD

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Material Safety Data Sheets Collection:
Sheet No. 351
Styrene *monomer*
Issued: 8/79 Revision: D, 6/92

Section 1. Material Identification

38

Styrene *monomer* ($C_6H_5CHCH_2$) **Description:** Produced by catalytic dehydrogenation of ethylbenzene at 932 to 1292 °F (500 to 700 °C) at 30 mm Hg; catalyst is a mixture of zinc oxide (86%), aluminum, calcium, and magnesium. Available in technical (99.2% pure) and polymer (99.6% pure) grades. Occurs naturally in the sap of styracaceous plants, in pyrolysis and cracking products of petroleum derivatives, in bituminous-coal and shale-oil tars, in rubber latexes, and as a product of organic substance pyrolysis. Used in the manufacture of a wide range of polymers including polystyrene and copolymer elastomers such as butadiene-styrene rubber or acrylonitrile-butadiene-styrene (ABS); in production of plastics and insulators, as a resin modifying additive, dental filling component, chemical reaction intermediate, and in agricultural products.
Other Designations: CAS No. 100-42-5, cinnamene, Diarex HF 77, ethenylbenzene, NCI-C02200, phenylethylene, styrol, styropor, vinylbenzene.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.
Cautions: Styrene is extremely flammable and polymerizes easily. The vapor is irritating to eyes, skin, and respiratory system and the liquid may cause burns. Inhalation of high concentrations can lead to central nervous system (CNS) depression.

R 2
I 3
S 2*
K 3
* Skin absorption

NFPA†

HMIS
H 2
F 3
R 2
PPG‡
‡ Sec. 8
† Rating is for *inhibited* monomer

Section 2. Ingredients and Occupational Exposure Limits

Styrene *monomer*, ca 99.6%, containing inhibitors butylcatechol or hydroquinone

1991 OSHA PELs
8-hr TWA: 50 ppm (215 mg/m³)
15-min STEL: 100 ppm (425 mg/m³)

1990 IDLH Level
5000 ppm

1990 NIOSH RELs
TWA: 50 ppm (215 mg/m³)
STEL: 100 ppm (425 mg/m³)

1991-92 ACGIH TLVs (Skin)
TWA: 50 ppm (213 mg/m³)
STEL: 100 ppm (426 mg/m³)

1990 DFG (Germany) MAKs
Ceiling: 20 ppm (85 mg/m³)
Half-life: < 2 hr
Peak Exposure Limit: 40 ppm, 30 min. average value, 4 per shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 20 μg/m³ caused eye effects.
Human, skin: 500 mg (non-standard test, *accident*) caused irritation.
Human, HeLa cell: 28 mmol/L caused unscheduled DNA synthesis.
Rat, oral, LD_{50}: 5000 mg/kg; toxic effects not yet reviewed
Rat, inhalation, LC_{50}: 24 g/m³/ 4 hr produced an antipsychotic effect.

* See NIOSH, *RTECS* (WL3675000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 293 °F (145 °C)
Freezing Point: -23 °F (-31 °C)
Vapor Pressure: 5 mm Hg at 68 °F (20 °C)
Viscosity: 0.751 mPa
Refraction Index: 1.5463 at 68 °F (20 °C)
Odor Threshold Range: 0.15 to 25 ppm
Density: 0.9045 at 25/25 °C
Surface Tension: 32.14 dyne/cm at 66.2 °F (19 °C)
Molecular Weight: 104.2
Saturated Vapor Density (air = 1.2 kg/m³): 1.22 kg/m³ or 0.076 lbs/ft³
Water Solubility: Practically insoluble, 0.3 lbs/100 lbs water; floats on water
Other Solubilities: Soluble in benzene, carbon disulfide, carbon tetrachloride, ethanol, ethyl ether and ketones. Dissolves organic substances and polymers.
Appearance and Odor: Colorless to slightly yellow oily liquid with a sweet, pleasant odor at low levels becoming pungent as levels increase.

Section 4. Fire and Explosion Data

Flash Point: 88 °F (31 °C), CC	**Autoignition Temperature:** 914 °F (490 °C)	**LEL:** 1.1% v/v	**UEL:** 7% v/v

Extinguishing Media: A Class 1C flammable liquid. For small fires, use dry chemical, carbon dioxide (CO_2), or regular foam. For large fires, use fog, or regular foam. Water may be ineffective since styrene tends to float on water; use only when other agents are unavailable.
Unusual Fire or Explosion Hazards: Styrene may accumulate static electricity. Hazardous polymerization can occur causing container to rupture due to heat of fire. Vapors may travel to ignition source and flash back. Styrene poses a vapor explosion hazard indoors, outdoors, and in sewers.
Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection. Use protective clothing specifically recommended by manufacturer. Apply cooling water to container sides until well after fire is out. If possible without risk, remove container from fire area. Stay away from ends of tanks. For massive fire in cargo area use monitor nozzles or unmanned hose holders; if this is impossible, withdraw from area and let fire burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Uninhibited styrene monomer is very unstable and even when inhibited (butylcatechol or hydroquinone) polymerization occurs slowly at room temperature and fast at elevated temperatures or in contact with certain initiators. **Chemical Incompatibilities:** Styrene vapor is explosive when exposed to heat or flame; reacts with oxygen above 104 °F (40 °C) to form a heat-sensitive explosive peroxide. Violent polymerization may be initiated by alkali metal-graphite composites, butyllithium, dibenzoyl peroxide, azoisobutyronitrile or di-*tert*-butyl peroxide. Styrene reacts violently with chlorosulfonic acid, oleum, sulfuric acid, chlorine + iron (II) chloride (above 50 °C) and can react vigorously with oxidizing materials. **Conditions to Avoid:** Exposure to heat and ignition sources, light, and contact with incompatibles.
Hazardous Decomposition Products: Thermal oxidative decomposition of styrene can produce carbon dioxide, acrid smoke and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC(164) lists styrene monomer as a carcinogen; Class 2B (possibly carcinogenic, limited human evidence in the absence of sufficient animal data). **Summary of Risks:** Styrene is irritating to the eyes, skin, and respiratory system. It is absorbed through the skin at 9 to 15 mg/m²/hr (hand and forearm). Inhalation of high concentrations can cause CNS depression but styrene's pungent, irritating odor is usually enough to prevent acute toxic exposures. If heavy exposure occurs, styrene can saturate the body in 30-40 minutes, is distributed throughout the organs and is rapidly eliminated (~85% in 24 hr) either in urine (71%) or expired air (10%). Unexcreted styrene accumulates in adipose tissue (subcutaneous connective tissue containing fat cells). Ovulation and menstrual disorders were observed in women exposed to styrene. In one case, CNS effects were observed in infants whose mother was exposed to chemicals such as styrene during pregnancy. In general, pregnant women may be at elevated risk because styrene crosses the placental barrier. **Target Organs:** CNS, eyes, respiratory system, and skin. **Primary Entry Routes:** Inhalation, skin contact/absorption. **Medical Conditions Aggravated by Long-term Exposure:** Possibly, liver, kidney, blood, skin, and CNS disorders.
Acute Effects: Inhalation of concentrations as low as 50 ppm causes irritation of the eyes, and respiratory tract.

Continue on next page

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Section 6. Health Hazard Data, *continued*

Symptoms include watering eyes and nose, chest heaviness or pain, difficulty breathing, coughing, bluish face and lips, wheezing, headache, nausea, vomiting, dizziness, fatigue, diarrhea and risk of pulmonary edema (fluid in lungs). Skin contact is irritating, with itching, inflammation and possible blisters. Splashes to the eyes cause irritation, watering, lid inflammation, chemical corneal burns, and possibly, serious lesions. Cases of ingestion have not been reported but by analogy to animal studies it could cause irritation of the lips, mouth, and throat; painful swallowing, abdominal pain, nausea, vomiting, state of shock, possible convulsions and risk of pulmonary edema. **Chronic Effects:** Repeated exposure has caused "styrene sickness" described by nausea, vomiting, appetite loss, and general weakness. Occupational asthma may occur rarely. Functional disorders of the nervous system, irritation of the upper airways, and blood changes particularly leukopenia (abnormally low number of circulating, nucleated white or colorless blood cells) and lymphocytosis (increased number of lymphocytes which are involved in the immune system) have also been observed. Medical exams revealed toxic hepatitis in workers exposed to ~50 mg/m^3 styrene for over 5 yr. Prolonged exposure to < 50 mg/m^3 caused certain liver function disorders (protein, pigment, glycogen). Peripheral neuropathies were observed in chronically exposed workers. Repeated or prolonged skin exposure may cause dermatitis with rough, dry, fissured skin due to defatting.

FIRST AID Eyes: Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Do *not* allow victim to rub or keep eyes tightly shut. Immediately consult a physician. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not induce vomiting!* Gastric lavage may be indicated if victim is at risk of convulsing but the decision should be carefully weighed since severe esophageal irritation may occur. **Note to Physicians:** For acute exposure, give baseline liver and kidney function tests and obtain urinalysis, CBC, amylase and lipase levels. Monitor arterial blood gases and perform chest X-ray if significant respiratory irritation occurs. Phenylglyoxylic and mandelic acid may be determined in urine.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should protect against inhalation and eye and skin contact. Shut off all ignition sources. Use water spray to cool and disperse vapors (this may not prevent ignition in closed spaces). For small spill, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers. For large spills, dike far ahead of liquid spill for later disposal or reclamation. For spills in water, apply activated carbon at 10 X the spilled amount (at least 10,000 ppm) or use barriers or oil spill booms to limit motion. "Universal" gelling agent injected into spill may aid in solidification. Remove material with suction hoses or mechanical dredges. Follow applicable OSHA regulations (29 CFR 1910.120). Report spills in excess of 1000 lb. **Ecotoxicity Values:** TLm, *Pimephales promelas* (fathead minnow), 53.6 mg/L/48 hr; TLm, *Artemia salina* (brine shrimp), 68 mg/L/24 hr and 52 mg/L/48 hr. **Environmental Degradation:** In water, styrene monomer volatilizes rapidly and may be subjected to biodegradation. It is not expected to hydrolyze. In air, styrene will react rapidly with hydroxyl radicals and ozone with a combined calculated half-life of 2.5 to 9 hr. In soil, styrene will biodegrade and leach to groundwater with low to moderate mobility (depending on soil conditions). **Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations Listed as a RCRA Hazardous Waste (40 CFR 261.21 & 261.23): D001 and D003, Characteristic of ignitability and reactivity
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311(b)(4)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A & Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH/MSHA-approved respirator. For < 500 ppm, use any supplied air respirator (SAR) or SCBA. For < 1250 ppm, use any SAR operated in a continuous flow mode. For < 5000 ppm, use any SAR with a full facepiece in positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol is recommended as suitable material for PPG. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Thoroughly decontaminate PPG. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Styrene is corrosive to copper or copper alloy containers. Store in cool (hazardous above 32 °C), dry, well-ventilated area away from incompatibles (Sec. 5). Store small refrigerated amounts in glass containers and large amounts in vented metal tanks in outside or detached storage under an inert blanket (i.e., nitrogen). Install electrical equipment Class 1, Group D. Inhibit styrene during storage to prevent polymerization. Uninhibited vapor may polymerize in vents and cause blockage. To prevent static sparks, electrically ground and bond all equipment used in styrene manufacture, use, storage, transfer, and shipping. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Continuously monitor workplace air levels of styrene. Make sure ducting, piping, and pipe joints are leak tight. Give preference to continuous rather than batch techniques and mechanize manual operations. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, blood, liver, kidney, and skin. Consider precluding pregnant women from styrene exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Styrene monomer, inhibited
DOT Hazard Class: Flammable liquid
ID No.: UN2055
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Styrene monomer, inhibited
IMO Hazard Class: 3.3
ID No.: UN2055
IMO Label: Flammable liquid
IMDG Packaging Group: II

MSDS Collection **References:** 73, 89, 100, 101, 103, 124, 126, 127, 131, 132, 133, 136, 139, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MPH, MD

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Material Safety Data Sheets Collection

Sheet No. 317
Toluene

Issued: 8/79 Revision: E, 9/92 Errata: 2/94

Section 1. Material Identification

Toluene ($C_6H_5CH_3$) Description: Derived from petroleum i.e., dehydrogenation of cycloparaffin fractions followed by the aromatization of saturated aromatic hydrocarbons or by fractional distillation of coal-tar light oil and purified by rectification. Used widely as a solvent (replacing benzene in many cases) for oils, resins, adhesives, natural rubber, coal tar, asphalt, pitch, acetyl celluloses, cellulose paints and varnishes; a diluent for photogravure inks, raw material for organic synthesis (benzoyl & benzilidene chlorides, saccharine, TNT, toluene diisocyanate, and many dyestuffs), in aviation and high octane automobile gasoline, as a nonclinical thermometer liquid and suspension solution for navigational instruments.

Other Designations: CAS No. 108-88-3, Methacide, methylbenzene, methylbenzol, phenylmethane, toluol, Tolu-sol.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Toluene is an eye, skin, and respiratory tract irritant becoming narcotic at high centrations. Liver and kidney damage has occurred. Pregnant women chronically exposed to toluene have shown teratogenic effects. Toluene is highly flammable.

R 1
I 3
S 2*
K 3
* Skin absorption

NFPA
3
2 0
-

HMIS
H 2- Chronic effects
F 3
R 0
PPE-Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Toluene, < 100%; may contain a small amount of benzene (~ 1%), xylene, and nonaromatic hydrocarbons.

1991 OSHA PELs
8-hr TWA: 100 ppm (375 mg/m³)
15-min STEL: 150 ppm (560 mg/m³)

1990 IDLH Level
2000 ppm

1990 NIOSH RELs
TWA: 100 ppm (375 mg/m³)
STEL: 150 ppm (560 mg/m³)

1992-93 ACGIH TLV (Skin)
TWA: 50 ppm (188 mg/m³)

1990 DFG (Germany) MAK*
TWA: 100 ppm (380 mg/m³)
Half-life: 2 hr to end of shift
Category II: Substances with systemic effects
Peak Exposure Limit: 500 ppm, 30 min average value, 2/shift

1985-86 Toxicity Data†
Man, inhalation, TC_{Lo}: 100 ppm caused hallucinations, and changes in motor activity and changes in psychophysiological tests.
Human, oral, LD_{Lo}: 50 mg/kg; toxic effects not yet reviewed
Human, eye: 300 ppm caused irritation.
Rat, oral, LD_{50}: 5000 mg/kg
Rat, liver: 30 µmol/L caused DNA damage.

* Available information suggests damage to the developing fetus is probable.
†See NIOSH, *RTECS* (XS5250000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 232 °F (110.6 °C)
Melting Point: -139 °F (-95 °C)
Molecular Weight: 92.15
Density: 0.866 at 68 °F (20/4 °C)
Surface Tension: 29 dyne/cm at 68 °F (20 °C)
Viscosity: 0.59 cP at 68 °F (20 °C)
Refraction Index: 1.4967 at 20 °C/D
Water Solubility: Very slightly soluble, 0.6 mg/L at 68 °F (20 °C)
Other Solubilities: Soluble in acetone, alcohol, ether, benzene, chloroform, glacial acetic acid, petroleum ether, and carbon disulfide.
Vapor Pressure: 22 mm Hg at 68 °F (20 °C); 36.7 mm Hg at 86 °F (30 °C)
Saturated Vapor Density (Air = 0.075 lb/ft³ or 1.2 kg/m³): 0.0797 lb/ft³ or 1.2755 kg/m³
Odor Threshold (range of all referenced values): 0.021 to 69 ppm

Appearance and Odor: Colorless liquid with a sickly sweet odor.

Section 4. Fire and Explosion Data

Flash Point: 40 °F (4.4 °C) CC	**Autoignition Temperature:** 896 °F (480 °C)	**LEL:** 1.27% v/v	**UEL:** 7.0% v/v

Extinguishing Media: Toluene is a Class 1B flammable liquid. To fight fire, use dry chemical carbon dioxide, or 'alcohol-resistant' foam. Water spray may be ineffective as toluene floats on water and may actually spread fire. **Unusual Fire or Explosion Hazards:** Concentrated vapors are heavier than air and may travel to an ignition source and flash back. Container may explode in heat of fire. Toluenes' burning rate = 5.7 mm/min and its flame speed = 37 cm/sec. Vapor poses an explosion hazard indoors, outdoors, and in sewers. May accumulate static electricity. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection. Apply cooling water to sides of tanks until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from fire and let burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire because a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Toluene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can't occur. **Chemical Incompatibilities:** Strong oxidizers, concentrated nitric acid, nitric acid + sulfuric acid, dinitrogen tetroxide, silver perchlorate, bromine trifluoride, tetranitromethane, and 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione. **Conditions to Avoid:** Contact with heat, ignition sources, or incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of toluene can produce carbon dioxide, and acrid, irritating smoke.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list toluene as a carcinogen. **Summary of Risks:** Toluene is irritating to the eyes, nose, and respiratory tract. Inhalation of high concentrations produces a narcotic effect sometimes leading to coma as well as liver and kidney damage. 93% of inhaled toluene is retained in the body of which 80% is metabolized to benzoic acid, then to hippuric acid and excreted in urine. The remainder is metabolized to *o*-cresol and excreted or exhaled unchanged. Toluene metabolism is inhibited by alcohol ingestion and is synergistic with benzene, asphalt fumes, or chlorinated hydrocarbons (i.e. perchloroethylene). Toluene is readily absorbed through the skin at 14 to 23 mg/cm²/hr. Toluene is absorbed quicker during exercise than at rest and appears to be retained longer in obese versus thin victims; presumably due to lipid solubility. There is inconsistent data on toluene's ability to damage bone marrow; chronic poisoning has resulted in anemia and leucopenia with biopsy showing bone marrow hypo-plasia. These reports are few and some authorities argue that the effects may have been due to benzene contaminants. Chronic inhalation during pregnancy has been associated with teratogenic effects on the fetus including microcephaly, CNS dysfunction, attentional deficits, developmental delay + language impairment, growth retardation, and physical defects including a small midface, short palpebral fissures, with deep-set eyes, low-set ears, flat nasal bridge with a small nose, micrognathia, and blunt fingertips. There is some evidence that toluene causes an autoimmune illness in which the body produces antibodies that cause inflammation of its own kidney.

Continue on next page

ection 6. Health Hazard Data

edical Conditions Aggravated by Long-Term Exposure: Alcoholism and CNS, kidney, skin, or liver disease. Target Organs: CNS, liver, ney, skin. **Primary Entry Routes:** Inhalation, skin contact/absorption. **Acute Effects:** Vapor inhalation causes respiratory tract irritation, fatigue, akness, confusion, dizziness, headache, dilated pupils, watering eyes, nervousness, insomnia, parasthesis, and vertigo progressing to narcotic coma. ath may result from cardiac arrest due to ventricular fibrillation with catecholamines loss. Liquid splashed in the eye causes conjunctival irritation, nsient corneal damage and possible burns. Prolonged skin contact leads to drying and fissured dermatitis. Ingestion causes GI tract irritation and ms associated with inhalation. **Chronic Effects:** Symptoms include mucous membrane irritation, headache, vertigo, nausea, appetite loss and intolerance. Repeated heavy exposure may result in encephalopathies (cerebellar ataxia and cognitive dysfunction), liver enlargement, and ey dystrophy (wasting away). Symptoms usually appear at workdays end, worsen at weeks end and decrease or disappear over the weekend.

IRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding nounts of water until transported to an emergency medical facility. Consult an ophthalmologist immediately. **Skin:** *Quickly* remove contaminated othing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to esh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control nter and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of nger of aspiration into the lungs. Gastric lavage may be indicated if large amounts are swallowed; potential toxicity needs to be weighed against piration risk when deciding for or against gastric lavage. **Note to Physicians:** Monitor cardiac function. If indicated, use epinephrine and other techolamines carefully, because of the possibility of a lowered myocardial threshold to the arrhythmogenic effects of such substances. Obtain CBC, ectrolytes, and urinalysis. Monitor arterial blood gases. If toluene has > 0.02% (200 ppm) benzene, evaluate for potential benzene toxicity. BEI: ppuric acid in urine, sample at shift end (2.5 g/g creatinine); Toluene in venous blood, sample at shift end (1.0 mg/L).

ection 7. Spill, Leak, and Disposal Procedures

pill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel protect against inhalation and skin/eye ntact. Use water spray to cool and disperse vapors but it may not prevent ignition in closed spaces. Cellosolve, hycar absorbent materials, and uorocarbon water can also be used for vapor suppression/containment. Take up small spill with earth, sand, vermiculite, or other absorbent, ncombustible material. Dike far ahead of large spills for later reclamation or disposal. For water spills, (10 ppm or greater) apply activated carbon at X the spilled amount and remove trapped material with suction hoses or use mechanical dredges/lifts to remove immobilized masses of pollutants d precipitates. Toluene can undergo fluidized bed incineration at 842 to 1796 °F (450 to 980 °C), rotary kiln incineration at 1508 to 2912 °F (820 to 00 °C), or liquid injection incineration at 1202 to 2912 °F (650 to 1600 °C). Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity** alues: Blue gill, LC_{50} = 17 mg/L/24 hr; shrimp (*Crangonfracis coron*), LC_{50} = 4.3 ppm/96 hr; fathead minnow (*Pimephales promelas*), LC_{50} = 36.2 g/L/96 hr. **Environmental Degradation:** If released to land, toluene evaporates and undergoes microbial degradation. In water, toluene volatilizes d biodegrades with a half-life of days to several weeks. In air, toluene degrades by reaction with photochemically produced hydroxyl radicals. **isposal:** Treat contaminated water by gravity separation of solids, followed by skimming of surface. Pass through dual media filtration and carbon sorption units (carbon ratio 1 kg to 10 kg soluble material). Return waste water from backwash to gravity separator. Contact your supplier or a ensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

A Designations

sted as a RCRA Hazardous Waste (40 CFR 261.33): No. U220
RA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
sted as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg)
CRA, Sec. 3001; CWA, Sec. 311 (b)(4); CWA, Sec. 307 (a)]
a SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

ction 8. Special Protection Data

oggles: Wear protective eyeglasses with shatter-resistant glass and side-shields or chemical safety goggles, per OSHA eye- and face-protection gulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional vice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-proved respirator. For < 1000 ppm, use any chemical cartridge respirator with appropriate organic vapor cartridges, any supplied-air respirator AR), or SCBA. For < 2000 ppm, use any SAR operated in continuous-flow mode, any SAR or SCBA with a full facepiece, or any air-purifying spirator with a full facepiece having a chin-style, front or back mounted organic vapor canister. For emergency or nonroutine operations (cleaning ills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, iodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective ves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol with a breakthrough time of > 8 hr, Teflon and Viton are recommended as suitable materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its rce.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **ntaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove toluene from your shoes and an PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, nking, smoking, using the toilet, or applying cosmetics.

ction 9. Special Precautions and Comments

rage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from ignition sources and incomibles. Outside or detached storage is preferred. If stored inside, use a standard flammable liquids warehouse, room, or cabinet. To prevent static rks, electrically ground and bond all equipment used with toluene. Do not use open lights in toluene areas. Install Class 1, Group D electrical ipment. Check that toluene is free of or contains < 1% benzene before use. **Engineering Controls:** To reduce potential health hazards, use ficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administive Controls:** Adopt controls for confined spaces (29 CFR 1910.146) if entering areas of unknown toluene levels (holes, wells, storage tanks). nsider preplacement and periodic medical exams of exposed workers that emphasize the CNS, liver, kidney, and skin. Include hemocytometric thrombocyte count in cases where benzene is a contaminant of toluene. Monitor air at regular intervals to ensure effective ventilation.

Transportation Data (49 CFR 172.101)

	Packaging Authorizations	Quantity Limitations	Vessel Stowage Requirements
ping Name: Tolnene	a) Exceptions: 150	a) Passenger Aircraft or Railcar: 5L	Vessel Stowage: B
azard Class: 3	b) Non-bulk Packaging: 202	b) Cargo Aircraft Only: 60L	Other: –
No.: UN1294	c) Bulk Packaging: 242		
T Packing Group: II			
T Label: Flammable Liquid			
cial Provisions (172.102): T1			

DS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 140, 148, 153, 159, 163, 164, 167, 169, 171, 174, 175, 176, 180.
pared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, CIH, MPH; **Medical Review:** AC Darlington, MD, MPH

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Material Safety Data Sheets Collection:

Sheet No. 318
Xylene *(Mixed Isomers)*

Issued: 11/80 Revision: E, 9/92 Errata: 12/94

Section 1. Material Identification

Xylene (Mixed Isomers) (C_8H_{10}) Description: The commercial product is a blend of the three isomers [*ortho*-(*o*-), *meta*-(*m*-), *para*-(*p*-)] with the largest proportion being *m*- xylene. Xylene is obtained from coal tar, toluene by transalkylation, and pseudocumene. Used in the manufacture of dyes, resins, paints, varnishes, and other organics; as a general solvent for adhesives, a cleaning agent in microscope technique; as a solvent for Canada balsam microscopy; as a fuel component; in aviation gasoline, protective coatings, sterilizing catgut, hydrogen peroxide, perfumes, insect repellants, pharmaceuticals, and the leather industry; in the production of phthalic anhydride, isophthalic, and terephthalic acids and their dimethyl esters which are used in the manufacture of polyester fibers; and as an indirect food additive as a component of adhesives. Around the home, xylene is found as vehicles in paints, paint removers, degreasing cleaners, lacquers, glues and cements and as solvent/vehicles for pesticides.

Other Designations: CAS No. 1330-20-7 [95-47-6; 108-38-3; 106-42-3 (*o*-, *m*-, *p*-isomers)], dimethylbenzene, methyltoluene, NCI-C55232, Violet 3, xylol.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Xylene is an eye, skin, and mucous membrane irritant and may be narcotic in high concentrations. It is a dangerous fire hazard.

R 1
I 2
S 2
K 3

NFPA
3
2 0
–

HMIS
H 2†
F 3
R 0
PPE ‡
† Chronic Effects
‡ Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Xylene (mixed isomers): the commercial product generally contains ~ 40% *m*-xylene; 20% each of *o*-xylene, *p*-xylene, and ethylbenzene; and small quantities of toluene. Unpurified xylene may contain pseudocumene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m^3)
15-min STEL: 150 ppm (655 mg/m^3)

1990 IDLH Level
1000 ppm

1990 NIOSH RELs
TWA: 100 ppm (435 mg/m^3)
STEL: 150 ppm (655 mg/m^3)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m^3)
STEL: 150 ppm (651 mg/m^3)
BEI (Biological Exposure Index): Methylhippuric acids in urine at end of shift: 1.5 g/g creatinine

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m^3)
Category II: Substances with systemic effects
Half-life: < 2 hr
Peak Exposure: 200 ppm, 30 min, average value, 4 peaks per shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 200 ppm produced olfaction effects, conjunctiva irritation, and other changes involving the lungs, thorax, or respiration.
Man, inhalation, LC_{Lo}: 10000 ppm/6 hr; toxic effects not yet reviewed.
Human, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted.
Rat, oral, LD_{50}: 4300 mg/kg; toxic effect not yet reviewed.
Rat, inhalation, LC_{50}: 5000 ppm/4 hr; toxic effects not yet reviewed.

* See NIOSH, *RTECS* (XE2100000), for additional toxicity data.

Section 3. Physical Data

oiling Point Range: 279 to 284 °F (137 to 140 °C)*
Boiling Point: *ortho:* 291 °F (144 °C); *meta:* 281.8 °F (138.8 °C); *para:* 281.3 °F (138.5 °C)
Freezing Point/Melting Point: *ortho:* -13 °F (-25 °C); *meta:* -53.3 °F (- 47.4 °C); *para:* 55 to 57 °F (13 to 14 °C)
Vapor Pressure: 6.72 mm Hg at 70 °F (21 °C)
Saturated Vapor Density (Air = 1.2 kg/m^3): 1.23 kg/m^3, 0.077 lbs/ft^3

Appearance and Odor: Clear, sweet-smelling liquid.

Molecular Weight: 106.16
Specific Gravity: 0.864 at 20 °C/4 °C
Water Solubility: Practically insoluble
Other Solubilities: Miscible with absolute alcohol, ether, and many other organic liquids.
Octanol/Water Partition Coefficient: logKow = 3.12-3.20
Odor Threshold: 1 ppm
Viscosity: <32.6 SUS

* Materials with wider and narrower boiling ranges are commercially available.

Section 4. Fire and Explosion Data

Flash Point: 63 to 77 °F (17 to 25 °C) CC	**Autoignition Temperature:** 982 °F (527 °C) (*m*-)	**LEL:** 1.1 (*m*-, *p*-); 0.9 (*o*-)	**UEL:** 7.0 (*m*-, *p*-); 6.7 (*o*-)

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2), water spray or regular foam. For large fires, use water spray, fog or regular foam. Water may be ineffective. Use water spray to cool fire-exposed containers. **Unusual Fire or Explosion Hazards:** Xylene vapors or liquid (which floats on water) may travel to an ignition source and flash back. The heat of fire may cause containers to explode and/or produce irritating or poisonous decomposition products. Xylene may present a vapor explosion hazard indoors, outdoors, or in sewers. Accumulated static electricity may occur from vapor or liquid flow sufficient to cause ignition. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing will provide limited protection. If feasible and without risk, move containers from fire area. Otherwise, cool fire-exposed containers until well after fire is extinguished. Stay clear of tank ends. Use unmanned hose holder or monitor nozzles for massive cargo fires. If impossible, withdraw from area and let fire burn. Withdraw immediately in case of any tank discoloration or rising sound from venting safety device. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Xylene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Xylene is easily chlorinated, sulfonated, or nitrated. **Chemical Incompatibilities:** Incompatibilities include strong acids and oxidizers and 1,3-dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin). Xylene attacks some forms of plastics, rubber, and coatings. **Conditions to Avoid:** Avoid heat and ignition sources and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of xylene can produce carbon dioxide, carbon monoxide, and various hydrocarbon products.

Section 6. Health Hazard Data

rcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list xylene as a carcinogen. **Summary of Risks:** Xylene is an eye, mucous embrane, and respiratory tract irritant. Irritation starts at 200 ppm; severe breathing difficulties which may be delayed in onset can occur at high concentrations. It is a central nervous system (CNS) depressant and at high concentrations can cause coma. Kidney and liver damage can occur with xylene exposure. With prolonged or repeated cutaneous exposure, xylene produces a defatting dermatitis. Chronic toxicity is not well defined, but it is less toxic than benzene. Prior to the 1950s, benzene was often found as a contaminant of xylene and the effects attributed to xylene such as blood dyscrasias are questionable. Since the late 1950s, xylenes have been virtually benzene-free and blood dyscrasias have not been associated with xylenes. Chronic exposure to high concentrations of xylene in animal studies have demonstrated mild reversible decrease in red and white cell counts as well as increases in platelet counts.

Continue on next page

Section 6. Health Hazard Data, *continued*

Menstrual irregularity was reported in association with workplace exposure to xylene perhaps due to effects on liver metabolism. Xylene crosses the human placenta, but does not appear to be teratogenic under conditions tested to date. **Medical Conditions Aggravated by Long-Term Exposure:** CNS, respiratory, eye, skin, gastrointestinal (GI), liver and kidney disorders. **Target Organs:** CNS, eyes, GI tract, liver, kidneys, and skin. **Primary Entry Routes:** Inhalation, skin absorption (slight), eye contact, ingestion. **Acute Effects:** Inhalation of high xylene concentrations may cause dizziness; nausea, vomiting, and abdominal pain; eye, nose, and throat irritation; respiratory tract irritation leading to pulmonary edema (fluid in lung); drowsiness; and unconsciousness. Direct eye contact can result in conjunctivitis and corneal burns. Ingestion may cause a burning sensa- on in the oropharynx and stomach and transient CNS depression. **Chronic Effects:** Repeated or prolonged skin contact may cause drying and fatting of the skin leading to dermatitis. Repeated eye exposure to high vapor concentrations may cause reversible eye damage, peripheral and central neuropathy, and liver damage. Other symptoms of chronic exposure include headache, fatigue, irritability, chronic bronchitis, and GI disturbances such as nausea, loss of appetite, and gas.

FIRST AID *Emergency personnel should protect against exposure.* **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. Carefully dispose of contaminated clothing as it may pose a fire hazard. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. Monitor exposed person for respiratory distress. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, *do not induce vomiting!* If spontaneous vomiting should occur, keep exposed person's head below the hips to prevent aspiration (breathing liquid xylene into the lungs). *Aspiration of a few millimeters of xylene can cause chemical pneumonitis, pulmonary edema, and hemorrhage.* **Note to Physicians:** Hippuric acid or the ether glucuronide of *ortho*-toluic acid may be useful in diagnosis of *meta-*, *para-* and *ortho*-xylene exposure, respectively. Consider gastric lavage if a large quantity of xylene was ingested. Proceed gastric lavage with protection of the airway from aspiration; consider endotracheal intubation with inflated cuff.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and ventilate spill area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If feasible and without undue risk, stop leak. Use appropriate foam to blanket release and suppress vapors. Water spray may reduce vapor, but does not prevent ignition in closed spaces. For small spills, absorb on paper and evaporate in appropriate exhaust hood or absorb with sand or some non-combustible absorbent and place in containers for later disposal. For large spills dike far ahead of liquid to contain. Do not allow xylene to enter a confined space such as sewers or drains. On land, dike to contain or divert to impermeable holding area. Apply water spray to control flammable vapor and remove material with pumps or vacuum equipment. On water, contain material with natural barriers, booms, or weirs; apply universal gelling agent; and use suction hoses to remove spilled material. Report any release in excess of 1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** Little bioconcentration is expected. Biological oxygen demand 5 (after 5 days at 20 °C): 0.64 (no stated isomer). **Ecotoxicity values:** LD_{50}, Goldfish, 13 mg/L/24 hr, conditions of bioassay not specified, no specific isomer. **Environmental Degradation:** In the atmosphere, xylenes degrade by reacting with photochemically produced hydroxyl radicals with a half-life ranging from 1-1.7 hr. in the summer to 10-18 hr in winter or a typical loss of 67-86% per day. Xylenes are resistant to hydrolysis. **Soil Absorption/Mobility:** Xylenes have low to moderate adsorption to soil and when spilled on land, will volatilize and leach into groundwater. **Disposal:** As a hydrocarbon, xylene is a good candidate for controlled incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

SARA Extremely Hazardous Substance (40 CFR 355): Not listed
as a SARA Toxic Chemical (40 CFR 372.65)
as a RCRA Hazardous Waste (40 CFR 261.33): No. U239, F003 (spent solvent)
ted as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per Clean Water Act, Sec. 311(b)(4); per RCRA, Sec. 3001]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations >1000 ppm, use any chemical cartridge respirator with organic vapor cartridges; any powered, air-purifying respirator with organic vapor cartridges; any supplied-air respirator; or any self-contained breathing apparatus. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. With breakthrough times > 8 hr, consider polyvinyl alcohol and fluorocarbon rubber (Viton) as materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in clearly labelled, tightly closed, containers in a cool, well-ventilated place, away from strong oxidizing materials and heat and ignition sources. During transferring operations, electrically ground and bond metal containers. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Use hermetically sealed equipment, transfer xylene in enclosed systems, avoid processes associated with open evaporating surfaces, and provide sources of gas release with enclosures and local exhaust ventilation. Use Class I, Group D electrical equipment. **Administrative Controls:** Establish air and biological monitoring programs and evaluate regularly. Consider preplacement and periodic medical examinations including a complete blood count, a routine urinalysis, and liver function tests. Consider hematologic studies if there is any significant contamination of the solvent with benzene. If feasible, consider the replacement of xylene by less toxic solvents such as petrol (motor fuel) or white spirit. Before carrying out maintenance and repair work, steam and flush all equipment to remove any xylene residues.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Xylenes
DOT zard Class: 3
UN1307
Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Nonbulk Packaging : 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: –

***MSDS Collection* References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 171, 174, 176, 180.
Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** W Silverman, MD

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Material Safety Data Sheets Collection:

Sheet No. 683
Polychlorinated Biphenyls (PCBs)

Issued: 11/88 Revision: A, 9/92

Section 1. Material Identification

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Polychlorinated Biphenyls [$C_{12}H_{10-n}Cl_n$ (n=3, 4, 5)] Description: A class of nonpolar chlorinated hydrocarbons with a biphenyl nucleus (two benzene nuclei connected by a single C-C bond) in which any or all of the hydrogen atoms have been replaced by chlorine. Commercial PCBs are mixtures of chlorinated biphenyl isomers with varying degrees of chlorination. Prepared industrially by the chlorination of biphenyl with anhydrous chlorine in the presence of a catalyst such as ferric chloride or iron filings. Except for limited research and development applications, PCBs have not been produced in the US since 1977. When large quantities of PCBs were manufactured in the US, they were marketed under the tradename Aroclor (Monsanto) and were characterized by four digit numbers. The first two digits indicating biphenyls (12), triphenyls (54), or both (25, 44); the last two digits indicating the weight percent of chlorine. PCBs' thermal stability, nonflammability, and high dielectric capability made them very useful in electrical equipment. Formerly used as additives in hydraulic fluids, heat transfer systems, lubricants, cutting oils, printer's ink, fire retardants, asphalt, brake linings, automobile body sealants, plasticizers, adhesives, synthetic rubber, floor tile, wax extenders, dedusting agents, pesticide extenders, and carbonless reproducing paper. PCBs are still used in certain existing electrical capacitors and transformers that require enhanced electrical protection to avoid heating from sustained electric faults.

Other Designations: CAS No. 1336-36-3, Aroclor, Clophen, Chlorextol, chlorinated biphenyls, chlorinated diphenyl, chlorinated diphenylene, chloro biphenyl, chloro-1,1-biphenyl, Dykanol, Fenclor, Inerteen, Kaneclor, Montar, Noflamol, Phenoclor, Pyralene, Pyranol, Santotherm, Sovol, Therminol FR-1

R 1
I 4
S 3*
K 1
* Skin absorption

NFPA
1
2 0
-

HMIS
H 2‡
F 1
R 0
PPE†
† Sec. 8
‡ Chronic Effects

Cautions: PCBs are potent liver toxins that may be absorbed through skin. Potentially, chronic or delayed toxicity is significant because PCBs accumulate in fatty tissue and may reasonably be anticipated to be carcinogens. PCBs are a bioaccumulative environmental hazard. When burned, decomposition products may be more hazardous than the PCBs.

Section 2. Ingredients and Occupational Exposure Limits

PCBs, contain various levels of polychlorinated dibenzofurans and chlorinated naphthalenes as contaminants

1991 OSHA PELs, Skin
8-hr TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
8-hr TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

1990 DFG (Germany) MAK, Danger of Cutaneous Absorption
TWA (Chlorodiphenyl, 42% chlorine): 0.1 ppm (1 mg/m^3)
Category III: Substances with systemic effects, onset of effect > 2 hr., half-life > shift length (strongly cumulative)
Short-term Level: 1 ppm, 30 min., average value, 1 per shift
TWA (Chlorodiphenyl, 54% chlorine): 0.05 ppm (0.5 mg/m^3)
Category III: (see above)
Short-term Level: 0.5 ppm, 30 min., average value, 1 per shift

1985-86 Toxicity Data*
Rat, oral, TD: 1250 mg/kg administered intermittently for 25 weeks produced liver tumors.
Mammal, oral, TD$_{Lo}$: 325 mg/kg administered to female for 30 days prior to mating and from the 1st to the 36th day of gestation produced effects on newborn (stillbirth; live birth index; viability index).

1990 NIOSH REL
TWA (Chlorodiphenyl, 42% chlorine): 0.001 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.001 mg/m^3

1992-93 ACGIH TLVs, Skin *
TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

* These guidelines offer reasonably good protection against systemic intoxication, but may not guarantee that chloroacne won't occur.
† See NIOSH, *RTECS* (TQ1350000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: 644-707 °F (340-375 °C)
Melting Point: 42%: -2.2 °F (-19°C); 54%: 14 °F (-10 °C)
Vapor Pressure: 1 mm Hg at 100 °F (38 °C); 10^{-6} to 10^{-3} mm at 20 °C
Molecular Weight: 188.7 to 398.5
Specific Gravity: 1.3 to 1.8 at 20 °C
Water Solubility: Low solubility (0.007 to 5.9 mg/L)
Other Solubilities: Most common organic solvents, oils, and fats; slightly soluble in glycerol and glycols.

Appearance and Odor: PCBs vary from mobile oily liquids to white crystalline solids and hard non-crystalline resins, depending upon chlorine content.

* Physical and chemical properties vary widely according to degree and to the position of chlorination.

Section 4. Fire and Explosion Data

Flash Point: 286-385 °F (141-196 °C) OC*	**Autoignition Temperature:** 464 °F (240 °C)	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use extinguishing media suitable to the surrounding fire. Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water spray may be ineffective. Use water spray to cool fire-exposed containers or transformers. Do not scatter PCBs with high-pressure water streams. **Unusual Fire or Explosion Hazards:** Combustion products (hydrogen chloride, phosgene, polychlorinated dibenzofurans, and furans) are more hazardous than the PCBs themselves. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Approach fire from upwind to avoid highly toxic decomposition products. Structural firefighter's protective clothing will provide *limited* protection. Do not release runoff from fire control methods to sewers or waterways. Dike for later disposal.

* Flash points shown are a range for various PCBs. Some forms do not have flash points.

Section 5. Reactivity Data

Stability/Polymerization: PCBs are very stable materials but are subject to photodechlorination when exposed to sunlight or UV (spectral region above 290 nanometers). Hazardous polymerization cannot occur. **Chemical Incompatibilities:** PCBs are chemically inert and resistant to oxidation, acids, and bases. **Conditions to Avoid:** Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition [1112-1202 °F (600-650 °C)] of PCBs can produce highly toxic derivatives, including polychlorinated dibenzo-para-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), hydrogen chloride, phosgene and other irritants.

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Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) and NTP(169) list PCBs as an IARC probable carcinogen (overall evaluation is 2A; limited human data; sufficient animal data) and NTP anticipated carcinogen, respectively. **Summary of Risks:** PCBs are potent liver toxins that can be absorbed through broken skin in toxic amounts without immediate pain or irritation. PCBs have low acute toxicity, but can accumulate in fatty tissue and severe lth effects may develop later. Generally, toxicity increases with a higher chlorine content; PCB-oxides are more toxic. The toxic action on the er also increases with simultaneous exposure to other liver toxins, e.g. chlorinated solvents, alcohol, and certain drugs. Pathological pregnancies (abnormal pigmentations, abortions, stillbirths, and underweight births) have been associated with increased PCB serum levels in mothers; PCBs can be passed in breast milk. PCBs can affect the reproductive system of adults. **Medical Conditions Aggravated by Long-Term Exposure:** Skin, liver, and respiratory disease. **Target Organs:** Skin, liver, eyes, mucous membranes, and respiratory tract. **Primary Entry Routes:** Inhalation, dermal contact, ingestion. **Acute Effects:** Exposure to PCB vapor or mist is severely irritating to the skin, eyes, nose, throat, and upper respiratory tract. Intense acute exposure to high concentrations may result in eye, lung, and liver injury. Systemic effects include nausea, vomiting, increased blood pressure, fatigue, weight loss, jaundice, edema and abdominal pain. Cognitive, neurobehavior and psychomotor impairment and memory loss have also been seen after acute exposure. **Chronic Effects:** Repeated exposure to PCBs can cause chloroacne; redness, swelling, dryness, thickening and darkening of the skin and nails; swelling and burning of the eyes, and excessive eye discharge; distinctive hair follicles; gastrointestinal disturbances; neurological symptoms including headache, dizziness, depression, nervousness, numbness of the extremities, and joint and muscle pain; liver enlargement; menstrual changes in women; and chronic bronchitis. Cancer, primarily liver, is also a possible result of exposure, but data is inconclusive.

FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Rinsing eyes with medical oil (olive, mineral) initially may remove PCB and halt irritation better than water rinsing alone. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. *Multiple soap and water washings are necessary.* Avoid the use of organic solvents to clean the skin. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** In most cases, accidental PCB ingestion will not be recognized until long after vomiting would be of any value. Never give anything by mouth to an unconscious or convulsing person. Vomiting of the pure substance may cause aspiration. Consult a physician. **Note to Physicians:** Monitor patients for increased hepatic enzymes, chloroacne, and eye, gastrointestinal, and neurologic symptoms listed above. Diagnostic tests include blood levels of PCBs and altered liver enzymes.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, provide adequate ventilation, and isolate hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. For small spills, take up with sand or other noncombustible material and place into containers for later disposal. For larger spills, dike far ahead of spill to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** PCBs have been shown to bio-concentrate significantly in aquatic organisms. **Ecotoxicity:** Bluegill, TLm: 0.278 ppm/96 hr. Mallard Duck, LD_{50}: 2000 ppm. **Environmental Degradation:** In general, the persistence of PCBs increases with an increase degree of chlorination. **Soil Absorption/Mobility:** PCBs are tightly absorbed in soil and generally do not leach significantly in most aqueous soil systems. However, in the presence of organic solvents, PCBs may leach rapidly through the soil. Volatilization of PCBs from soil may be slow, but over time may be significant. **Disposal:** Approved PCB disposal methods include: incineration with scrubbing, high-efficiency boilers, landfills, and EPA-approved alternative disposal methods. Each disposal method has various criteria. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Designations
A Hazardous Waste (40 CFR 261.33): Not listed
ARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1 lb (0.454 kg) [* per CWA, Sec. 311(b)(4) and 307(a)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Minimum respiratory protection should include a combination dust-fume-mist and organic vapor cartridge or canister or air-supplied, depending upon the situation. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. Butyl rubber, neoprene, Teflon, and fluorocarbon rubber have break through times greater than 8 hrs. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Segregate contaminated clothing in such a manner so that there is no direct contact by laundry personnel. Implement quality assurance to ascertain the completeness of the cleaning procedures. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a closed, labelled, container in a ventilated area with appropriate air pollution control equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Inform employees of the adverse health effects associated with PCBs. Limit access to PCB work areas to authorized personnel. Consider preplacement and periodic medical examinations with emphasis on the skin, liver, lung, and reproductive system. Monitor PCB blood levels. Consider possible effects on the fetus. Keep medical records for the entire length of employment and for the following 30 yrs.

Transportation Data (49 CFR 172.101)

DO Shipping Name: Polychlorinated biphenyls
lazard Class: 9
.: UN2315
OT Packing Group: II
DOT Label: CLASS 9
Special Provisions (172.102): 9, N81

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 100 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 34

***MSDS Collection* References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 163, 164, 168, 169, 174, 175, 180

Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** PA Roy MPH, CIH; **Medical Review:** AC Darlington, MD

MATERIAL SAFETY DATA SHEET

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Ref. No.: 2001
Date: 10/6/2000

Phone: 01 (978) 392-0689
Phone: 01 (508) 885-1113
Emergency Phone-24 Hours: 1-800-225-3909

Fax: 01 (978) 692-3487 / 01 (508) 885-1114
Web Site: http://www.BioSolve.com
E-Mail: info@BioSolve.com

SECTION I - IDENTITY

Name:	**BioSolve®**
CAS #:	138757-63-8
Formula:	Proprietary
Chemical Family:	Water Based, Biodegradable, Wetting Agents & Surfactants
HMIS Code:	Health 1, Fire 0, Reactivity 0
HMIS Key:	4 = Extreme, 3 = High, 2 = Moderate, 1 = Slight, 0 = Insignificant

SECTION II - HAZARDOUS INGREDIENTS

Massachusetts Right to Know Law or 29 C.F.R. (Code of Federal Regulations) 1910.1000 require listing of hazardous ingredients.

This product does not contain any hazardous ingredients as defined by CERCLA, Massachusetts Right to Know Law and California's Prop. 65.

SECTION III - PHYSICAL - CHEMICAL CHARACTERISTICS

Boiling Point : 265°F Specific Gravity : 1.006 +/-.01

Melting Point	: 32°F	Vapor Pressure mm/Hg	: NA
Surface Tension- 6% Solution	: 29.1 Dyne/cm at 25°C	Vapor Density Air = 1	: NA
Reactivity with Water	: No	Viscosity - Concentrate	: 490 Centipoise
Evaporation Rate	: >1 as compared to Water	Viscosity - 6% Solution	: 15 Centipoise
Appearance	: Clear Liquid unless Dyed	Solubility in Water	: Complete
Odor	: Pleasant Fragrance	pH	: 8.81+/-.5
Pounds per Gallon	: 8.37		

SECTION IV - FIRE AND EXPLOSION DATA

Special Fire Fighting Procedures : NA
Unusual Fire and Explosion Hazards : None
Solvent for Clean-Up : Water

Percent Volatile by Volume : NA
Flammable Limit : NA
Auto Ignite Temperature : NA

lash Point	: NA	Fire Extinguisher Media	: NA

SECTION V - SPECIAL PRECAUTIONS AND SPILL/LEAK PROCEDURES

Precautions to be taken in Handling and Storage: Use good normal hygiene.

Precautions to be taken in case of Spill or Leak -

Small spills, in an undiluted form, contain. Soak up with absorbent materials.

Large spills, in an undiluted form, dike and contain. Remove with vacuum truck or pump to storage/salvage vessel. Soak up residue with absorbent materials.

Waste Disposal Procedures -

Dispose in an approved disposal area or in a manner which complies with all local, state, and federal regulations.

SECTION VI - HEALTH HAZARDS

Threshold Limit Values: NA

Signs and Symptoms of Over Exposure-

Acute : Moderate eye irritation. Skin: Causes redness, edema, drying of skin.

Chronic: Pre-existing skin and eye disorders may be aggravated by contact with this product.

Medical Conditions Generally Aggravated by Exposure: Unknown

Carcinogen: No

Emergency First Aid Procedures -

Eyes: Flush thoroughly with water for 15 minutes. Get medical attention.

Skin: Remove contaminated clothing. Wash exposed areas with soap and water. Wash clothing before reuse. Get medical attention if irritation develops.

Ingestion: Get medical attention.

Inhalation: None considered necessary.

SECTION VII - SPECIAL PROTECTION INFORMATION

Respiratory Protection	: Not necessary	Local Exhaust Required	: No
Ventilation Required	: Normal	Protective Clothing	: Gloves, safety glasses Wash clothing before reuse.

SECTION VIII - PHYSICAL HAZARDS

Stability	: Stable	Incompatible Substances	: None Known
Polymerization	: No	Hazardous Decomposition Products	: NA

SECTION IX - TRANSPORT & STORAGE

DOT Class	: Not Regulated/Non Hazardous		
Freeze Temperature	: 28°F	Storage	: 35°F-120°F
Freeze Harm	: None	Shelf Life	: Unlimited Unopened

SECTION X - REGULATORY INFORMATION

The Information on this Material Safety Data Sheet reflects the latest information and data that we have on hazards, properties, and handling of this product under the recommended conditions of use. Any use of this product or method of application, which is not described on the Product label or in this Material Safety Data Sheet, is the sole responsibility of the user. This Material Safety Data Sheet was prepared to comply with the OSHA Hazardous Communication Regulation and Massachusetts Right to Know Law.

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MATERIAL SAFETY DATA SHEET: SIMPLE GREEN®

I. PRODUCT & COMPANY INFORMATION

PRODUCT NAME: **SIMPLE GREEN® CLEANER / DEGREASER / DEODORIZER**

Page 1 of 4

COMPANY NAME: **SUNSHINE MAKERS, INC.**
15922 Pacific Coast Highway
Huntington Harbour, CA 92649 USA
Telephone: 800-228-0709 • 562-795-6000
Fax: 562-592-3034
Website: www.simplegreen.com

Version No. 1007
Issue Date: January, 2002

For 24-hour emergency, call Chem-Tel, Inc.: 800-255-3924

USE OF PRODUCT: An all purpose cleaner and degreaser used undiluted or diluted in water for direct, spray, and dip tank procedures.

II. INGREDIENT INFORMATION

The only ingredient of Simple Green® with established exposure limits is undiluted 2-butoxyethanol (<6%) (Butyl Cellosolve; CAS No. 111-76-2): the OSHA PEL and ACGIH TLV is 25 ppm (skin). Note, however, that Butyl Cellosolve is only one of the raw material ingredients that undergo processing and dilution during the manufacture of Simple Green®. Upon completion of the manufacturing process, Simple Green® does not possess the occupational health risks associated with exposure to undiluted Butyl Cellosolve. Verification of this is contained in the independent test results detailed under "Toxicological Information" on Page 3 of this MSDS.

The Butyl Cellosolve in Simple Green® is part of a chemical category (glycol ethers) regulated by the Emergency Planning and Community Right-to-Know Act (SARA, Title III, section 313); therefore, a reporting requirement exists. Based upon chemical analysis, Simple Green® contains no known EPA priority pollutants, heavy metals, or chemicals listed under RCRA, CERCLA, or CWA. Analysis by TCLP (Toxicity Characteristic Leaching Procedure) according to RCRA revealed no toxic organic or inorganic constituents.

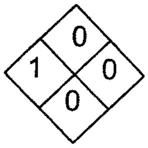
All components of Simple Green® are listed on the TSCA Chemical Substance Inventory.

III. HAZARDS IDENTIFICATION

UN Number:	Not required
Dangerous Goods Class:	Nonhazardous

Hazard Rating (NFPA/HMIS)

Health = 1* Reactivity = 0
Fire = 0 Special = 0



Rating Scale

0 = minimal 1 = slight
2 = moderate 3 = serious
4 = severe

*Mild eye irritant, non-mutagenic and non-carcinogenic. **None of the ingredients in Simple Green® are regulated or listed as potential cancer agents by Federal OSHA, NTP, or IARC.**

IV. FIRST AID MEASURES

SYMPTOMS OF OVEREXPOSURE AND FIRST AID TREATMENT

Eye contact:	Reddening may develop. Immediately rinse the eye with large quantities of cool water; continue 10-15 minutes or until the material has been removed; be sure to remove contact lenses, if present, and to lift upper and lower lids during rinsing. Get medical attention if irritation persists.
Skin contact:	Minimal effects, if any; rinse skin with water, rinse shoes and launder clothing before reuse. Reversible reddening may occur in some dermal-sensitive users; thoroughly rinse area and get medical attention if reaction persists.
Swallowing:	Essentially non-toxic. Give several glasses of water to dilute; do not induce vomiting. If stomach upset occurs, consult physician.
Inhalation:	Non-toxic. Exposures to concentrate-mist may cause mild irritation of nasal passages or throat; remove to fresh air. Get medical attention if irritation persists.

V. FIRE FIGHTING MEASURES

Simple Green® is stable, not flammable, and will not burn.

Flash Point/Auto-Ignition:	Not flammable.
Flammability Limits:	Not flammable.
Extinguishing Media:	Not flammable/nonexplosive. No special procedures required.
Special Fire Fighting Procedures:	None required.

VI. ACCIDENTAL RELEASE MEASURES

Recover usable material by convenient method; residual may be removed by wipe or wet mop. If necessary, unrecoverable material may be washed to drain with large quantities of water.

VII. HANDLING, STORAGE & TRANSPORT INFORMATION

No special precautions are required. **This product is non-hazardous for storage and transport according to the U.S. Department of Transportation Regulations.** Simple Green® requires no special labeling or placarding to meet U.S. Department of Transportation requirements.

UN Number: Not required
Dangerous Goods Class: Non-hazardous

VIII. EXPOSURE CONTROLS

Exposure Limits: The Simple Green® formulation presents no health hazards to the user when used according to label directions for its intended purposes. Mild skin and eye irritation is possible (please see Eye contact and Skin contact in Section IV.).

Ventilation: No special ventilation is required during use.

Human Health Effects or Risks from Exposure: Adverse effects on human health are not expected from Simple Green®, based upon twenty years of use without reported adverse health incidence in diverse population groups, including extensive use by inmates of U.S. Federal prisons in cleaning operations.

Simple Green® is a mild eye irritant; mucous membranes may become irritated by concentrate-mist.

Simple Green® is not likely to irritate the skin in the majority of users. Repeated daily application to the skin without rinsing, or continuous contact of Simple Green® on the skin may lead to temporary, but reversible, irritation.

Medical Conditions Aggravated by Exposure: No aggravation of existing medical conditions is expected; dermal sensitive users may react to dermal contact by Simple Green®.

IX. PERSONAL PROTECTION

Precautionary Measures:	No special requirements under normal use conditions.
Eye Protection:	**Caution, including reasonable eye protection, should always be used to avoid eye contact where splashing may occur.**
Skin Protection:	No special precautions required; rinse completely from skin after contact.
Respiratory Protection:	No special precautions required.
Work and Hygienic Practices:	No special requirements. Wash or rinse hands before touching eyes or contact lenses.

X. PHYSICAL AND CHEMICAL PROPERTIES

Appearance/odor:	Translucent green liquid with characteristic sassafras odor.		
Specific Gravity:	1.0257	**Vapor Pressure:**	17 mm Hg @ 20 °C; 22 mm Hg @ 25 °C
pH of concentrate:	9.5	**Vapor Density:**	1.3 (air = 1)
Evaporation:	>1 (butyl acetate = 1)	**Density:**	8.5 lbs./gallon
Boiling Point:	110 °C (231 °F)		
Freezing Point:	-9 °C (16 °F) If product freezes, it will reconstitute without loss of efficacy when brought back to room temperature and agitated.		

VOC Composite Partial Pressure: 0.006 mm Hg @ 20 °C

Volatile Organic Compounds (VOCs): 7.96 g/L per ASTM Method 3960-90. Per California AQMD's VOC test method, product must be diluted at least 2 parts of water to 1 part Simple Green® in order to meet SCAQMD Rule 1171 & Rule 1122 and BAAQMD Regulation 8-16 VOC requirements for solvent cleaning operations.

Water Solubility: Completely soluble in water. The higher salt concentrations in marine ecosystems will lead to complexes with Simple Green® that may become visible at ratios above one part Simple Green® to 99 parts seawater.

Ash Content: At 600 °F: 1.86% by weight.

Nutrient Content: Nitrogen: <1.0% by weight (fusion and qualitative test for ammonia).
Phosphorus: 0.3% by formula.
Sulfur: 0.6% by weight (barium chloride precipitation method).

Detection: Simple Green® has a characteristic sassafras odor that is not indicative of any hazardous situation.

XI. STABILITY AND REACTIVITY INFORMATION

Nonreactive. Simple Green® is stable, even under fire conditions, and will not react with water or oxidizers. Hazardous polymerization will not occur.

XII. TOXICOLOGICAL INFORMATION

Nonhuman Toxicity

Acute Mortality Studies:

Oral LD$_{50}$ (rat): >5.0 g/kg body weight // Dermal LD$_{50}$ (rabbit): >2.0 g/kg body weight

Dermal Irritation: Only mild, but reversible, irritation was found in a standard 72-hr test on rabbits. A value of 0.2 (non-irritating) was found on a scale of 8.

Eye Irritation: With or without rinsing with water, the irritation scores in rabbits at 24 hours did not exceed 15 (mild irritant) on a scale of 110.

Subchronic dermal effects: No adverse effects, except reversible dermal irritation, were found in rabbits exposed to Simple Green® (up to 2.0 g/kg/day for 13 weeks) applied to the skin of 25 males and 25 females. Only female body weight gain was affected. Detailed microscopic examination of all major tissues showed no adverse changes.

Fertility Assessment by Continuous Breeding: The Simple Green® formulation had no adverse effect on fertility and reproduction in CD-1 mice with continuous administration for 18 weeks, and had no adverse effect on the reproductive performance of their offspring.

XIII. BIODEGRADABILITY AND ENVIRONMENTAL TOXICITY INFORMATION

Biodegradability:

Simple Green® is readily decomposed by naturally occurring microorganisms. The biological oxygen demand (BOD), as a percentage of the chemical oxygen demand (COD), after 4, 7, and 11 days was 56%, 60%, and 70%, respectively. Per OECD Closed Bottle Test, Simple Green® meets OECD and EPA recommendations for ready biodegradability. In a standard biodegradation test with soils from three different countries, Butyl Cellosolve reached 50% degradation in 6 to 23 days, depending upon soil type, and exceeded the rate of degradation for glucose which was used as a control for comparison.

Environmental Toxicity Information:

Simple Green® is considered practically non-toxic per EPA's aquatic toxicity scale. Simple Green® is non-lethal to any of the marine and estuarine test animals listed in the following table at concentrations below 200 mg/L (0.02%). This table shows the Simple Green® concentrations that are likely to be lethal to 50% of the exposed organisms.

	LC_{50} in mg/L (ppm)	
	48-hour	96-hour
Marine Fish:		
Mud minnow *(Fundulus heteroclitus)*	1690	1574
Whitebait *(Galaxias maculatus)*	210	210
Marine/Estuarine Invertebrates:		
Brine Shrimp *(Artemia salina)*	610	399
Grass Shrimp *(Palaemonetes pugio)*	270	220
Green-lipped Mussel *(Perna canaliculus)*	220	220
Mud Snail *(Potamopyrgus estuarinus)*	410	350

XIV. DISPOSAL CONSIDERATIONS

Simple Green® is fully water soluble and biodegradable and will not harm sewage-treatment microorganisms if disposal by sewer or drain is necessary. Dispose of in accordance with all applicable local, state, and federal laws.

XV. OTHER INFORMATION

Containers:	Simple Green® residues can be completely removed by rinsing with water; the container may be recycled or applied to other uses.
Electrical Wiring Compatibility:	Polyimide insulated wiring is not affected by exposure to Simple Green®. After immersion in Simple Green® for 14 days at 74°F, the 61 cm piece of polyimide insulated wire passed a one minute dielectric proof test at 2500 volts (ASTM D-149).
Contact Point:	Sunshine Makers, Inc., Research and Development Division: 562-795-6000.

*** NOTICE ***

All information appearing herein is based upon data obtained by the manufacturer and recognized technical sources. Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of this information, Sunshine Makers, Inc. or its distributors extends no warranties, makes no representations and assumes no responsibility as to the suitability of such information for application to purchaser's intended purposes or for consequences of its use.

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Material Safety Data Sheets Collection:

Sheet No. 385
Ethylbenzene

Issued: 8/78 Revision: B, 9/92

Section 1. Material Identification

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Ethylbenzene ($C_6H_5C_2H_5$) Description: Derived by heating benzene and ethylene in presence of aluminum chloride with subsequent distillation, by fractionation directly from the mixed xylene stream in petroleum refining, or dehydrogenation of naphthenes. Used as a solvent, an antiknock agent in gasoline; and as an intermediate in production of synthetic rubber, styrene, cellulose acetate, diethylbenzene, acetophenone, ethyl anthraquinone, propyl oxide, and α-methylbenzol alcohol.
Other Designations: CAS No. 100-41-4, ethylbenzol, EB, phenylethane, NCI-C56393.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
I 3
S 2*
K 4
* Skin absorption

NFPA

HMIS
H 2†
F 3
R 0
PPE - Sec. 8
† Chronic effects

Cautions: Ethylbenzene is a skin and mucous membrane irritant considered the most irritating of the benzene series. Inhalation causes acute and chronic central nervous system (CNS) effects. It is highly flammable and forms explosive mixtures with air.

Section 2. Ingredients and Occupational Exposure Limits

Ethylbenzene, ca >99.0%. Impurities include ~ 0.1% *meta & para* xylene, ~ 0.1% cumene, and ~ 0.1% toluene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m^3)
15-min STEL: 125 ppm (545 mg/m^3)
Action Level: 50 ppm (217 mg/m^3)

1990 IDLH Level
2000 ppm

1990 NIOSH REL
TWA: 100 ppm (435 mg/m^3)
STEL: 125 ppm (545 mg/m^3)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m^3)
STEL: 125 ppm (545 mg/m^3)

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m^3)
Category 1: local irritants
Peak Exposure Limit: 200 ppm, 5 min momentary value, max of 8/shift
Danger of cutaneous absorption

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 100 ppm/8 hr caused eye effects, sleep, and respiratory changes.
Human, lymphocyte: 1 mmol/L induced sister chromatid exchange.
Rat, oral, LD_{50}: 3500 mg/kg; toxic effects not yet reviewed
Rat (female), inhalation, TC_{Lo}: 1000 ppm/7 hr/day, 5 days/wk, for 3 wk prior to mating and daily for 19 days of gestation produced pups with high incidence of extra ribs.(179)

* See NIOSH, *RTECS* (DA0700000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 277 °F (136 °C)
Melting Point: -139 °F (-95 °C)
Surface Tension: 31.5 dyne/cm
Ionization Potential: 8.76 eV
Viscosity: 0.64 cP at 77 °F (25 °C)
Refraction Index: 1.4959 at 68 °F (20 °C)
Relative Evaporation Rate (ether = 1): 0.0106
Bulk Density: 7.21 lb/Gal at 77 °F (25 °C)
Critical Temperature: 651 °F (343.9 °C)
Critical Pressure: 35.6 atm
Molecular Weight: 106.16
Density: 0.863 at 77 °F (25 °C)
Water Solubility: Slightly, 14 mg/100 mL at 59 °F (15 °C)
Other Solubilities: Miscible in alcohol, ether; soluble in carbon tetrachloride, benzene, sulfur dioxide, and many organic solvents; insoluble in ammonia
Odor Threshold: 2.3 ppm
Vapor Pressure: 7.1 mm Hg at 68 °F (20 °C); 10 mmHg at 78.62 °F (25.9 °C); 100 mm Hg 165.38 °F (74.1 °C)
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.0768 lb/ft^3 or 1.2298 kg/m^3

Appearance and Odor: Colorless, flammable liquid with a pungent odor.

Section 4. Fire and Explosion Data

Flash Point: 64 °F (18 °C) CC	Autoignition Temperature: 810 °F (432 °C)	LEL: 1.0% v/v	UEL: 6.7% v/v

Extinguishing Media: Class 1B Flammable liquid. For small fires, use dry chemical, carbon dioxide, or 'alcohol-resistant' foam. For large fires, use fog or 'alcohol-resistant' foam. Use water only if other agents are unavailable; EB floats on water and may travel to an ignition source and spread fire. **Unusual Fire or Explosion Hazards:** Burning rate = 5.8 mm/min. Vapors may travel to an ignition source and flash back. Container may explode in heat of fire. EB poses a vapor explosion hazard indoors, outdoors, and in sewers. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Cool container sides with water until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Withdraw immediately if you hear rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Ethylbenzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Reacts vigorously with oxidizers.
Conditions to Avoid: Exposure to heat and oxidizers.
Hazardous Products of Decomposition: Thermal oxidative decomposition of EB can produce acrid smoke and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list EB as a carcinogen. **Summary of Risks:** Occupational exposure to EB alone is rare since it is usually present together with other solvents. EB is irritating to the eyes, skin, and respiratory tract. Vapor inhalation produces varying degrees of CNS effects depending on concentration. The liquid is absorbed through the skin but vapors are not. 56 to 64% of inhaled ethylbenzene is retained and metabolized. Urinary metabolites following exposure to 23 to 85 ppm for 8 hr are mandelic acid (64%), phenylglyoxylic acid (25%), and methylphenylcarbinol/1-phenyl ethanol (5%). Concurrent exposure to xylene and ethylbenzene causes slower excretion of EB metabolites. Based on the rat LD_{50}, one manufacturer gives 3 to 4 oz. as the lethal dose for a 100 lb person.

Continue on next page

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Skin and CNS diseases and impaired pulmonary function (especially obstructive airway disease). **Target Organs:** Eyes, respiratory system, skin, CNS, blood. **Primary Entry Routes:** Inhalation, skin and eye contact. **Acute Effects:** Vapor inhalation of 200 ppm caused transient eye irritation; 1000 ppm caused eye irritation with profuse watering (tolerance developed rapidly); 2000 ppm caused severe and immediate eye irritation and watering, nasal irritation, chest constriction, and vertigo; 5000 ppm was intolerable and caused eye and nose irritation. Inhalation of high concentrations may cause narcosis, cramps, and death due to respiratory paralysis. Skin exposed to pure ethylbenzene for 10 to 15 min absorbed 22 to 33 $mg/cm^2/hr$. Immersion of hand in solutions of 112 & 156 mg/L for 1 hr absorbed 118 & 215.7 $\mu g/cm^2/hr$, respectively. **Chronic Effects:** Repeated skin contact may cause dryness, scaling, and fissuring. Workers chronically exposed to > 100 ppm complained of fatigue, sleepiness, headache, and mild irritation of the eyes and respiratory tract. Repeated vapor inhalation may result in blood disorders, particularly leukopenia (abnormally low level of white blood cells) and lymphocytosis.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting! Aspiration of even a small amount of EB in vomitus can cause severe damage since its low viscosity and surface tension will cause it to spread over a large area of the lung tissue.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: BEI = mandelic acid in urine (1.5 g/g of creatinine), sample at end of shift at workweeks end. Since this test is not specific, test for EB in expired air for confirmation.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate and ventilate area, deny entry and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container. Dike far ahead of large spill for later reclamation or disposal. Report any release >1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** If released to soil, EB partially evaporates into the atmosphere, with a half-life of hrs to wks, and some leaches into groundwater, especially in soil with low organic carbon content. Biodegradation occurs with a half-life of 2 days. Some EB may absorb to sediment or bioconcentrate in fish. Evidence points to slow biodegradation in groundwater. In air, it reacts with photochemically produced hydroxyl radicals with a half-life of hrs to 2 days. Additional amounts may be removed by rain. **Ecotoxicity Values:** Shrimp (*Mysidopsis bahia*), LC_{50} = 87.6 mg/L/96 hr; sheepshead minnow (*Cyprinodon variegatus*) LC_{50} = 275 mg/L/96 hr; fathead minnow (*Pimephales promelas*) LC_{50} = 42.3 mg/L/96 hr in hard water & 48.5 mg/L/96 hr in softwater. **Disposal:** A candidate for rotary kiln incineration at 1508 to 2912°F (820 to 1600°C), liquid injection incineration at 1202 to 2912°F (650 to 1600°C), and fluidized bed incineration at 842 to 1796°F (450 to 980°C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.21): No. D001
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311 (b)(4) & CWA, Sec. 307 (a)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use a powered air-purifying respirator with an appropriate organic vapor cartridge, a supplied-air respirator (SAR), SCBA, or chemical cartridge respirator with appropriate organic vapor cartridge. For < 2000 ppm, use a SAR or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of Viton or polyvinylchloride to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area away from ignition sources and oxidizers. Outside or detatched storage is preferred. If inside, store in a standard flammable liquids cabinet. Containers should have flame-arrester or pressure-vacuum venting. To prevent static sparks, electrically ground and bond all equipment used with ethylbenzene. Install Class 1, Group D electrical equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain levels as low as possible. Purge and ventilate reaction vessels before workers are allowed to enter for maintenance or cleanup. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, skin, blood, and respiratory system.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Ethylbenzene
DOT Hazard Class: 3
ID No.: UN1175
DOT Packing Group: II
DOT Label: Flammable liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60 L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: —

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 153, 159, 162, 163, 164, 167, 168, 171, 176, 179

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** W Silverman, MD

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Material Safety Data Sheets Collection:

Sheet No. 420
Acetone Solvent Blend

Issued: 4/79 Revision: A, 9/91

Section 1. Material Identification

Acetone Solvent Blend Description: A mixture of acetone and isopropanol. Used as a solvent for fats, oils, waxes, rubber, plastics, varnishes, gums, resins and rubber cements.
Other Designations: Acetone, CAS No. 0067-64-1; isopropyl alcohol, CAS No. 0067-63-0.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
I 1
S 2
K 3

NFPA
3
1 0
-

HMIS
H 1
F 3
R 0
PPG†
† Sec. 8

Cautions: Acetone solvent blend is a skin, eye, and mucous membrane irritant. It may be narcotic in high concentrations.

Section 2. Ingredients and Occupational Exposure Limits

Acetone, >60%
Isopropanol, 10 to 30%

1990 OSHA PELs
Acetone: 8-hr TWA: 750 ppm, 1800 mg/m^3
15-min STEL: 1000 ppm, 2400 mg/m^3
Isopropyl alcohol: 8-hr TWA: 400 ppm, 980 mg/m^3
15-min STEL: 500 ppm, 1225 mg/m^3

1990-91 ACGIH TLVs
Acetone: TWA: 750 ppm, 1,780 mg/m^3
STEL: 1000 ppm, 2400 mg/m^3
Isopropyl alcohol: TWA: 400 ppm, 985 mg/m^3
STEL: 500 ppm, 1,230 mg/m^3

1990 NIOSH RELs
Acetone: TWA: 250 ppm, 590 mg/m^3
Isopropyl alcohol: 400 ppm, 980 mg/m^3

1985-86 Toxicity Data*
Acetone: Man, oral, TD_{Lo}: 2857 mg/kg
Man, inhalation, TD_{Lo}: 440 $\mu g/m^3$/6 min
Isopropyl alcohol: Man, oral, LD_{Lo}: 5272 mg/kg
Human, oral, LD_{Lo}: 3570 mg/kg; toxic effects include central nervous system, pulmonary, and gastrointestinal

Calculated TLV for Acetone (70%) Isopropanol (30%) Mixture: 596 ppm

* See NIOSH, *RTECS* (AL3150000, NT8050000) for additional toxicity data on acetone and isopropyl alcohol, respectively.

Section 3. Physical Data

Boiling Point: 133 to 181 °F (56 to 83 °C) at 1 atm
Vapor Pressure: ca 225 mm Hg at 77 °F (25 °C)
Vapor Density (air = 1): ca 2
Appearance and Odor: A clear, colorless liquid with an acetone odor.

Density/Specific Gravity (20 °C/20 °C): 0.79
Water Solubility: Completely soluble
%Volatile by Volume: ca 100*

* Acetone solvent blend is a very volatile liquid that increases fire/explosion risk, especially at elevated temperatures.

Section 4. Fire and Explosion Data

Flash Point: 0 to 53 °F (-17.8 to 11.7 °C), CC
Autoignition Temperature: >750 °F (399 °C)*
LEL: 2.0% v/v
UEL: 12.0% v/v

Extinguishing Media: Alcohol foam, dry chemical, or carbon dioxide (CO_2). Use smothering effect to extinguish fire. Waterspray may be ineffective for extinguishing, but it is useful in cooling fire-exposed containers, in reducing fire intensity, and for diluting and flushing solvent.
Unusual Fire or Explosion Hazards: Acetone solvent blend is an OSHA Class 1B liquid. Fire and explosion hazards exist when this material is exposed to heat or ignition sources. Vapors may travel to an ignition source and flash back.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Stay upwind. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode, and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

* An estimated value.

Section 5. Reactivity Data

Stability/Polymerization: Acetone solvent blend is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Acetone solvent blend is incompatible with strong oxidizing agents, strong acids, and strong alkalies.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of acetone solvent blend can produce carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list acetone solvent blend as a carcinogen.
Summary of Risks: Excessive vapor inhalation can cause mucous membrane and respiratory tract irritation. Eye contact can cause severe irritation. Prolonged or repeated skin contact can defat skin. It may be narcotic in high concentrations.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eyes, respiratory system, and central nervous system (CNS).
Primary Entry Routes: Inhalation, skin contact.
Acute Effects: Symptoms include respiratory tract irritation, nasal irritation, conjunctiva irritation, cough, headache, fatigue, dizziness, narcosis, and even asphyxiation. Skin contact causes dryness, irritation, and mild dermatitis. Ingestion produces gastrointestinal (GI) tract irritation and nausea. Injury to the kidneys is associated with ingestion of isopropyl alcohol and could potentially occur with significant ingestions of acetone solvent blend. Aspiration of vomitus into the lungs is a hazard and can result in severe illness or even death.
Chronic Effects: None reported.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If a small amount is ingested, have that *conscious and alert* person drink 1 to 2 glasses of water. Consult a physician.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Accidental or intentional ingestion may result in a state of intoxication difficult to distinguish from ethanol ingestion. Serum acetone and alcohol levels may be necessary to diagnose and monitor such a patient's status. In severe intoxication, arterial blood gases and pH, blood electrolytes, liver function studies, a baseline creatinine, blood counts, and urinalysis may be indicated. Watch for deteriorating CNS and respiratory function.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of large spills, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide maximum, explosion-proof ventilation. Cleanup personnel should protect against inhalation and skin or eye contact. For small spills, 1) absorb liquid with a noncombustible, absorbent material, and dispose; or 2) absorb on paper and burn. For large spills, dike far ahead to contain and collect for recycle or disposal. Use nonsparking tools to place waste liquid or absorbent in closable containers for disposal. Keep waste out of sewers, watersheds, or waterways. Follow applicable OSHA regulations (29 CFR 1910.120).
Environmental Degradation: When released on soil, acetone solvent blend probably both volatilizes and leaches into the ground and probably biodegrades. If released into water, it probably also biodegrades.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.21): Ignitable Waste
Acetone is listed as a RCRA Hazardous Waste (40 CFR 261.33)
Acetone is listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 5000 lb (2270 kg) [* per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Acetone and isopropyl alcohol are listed as SARA Toxic Chemicals (40 CFR 372.65)
OSHA Designations
Acetone and isopropyl alcohol are listed as Air Contaminants (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles where necessary, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious natural rubber gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a clean, cool, well-ventilated area away from heat and ignition sources, oxidizing agents, strong acids, and bases. Protect containers from physical damage. Emptied containers may still be hazardous from residual liquid or vapors. Store and handle as an OSHA Class 1B flammable liquid.
Engineering Controls: Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Make sure all engineering systems are of maximum explosion-proof design. Acetone solvent blend presents a dangerous fire and explosion hazard; perform all work operations involving it carefully and in a way that prevents exposing liquid or its vapor to ignition sources. To prevent static sparks, electrically ground and bond all containers and pipelines used in shipping, transferring, reacting, production, and sampling operations. Consider automatic sprinkler systems for fire protection in work areas.

Transportation Data (49 CFR 172.101, .102): See acetone and isopropyl alcohol (*MSDS Collection*, Nos. 300 and 324)

***MSDS Collection* References:** 1, 2, 26, 38, 73, 84-94, 100, 101, 103, 116, 117, 120, 122, 124, 126, 132, 136, 138, 143, 146, 148, 159
Prepared by: M Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD ; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 397
***n*-Hexane**

Issued: 10/78 Revision: D, 9/92

Section 1. Material Identification

39

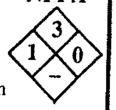
***n*-Hexane ($CH_3(CH_2)_4CH_3$) Description:** Derived by fractional distillation from petroleum (molecular sieve process). Used as a solvent for glues, cements, adhesives, fats, and oils; a lab reagent; liquid in low temperature thermometers (instead of mercury); thinner, cleaning agent; polymerization reaction medium; an alcohol denaturant; in retreading tires for determining the refraction index of minerals.

Other Designations: CAS No. 110-54-3, dipropyl, Gettysolve-B, hexyl hydride, NCI-C60571, Skellysolve-B.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
I 3
S 2*
K 3
* Skin absorption

NFPA



HMIS
H 2†
F 3
R 0
PPE-Sec. 8
† Chronic effects

Cautions: *n*-Hexane is highly flammable. It is irritating to the eyes, skin, and mucous membranes. Vapor inhalation produces central nervous system (CNS) depression, becoming anesthetic at high concentrations. Chronic exposure may result in polyneuropathy.

Section 2. Ingredients and Occupational Exposure Limits

n-Hexane; commercial hexane is a mixture of *n*-hexane and isomers of methyl pentane and heptane. 1 to 6% benzene may also be present.

1991 OSHA PEL
8-hr TWA: 50 ppm (180 mg/m^3)

1990 IDLH Level
5000 ppm

1990 NIOSH REL
TWA: 50 ppm (180 mg/m^3)

1992-93 ACGIH TLV
TWA: 50 ppm (176 mg/m^3)

1990 DFG (Germany) MAK
TWA: 50 ppm (180 mg/m^3)
Category II: substances with systemic effects
Half-life: < 2 hr
Peak Exposure Limit: 100 ppm, 30 min average value, 4/shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 5000 ppm/10 min caused hallucinations and distorted perceptions.
Rat, oral, LD_{50}: 28,710 mg/kg; no toxic effect noted
Rat, inhalation, TC_{Lo}: 1000 ppm/6 hr from the 8th to 16th day of pregnancy produced effects on newborn growth.
Rabbit, eye: 10 mg caused mild irritation.

* See NIOSH, *RTECS* (MN9275000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 156 °F (69 °C)
Freezing Point: -139 °F (-95 °C)
Vapor Pressure: 150 mm Hg at 77 °F (25 °C)
Refraction Index: 1.37486 at 68 °F (20 °C)
Critical Temperature: 453.2 °F (234 °C)
Critical Pressure: 29.7 atm
Liquid Surface Tension: 18.4 dyne/cm
Odor Threshold: 65 ppm
Molecular Weight: 86.17
Density: 0.66 at 20/4 °C
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.1049 lb/ft^3 or 1.678 kg/m^3
Water Solubility: Slightly, 0.014 mg/ml at 68 °F (20 °C)
Other Solubilities: Alcohol, acetone, chloroform, ether, and most non-polar solvents.
Ionization Potential: 10.18 eV
Viscosity: 0.334 cP at 35 °F (2 °C), 0.306 cP at 80 °F (27 °C), 0.276 cP at 145 °F (62.5 °C)
Appearance and Odor: A colorless, volatile liquid with a gasoline-like odor.

Section 4. Fire and Explosion Data

Flash Point: -7.6 °F (-22 °C)	**Autoignition Temperature:** 437 °F (225 °C)	**LEL:** 1.2% v/v	**UEL:** 7.5% v/v

Extinguishing Media: *n*-Hexane is a Class 1B Flammable Liquid. For small fires, use dry chemical, carbon dioxide, water spray, or regular foam. For large fires, use water spray, fog, or regular foam. **Unusual Fire or Explosion Hazards:** Vapors may travel to an ignition source and flash back. Container may explode in heat of fire. *n*-Hexane poses a vapor explosion hazard indoors, outdoors, and in sewers. Burning rate = 7.3 mm/min. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing appar-atus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection. If possible without risk, move container from fire area. Apply cooling water to sides of container until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from fire and let burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. Discoloration may indicate danger of BLEVE (boiling liquid expanding vapor explosion). Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: *n*-Hexane is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Incompatible with strong oxidizers and may explode at 82.4 °F (28 °C) when mixed with dinitrogen tetraoxide. **Conditions to Avoid:** Contact with heat and incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition of *n*-hexane can produce acrid smoke and irritating vapors.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list *n*-hexane as a carcinogen. Although there is no data on human carcinogenicity specifically caused by n-hexane, there is an increase in association between Leukemia risk in the rubber industry and exposure to a variety of substances including hexane. **Summary of Risks:** Vapors are irritating to the skin, eyes, and respiratory tract. Inhalation produces varying degrees of CNS depression depending on concentration. High concentrations may lead to asphyxia (oxygen displacement). Chronic exposure (usually at least 60 to 240 ppm) results in neurotoxicity characterized by sensory loss, pain, and neurogenic atrophy of skeletal muscle. Peripheral neuropathy is mostly of the 'stocking & glove' type. *n*-Hexane is ultimately converted to 2,5-hexanedione during metabolism and is considered to be the metabolite responsible for toxicity. Evidence exists that *n*-hexane accumulates in fatty tissue which would explain its affinity for the blood, liver, and brain where lipids are prevalent. After exposure has ceased, the half-life is 64 hrs. Metabolism is inhibited by co-exposure to toluene, methylethyl ketone, or methyl *n*-butyl ketone. *n*-Hexane is absorbed through the skin in both liquid and vapor form. Therefore, dermal vapor absorption raises biological levels above those reached during inhalation of or below the TLV concentration. This is why it is imperative that protective clothing be used so that the TLV levels are sufficient to prevent over-exposure. **Medical Conditions Aggravated by Long-Term Exposure:** Skin, CNS, PNS, and respiratory diseases. **Target Organs:** Eyes, skin, respiratory system, central and peripheral nervous system. **Primary Entry Routes:** Inhalation, skin contact/absorption, eyes, ingestion. **Acute Effects:** Vapor inhalation produced marked vertigo and hallucinations at 5000 ppm/10 min; drowsiness, fatigue, appetite loss, and paresthesia in the distal extremities at 1000 to 2500/12 hrs; muscle weakness, cold pulsation in extremeties, blurred vision, headache, anorexia and onset of polyneuropathy at 500 to 2500 ppm (time not given).

Continue on next page

Section 6. Health Hazard Data

Skin contact causes immediate irritation with redness, painful burning and possible blisters. Eye contact produces irritation, watering, and burning. Ingestion poses a serious aspiration hazard. If aspiration into the lungs occurs, asphyxiation from oxygen displacement may lead to brain damage and cardiac arrest. Cardiac sensitization to epinephrine (the body's adrenalin) may cause rhythm disturbances with potentially fatal consequences. **Chronic Effects:** Polyneuropathy occurs from repeated exposure to levels typically in the 400 to 600 ppm range; there is a case of polyneuropathy after exposure to 54 to 200 ppm/1 year. Initial symptoms include muscle weakness, motor loss, sensation disturbances (numbness and pain without stimulus), and distal symmetric leg pain after 2 to 6 months exposure. Clinical studies indicate muscle atrophy (wasting away), foot drop, decreased muscle tone and strength, and paresthesias of the arms and legs. Vision problems including changes in color vision, retinal pigmentation, and in perifoveal capillaries were found in workers exposed to 420 to 1280 ppm for > 5 years. Progression of neuropathy may continue for several months after exposure has ceased, followed by slow recovery taking on the average of 9 to 10 months and rarely, up to 2 years. Residual spinal cord damage was noted in most severely injured victims.

FIRST AID ***Emergency personnel should protect against exposure***

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and administer supplemental oxygen as needed. Intubation may be necessary in severe cases (aspiration of liquid). **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of severe aspiration hazard. If spontaneous vomiting occurs, position head to avoid aspiration of vomitus.

Note to Physicians: BEI = 2,5-hexanedione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also measure *n*-hexane in expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers. Dike far ahead of large spill for later disposal or reclamation. For water spills, use oil skimming equipment to lift spill. Absorbent foams can be applied to slick. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Degradation:** If released on soil, *n*-hexane will readily volatilize from moist surfaces although some may absorb to soil. In water, *n*-hexane will volatilize rapidly although some will absorb to sediment. The log bioconcentration factor (log BCF) estimated at 2.24 to 2.89 suggests bioconcentration is not an important factor in aquatic systems. The estimated Koc of 1250 to 4100 indicates that *n*-hexane absorbs to carbon/organic matter. Volatilization half-life from a model river is 2.7 hr at 77 °F (25 °C), 1 meter deep flowing at 1m/sec with a 3 m/sec wind speed. Volatilization from a model pond (which considers effect of absorption) is estimated at 6.8 days. In the atmosphere, it is expected to exist entirely in the vapor phase. It does not absorb UV light in the environmentally significant range (> 290 nm). It reacts with photochemically produced hydroxyl radicals. Estimated lifetime under photochemical smog conditions is 5.9 hr (SE England). **Disposal:** Spray into an incinerator (may burn quicker by addition of another flammable solvent). Evaporation in a suitable hood may be used for smaller amounts. Landfill is *not* recommended. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

SARA Toxic Chemical (40 CFR 372.65): Not listed

Listed as a RCRA Hazardous Waste (40 CFR 261.21): D001, *Characteristic of ignitability*

Listed as 'Unlisted hazardous Waste, *Characteristic of ignitability*' a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 500 ppm, use a supplied-air respirator (SAR) or SCBA. For < 1250 ppm, use a SAR operated in continuous-flow mode. For 2500 ppm, use a SAR with a tight-fitting facepiece operated in continuous-flow mode or a SCBA with a full facepiece. For < 5000 ppm, use a SAR operated pressure demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of nitrile, Viton, polyvinyl chloride, or chlorinated polyethylene to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec. 5). **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Purge all vessels previously containing *n*-hexane with steam before entering for the purpose of repair (cutting, welding). Refer to OSHA's Confined Space Standard (29 CFR 1910.119). **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the central and peripheral nervous systems, skin, eyes, and respiratory system.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Hexanes
DOT Hazard Class: 3
ID No.: UN1208
DOT Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T8

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
a) Vessel Stowage: E
b) Other:

***MSDS Collection* References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 139, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168, 171, 174

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** W Silverman, MD

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Material Safety Data Sheets Collection:

Sheet No. 3A
Sodium Hydroxide, 50% Liquid

Issued: 10/77 Revision: B, 11/91

Section 1. Material Identification

36

Sodium Hydroxide, 50% Liquid (NaOH), Description: Derived by electrolysis of sodium chloride brines, by reacting calcium chloride with sodium carbonate, or by electrolytic production using the diaphragm cell. Sodium hydroxide often contains minimal amounts of sodium chloride, sodium carbonate, sodium sulfate, sodium chlorate, iron, or nickel. Used in making plastics to dissolve casein; in treating cellulose in making rayon and cellophane; in explosives, dyestuffs, electrolytic extraction of zinc, reclaiming rubber, tin plating, oxide coating, etching and electroplating, laundering and bleaching, pulp and paper manufacture; in vegetable oil refining; in peeling fruits and vegetables in the food industry; to hydrolyze fats and form soaps; and in veterinary medicine as a disinfectant.

Other Designations: CAS No. 1310-73-2; Aetznatron; Collo-Grillrein; Collo-Tapette; Feurs Rohp; Lewis-Red Devil Lye; soda lye; soda, lye solution; sodium hydrate solution; sodium hydroxide solution; white caustic solution.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Sodium hydroxide is moderately toxic by ingestion and inhalation and can be seriously corrosive to eyes, skin, and mucous membranes.

R 0
I 2
S 4
K 0

NFPA
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3 1
W
Alkali

HMIS
H 3
F 0
R 1
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Sodium hydroxide, ca 50% water solution

1990 OSHA PEL
Ceiling: 2 mg/m³

1991-92 ACGIH TLV
Ceiling: 2 mg/m³

1990 DFG (Germany) MAK
2 mg/m³

1990 IDLH Level
250 ppm

1990 NIOSH REL
Ceiling: 2 mg/m³

1985-86 Toxicity Data*
Monkey, eye: 1% solution applied over 24 hr produced severe irritation
Rabbit, eye: 1% solution applied to the eye caused severe irritation
Grasshopper, parenteral: 20 µl produced cytogenic mutations

* See NIOSH, *RTECS* (WB4905000), for additional irritation, mutation and toxicity data.

Section 3. Physical Data

Boiling Point: 284 °F (140 °C)
Freezing Point: 53.6 °F (12 °C)
Viscosity: 50 cP at 68 °F (20 °C)
pH (0.5 % solution): 13
Molecular Weight: 40.01
Specific Gravity: 1.53 at 77 °F (25 °C)
Water Solubility: Completely soluble in water
Other Solubilities: Soluble in alcohol, methanol and glycerol; insoluble in acetone and ether

Appearance and Odor: An odorless, clear liquid.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Although noncombustible, when in contact with moisture or water sodium hydroxide, 50% liquid, can generate enough heat to ignite surrounding combustibles. If possible without risk, remove containers from area. Use extinguishing agents suitable for surrounding fire. For small fire, use dry chemical, carbon dioxide (CO_2), or regular foam. Avoid using water spray since water reacts with sodium hydroxide to generate substantial heat. If you must use water, be sure it is as cold as possible. For large fires, use fog or regular foam.

Unusual Fire or Explosion Hazards: Sodium hydroxide solution can become very hot when in contact with water.

Special Fire-fighting Procedures: Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear fully protective clothing. Structural firefighters' protective clothing provides limited protection. Apply cooling water to sides of fire-exposed containers until fire is well out. *Do not* splatter or splash this material. Stay away from ends of tanks. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Sodium hydroxide solution is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Violent polymerization can occur when in contact with acrolein or acrylonitrile. Since sodium hydroxide readily absorbs water and carbon dioxide from air, keep containers tightly closed.

Chemical Incompatibilities: Since it generates large amounts of heat when in contact with water, sodium hydroxide may steam and splatter. It reacts with mineral acids to form corresponding salts, and with weak-acid gases like hydrogen sulfide, sulfur dioxide and carbon dioxide. Sodium hydroxide can be very corrosive to metals such as aluminum, tin, and zinc, as well as alloys such as steel, and may cause formation of flammable hydrogen gas. An increase in temperature and pressure occurs in closed containers when sodium hydroxide is mixed with acetic anhydride, glacial acetic acid, chlorohydrin, chlorosulfonic acid, ethylene cyanohydrin, glyoxal, oleum, 36% hydrochloric acid, 48.7% hydrofluoric acid, 70% nitric acid, or 96% sulfuric acid.

Conditions to Avoid: Avoid generation of sodium hydroxide mists, and contact with water, metals, and the chemicals listed above.

Hazardous Products of Decomposition: Thermal oxidative decomposition of sodium hydroxide can produce toxic sodium oxide (Na_2O) and peroxide (Na_2O_2) fumes.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list sodium hydroxide as a carcinogen (see Chronic Effects).

Summary of Risks: Sodium hydroxide solution is toxic by mist inhalation, ingestion, or direct skin or eye contact. Damage is immediate and without prompt medical attention can become permanent. This strong, corrosive alkaline solution dissolves any living tissue it contacts.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Target Organs: Eyes, digestive tract, respiratory system, and skin.

Primary Entry Routes: Ingestion, inhalation, and skin and eye contact.

Acute Effects: Ingestion causes immediate burning of mouth, esophagus, and stomach; painful swallowing; excessive salivation; edematous (excess fluid in surrounding tissue) lips, chin, tongue, and pharynx covered with exudate (fluid oozed from swollen tissue); esophageal edema (swelling from fluid buildup in esophagus walls that can prevent swallowing within hours); edematous, gelatinous, and necrotic (localized tissue

Continue on next page

Section 6. Health Hazard Data, *continued*

death) mucous membranes; vomiting (sometimes coffee grounds-like material due to digestive hemorrhage); rapid, faint pulse; and cold, clammy skin. Death commonly occurs due to shock, asphyxia (oxygen loss due to interrupted breathing), or pneumonia by the second or third day after ingestion. Mist inhalation can cause many burns, temporary hair loss (in nasal passages since sodium hydroxide breaks down keratin), and possibly pulmonary edema (fluid in lungs). Skin contact causes slippery, soapy feeling that is usually not painful for 3 min after contact—even though skin damage begins immediately. It causes burns, keratin (hair and nails) destruction, and intracellular edema (excess fluid in skin cells), with damage progressing to severe burns, tissue corrosion, deep ulcerations, and permanent scarring if not washed off immediately. The cornea begins to corrode on contact. Disintegration and sloughing of conjunctival and corneal epithelium may progress to temporary or permanent corneal opacification (cloudiness, becoming impervious to light) or symblepharon (adhesion of lid to eyeball).
Chronic Effects: Dermatitis may result after repeated exposure to dilute solutions. Cases of squamous cell carcinoma (malignant tumors of epithelial origin) of the esophagus are reported 12 to 42 years after ingestion, although it is unclear whether the cancer resulted from scar formation caused by tissue destruction or directly from the chemical's possible carcinogenicity.
FIRST AID: Emergency personnel should protect against contamination.
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* allow victim to keep his eyes tightly shut. *Warning!* Although splashed in only one eye, sodium hydroxide may affect the other eye's sight if prompt medical attention is not received. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of cold water for at least 15 min. *Be aware* that this substance can become very hot when in contact with water. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious and alert* person drink 1 to 2 glasses of water followed by vinegar or fruit juice to neutralize the poison. *Do not* induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Perform endoscopy in all suspected cases of sodium hydroxide ingestion. Perform blood analysis to determine if dehydration, acidosis, or other electrolyte imbalances have occurred.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate hazard area, deny entry, and stay upwind of spills. Cleanup personnel should protect against vapor inhalation and skin or eye contact. Use water spray to disperse vapors but do not spray directly on spills. Absorb small liquid spills with fly ash or cement powder. Neutralize spill with vinegar or dilute acid. Perlite and Cellosolve WP 3H (hydroxyethyl cellulose) are recommended for vapor suppression and containment of 50% sodium hydroxide solutions. Place material in suitable container (sodium hydroxide corrodes steel at temperatures above 60 °C) for later disposal. For large wet spills, dike flow using soil, sand bags, foamed polyurethane, or foamed concrete to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120).
Environmental Transport: In solid form, sodium hydroxide is not mobile, although it very easily absorbs moisture. Once liquid, sodium hydroxide rapidly leaches into the soil, possibly contaminating water sources.
Environmental Degradation: Ecotoxicity values (as 100% NaOH): TLm, mosquito fish, 125 ppm/96 hr (fresh water); TLm, bluegill, 99 mg/48 hr (tap water).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.22): Characteristic of corrosivity
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 311 (b)(4)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Sodium hydroxide is listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Select the respirator based on its suitability to provide adequate worker protection for the given working conditions, level of ariborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent any skin contact.
Ventilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL and IDLH values (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Avoid physical damage to containers. Store in dry, well-ventilated area away from water, acids, metals, flammable liquids and organic halogens. Keep containers tightly closed since sodium hydroxide can decompose to sodium carbonate and carbon dioxide upon exposure to air. Since corrosion occurs easily above 140 °F (60 °C), do not store or transport in aluminum or steel containers when temperatures are near this level. Store containers in rooms equipped with trapped floor drains, curbs, or gutters.
Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control hazardous airborne contaminants and to maintain concentrations at the lowest practical level.
Other Precautions: Institute preplacement and periodic medical exams of exposed workers emphasizing the eyes, skin and respiratory tract. Consider a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Educate employees to the possible hazards in using sodium hydroxide.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Sodium hydroxide, liquid *or* solution
DOT Hazard Class: Corrosive material
ID No.: UN1824
DOT Label: Corrosive
DOT Packaging Exceptions: 173.244
DOT Packaging Requirements: 173.249

IMO Shipping Name: Sodium hydroxide, solution
IMO Hazard Class: 8
ID No.: UN1824
IMO Label: Corrosive
IMDG Packaging Group: II

MSDS Collection **References:** 26, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 143, 146, 148, 149, 153, 159, 161, 163
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 9
Sulfuric Acid, Concentrated

Issued: 10/77 Revision: D, 9/92

Section 1. Material Identification

Sulfuric Acid Concentrated (H_2SO_4) Description: Prepared by the "Cat-Ox" process; by the contact process (vanadium pentoxide catalyst) with sulfur, pyrite (FeS_2), hydrogen sulfide, or sulfur-containing smelter gases; and from gypsum (calcium sulfate). Sulfuric acid is by far the most widely used industrial chemical. Its uses include: in the manufacture of fertilizers, chemicals, nitrate explosives, parchment paper, glue, dyes and pigments; as an etchant, a lab reagent, an electrolyte in lead/acid batteries, a dehydrating agent in the manufacture of ethers and esters, and an alkylation catalyst; in the purification of petroleum, the refining of mineral and vegetable oils, the leather industry, the carbonization of wool fabrics, the recuperation of fatty acids from soapworks waste water, the production of rayon and film, the extraction of uranium from pitchblende, and pickling of metal; in electroplating baths, gas drying and nonferrous metallurgy; and to obtain glucose by the hydrolysis of cellulose.

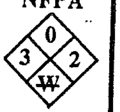
Other Designations: CAS No. 7664-93-9, battery acid, BOV, Caswell No 815, dipping acid, electrolyte acid, hydrogen sulfate, matting acid, oil of vitriol, sulphuric acid, vitriol brown oil.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Handle concentrated sulfuric acid with extreme caution because it is corrosive to all body tissues. Vapor inhalation can cause severe lung damage. Skin or eye contact can produce severe burns; blindness may result.

R	1
I	3
S	4
K	0

NFPA



HMIS

H	3*
F	0
R	2
PPE†	

* Chronic effects
† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Sulfuric acid concentrated, 93-98% sulfuric acid; remainder is water. Impurities include nonvolatiles, 0.02-0.03 ppm; SO_2, 40-80 ppm; iron, 50-100 ppm; nitrate, 5-20 ppm.

1991 OSHA PEL
8-hr TWA: 1 mg/m^3

1990 IDLH Level
80 mg/m^3

1990 NIOSH REL
TWA: 1 mg/m^3

1992-93 ACGIH TLVs
TWA: 1 mg/m^3
STEL: 3 mg/m^3

1990 DFG (Germany) MAK
TWA: 1 mg/m^3
Category: Local irritants
Peak: 2 mg/m^3, 5 min, momentary value †, 8 peaks per shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 3 mg/m^3 for 24 weeks; toxic effects not yet reviewed.
Man, unreported route, LD_{Lo}: 135 mg/kg; toxic effects not yet reviewed.
Rat, oral, LD_{50}: 2140 mg/kg; toxic effects not yet reviewed.
Rabbit, eye: 100 mg rinse produced severe irritation.

* See NIOSH, *RTECS* (WS5600000), for additional toxicity data.
† The momentary value is a level which the concentration should never exceed.

Section 3. Physical Data

Boiling Point: 554 °F (290 °C); decomposes at 644 °F (340 °C) into sulfur trioxide and water.
Melting Point (100%): 50.65 °F (10.36 °C)
Vapor Pressure: <0.001 mm Hg at 20 °C
Saturated Vapor Density (air = 1.2 kg/m^3): 1.2 kg/m^3, 0.075 lbs/ft^3
pH: 1 N sol = 0.3, 0.1 N sol = 1.2, 0.01 N sol = 2.1

Molecular Weight: 98.08
Density/Specific Gravity (96-98%): 1.841
Water Solubility: Soluble; reacts!*
Other Solubilities: Ethyl alcohol
Odor Threshold: 0.150 ppm

Appearance and Odor: Colorless (pure) to dark brown (impure), odorless, dense, oily liquid. Pure compound is a solid below 51 °F (11 °C).

* Sulfuric acid reacts violently with water with the evolution of heat. *Always add the acid to water or other diluent, not the water to acid!*

Section 4. Fire and Explosion Data

Flash Point: Not combustible	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use extinguishing media appropriate to surrounding fire. Only use water if absolutely necessary and use with great caution. Water applied directly to sulfuric acid results in violent heat liberation and splattering of the material. Use water spray only to keep fire-exposed containers cool. **Unusual Fire or Explosion Hazards:** Sulfuric acid, a strong dehydrating agent, reacts with organic materials and produces enough heat ignition, chars wood, and may cause ignition of finely divided materials on contact. Reaction with metals may produce highly flammable, hydrogen gas. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing is *not* effective. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Sulfuric acid is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include acetic acid; acetone cyanohydrin; (acetone + nitric acid); (acetone + potassium dichromate); acetonitrile; acrolein; acrylonitrile; acrylonitrile + water; (alcohol + hydrogen peroxide); allyl alcohol; allyl chloride; ammonium hydroxide; 2-amino ethanol; ammonium; triperchromate; aniline; (bromates + metals); bromine pentafluoride; *n*-butyraldehyde; carbides; cesium acetylene carbide; chlorates; (chlorates + metals); chlorine trifluoride; chlorosulfonic acid; cuprous nitride; diisobutylene; (dimethylbenzylcarbinol + hydrogen peroxide); epichlorohydrin; ethylene cyanohydrin; ethylene diamine; ethylene glycol; ethylene imine; fulminates; hydrochloric acid; hydrogen; iodine heptafluoride; (indene + nitric acid); iron; isoprene; lithium silicide; mercuric nitride; mesityl oxide; powdered metals; (nitric acid + glycerides); *p*-nitrotoluene; pentasilver trihydroxydiaminophosphate; perchlorates; perchloric acid; (permanganates + benzene); (1-phenyl-2-methylpropryl alcohol + hydrogen peroxide); phosphorus; phosphorus isocyanate; picrates; potassium *tert*-butoxide; potassium chlorate; (potassium permanganate + potassium chloride); (potassium permanganate + water); beta-propiolactone; propylene oxide; pyridine; rubidium acetylene carbide; silver permanganate; sodium; sodium carbonate; sodium chlorate; sodium hydroxide; steel; styrene monomer; (toluene + nitric acid); vinyl acetate; and water. **Conditions to Avoid:** Water, combustibles, heat, ignition sources, and other incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of sulfuric acid can produce sulfur oxides.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list sulfuric acid as a carcinogen. However, a number of studies have associated exposures to sulfuric acid or to acid mists in general with laryngeal cancer. In 50 confirmed cases there was an approximately four-fold increased risk among highly exposed individuals relative to matched controls. It is not known if sulfuric acid can act as a direct carcinogen, as a promoter, or in combination with other substances. (167) **Summary of Risks:** Concentrated sulfuric acid is a severe respiratory tract, skin, and eye irritant.

Continue on next page

Section 6. Health Hazard Data, *continued*

Exposure can result in severe burns, tissue damage, scarring, functional inhibition, and blindness if splashed in the eye. Although ingestion is unlikely, it may cause severe injury and death. **Medical Conditions Aggravated by Long-Term Exposure:** Chronic respiratory, gastrointestinal, nervous, skin or eye diseases. **Target Organs:** Respiratory system, eyes, skin, and teeth. **Primary Entry Routes:** Inhalation, skin and eye contact. **Acute Effects:** Vapor or mist inhalation causes coughing, sneezing, nose irritation and nose bleeds, reflex bronchospasm, shortness of breath, pulmonary edema (fluid in lungs), emphysema, and permanent changes in pulmonary function. Ingestion causes corrosion of the mucous membranes of mouth, throat, and esophagus; and epigastric pain with nausea and vomiting of mucoid and "coffee ground" material. Skin contact produces severe burns; initially the zone of contact is bleached and turns brown prior to the formation of a clearly defined ulcer. These wounds are slow in healing and may cause extensive scarring that results in functional inhibition. If burns are extensive, the outcome may prove fatal. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death. Eye contact produces deep corneal ulceration, kerato-conjunctivitis, palpebral lesions, and possible blindness. **Chronic Effects:** Chronic effects may include dental erosion, conjunctivitis, tracheobronchitis, emphysema, stomatitis (inflammation of the mouth mucous membranes), gastritis (inflammation of stomach mucous membranes), and dermatitis. **FIRST AID Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult an ophthalmologist immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Use a 2% sodium bicarbonate solution to further neutralize any H_2SO_4 on the skin. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water or milk to dilute. *Do not* induce vomiting! Do not attempt to neutralize the acid with sodium bicarbonate. **Note to Physicians:** Monitor arterial blood gases, chest x-ray, and pulmonary function tests if respiratory tract irritation or respiratory depression is evident. Treat dermal irritation or burns with standard topical therapy.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill, evacuate all unnecessary personnel, remove all ignition sources, and provide adequate ventilation. Cleanup personnel should wear fully-encapsulating, vapor-protective clothing to protect against inhalation and skin or eye contact. Keep water and combustibles away from release. Stop or control leak if this can be done without undue risk. Neutralize small spills with sodium bicarbonate or a mixture of soda ash/slaked lime (50/50) and place into sealed containers for disposal. If a neutralizing agent is not available, absorb spilled sulfuric acid with vermiculite, dry sand, or earth. *Never* use organic material (e.g., sawdust) to absorb spill. For large spills, dike far ahead to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120). Report any release in excess of 1000 lbs. **Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Neutralize waste water pH between 5.5 and 8.5. Follow applicable Federal, state, and local regulations.

Aquatic Toxicity: LC_{50} (saltwater, prawns): 42.5 ppm for 48 hrs; lethal (freshwater, bluegill): 24.5 ppm/24 hr.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): Characteristic of corrosivity
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311(b)(4)]
Listed as a SARA Extremely Hazardous Substance (40 CFR 355), TPQ: 1000 lbs.
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations < 25 mg/m^3 use any powered, air-purifying respirator with acid gas cartridge(s) in combination with a high-efficiency particulate filter. For concentrations < 50 mg/m^3, use any chemical cartridge respirator with a full facepiece and acid gas cartridge(s) in combination with a high-efficiency particulate filter. For concentrations < 80 mg/m^3, use any supplied air-respirator with a full facepiece and operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. H_2SO_4 has a minor to moderate effect on neoprene or rubber.(131) **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in clearly labelled, steel containers in a cool [below 50 °F (10 °C)], dry, well-ventilated location on an acid-resistant cement floor and away from direct sunlight, combustibles, and other reactive materials. Separate from carbides, chlorates, fulminates, nitrates, picrates, and powdered metals. Protect storage containers against damage and water. Use non-sparking tools near sulfuric acid carboys, drums, tank cars, or metal storage tanks because of the possible production of hydrogen during storage. Use hand pumps for the decanting and emptying of carboys. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Total enclosures of processes and the mechanization of handling procedures are the most effective measures to prevent contact with sulfuric acid. Protect electrical installations against the corrosive action of acid vapors. **Administrative Controls:** Consider preplacement and periodic physical examinations with emphasis on the respiratory tract (including pulmonary function tests), skin, eyes, and teeth.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Sulfuric acid
DOT Hazard Class: 8
ID No.: UN1830
DOT Packaging Group: II
DOT Label: Corrosive
Special Provisions (172.102): A3, A7, B2, B83, B84, N34, T9, T27

Packaging Authorizations
a) Exceptions: 173.154
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 1L
b) Cargo Aircraft Only: 30L

Vessel Stowage Requirements
a) Vessel Stowage: C
b) Other: 14

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 131, 132, 139, 140, 148, 149, 153, 159, 163, 164, 167, 171, 174, 180
Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MPH

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Material Safety Data Sheets Collection:

Sheet No. 30A
Hydrochloric Acid

Issued: 10/77 Revision: C, 9/92 Erratum: 5/93

Section 1. Material Identification

Hydrochloric Acid (HCl) Description: An aqueous solution of hydrogen chloride. Derived by dissolving hydrogen chloride gas in water at various concentrations. Hydrochloric acid is also formed as a byproduct from oxychlorination and/or oxyhydrochlorination of organic materials. Used in metal pickling and cleaning (boiler and heat exchange equipment scale removal), ore reduction, processing (corn syrup, hydrolyzing starch), dye and dye intermediate production, electroplating, leather tanning, in fertilizer, artificial silk, and paint pigment production, refining soaps and edible fats and oils, petroleum extraction, toilet bowl cleaners; as an alcohol denaturant, a chemical intermediate and solvent in organic synthesis, and in the photographic, textile, and rubber industries.

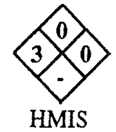
Other Designations: CAS No. 7647-01-0, Caswell No. 486, chlorohydric acid, Muriatic acid, spirits of salt.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Hydrochloric acid is highly corrosive and causes serious skin and eye burns as well as acute and chronic respiratory problems.

R	1
I	4
S	4
K	0

NFPA



HMIS	
H	2*
F	0
R	0
PPE†	

* Chronic effects
† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Hydrochloric acid; ~38% (commercial), 20% ("azeotrope"). Trace impurities include ammonia, arsenic, iron, sulfate, free Cl-, and heavy metals.

1991 OSHA PEL
Ceiling: 5 ppm (7 mg/m^3)

1990 IDLH Level
100 ppm

1990 NIOSH REL
Ceiling: 5 ppm (7 mg/m^3)

1992-93 ACGIH TLV
Ceiling: 5 ppm (7.5 mg/m^3)

1990 DFG (Germany) MAK
Ceiling: 5 ppm (7 mg/m^3)
Category 1: local irritants
Peak Exposure Limit: 10 ppm, 5 min momentary value/8 per shift

1985-86 Toxicity Data*
Human, inhalation, LC_{Lo}: 1300 ppm/30 min; toxic effects not yet reviewed
Rabbit, oral, LD_{50}: 900 mg/kg; toxic effects not yet reviewed
Rat, inhalation, TC_{Lo}: 450 mg/m^3/1 hr (1 day prior to pregnancy) produced fetotoxicity (except death) & specific developmental abnormalities (homeostasis).
Rabbit, eye: 100 mg rinse caused mild irritation.

*See NIOSH, *RTECS* (MW4025000), for additional irritation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: -120.64 °F (-84.8 °C)*
Vapor Pressure: 4 atm at 64 °F (17.8 °C)
Vapor Density (Air = 1): 1.257
Surface Tension: 23 at 244.68 (118.16 °C)
Molecular Weight: 36.46
Odor Threshold: 0.1 to 5 ppm
Ionization Potential: 12.74 eV

Freezing Point: 1.1 °F (-17.14 °C) for 10.81%, -51.16 °F (-46.2 °C) for 31.24%
Density: 1.194 at -14.8 °F (-26 °C)
Water Solubility: Soluble, 823 g/L at 32 °F (0 °C); 561 g/L at 140 °F (60 °C).
Other Solubilities: Soluble in alcohol, benzene, and ether; insoluble in hydrocarbons.
pH: 1N (0.1), 0.1N (1.1), 0.01N (2.02), 0.001N (3.02), 0.0001N (4.01)
Refraction Index (1N solution): 1.34168 at 64.4 °F (18 °C/D)

Appearance and Odor: Colorless liquid that fumes in air and has a strong pungent odor. Can be slightly yellow from traces of iron, chlorine, or organic matter. Forms a constant boiling azeotrope at 20 % HCl, 108.58 °C and 760 mm Hg.

* Decomposes at 3239.6 °F (1782 °C).

Section 4. Fire and Explosion Data

Flash Point: Noncombustible	**Autoignition Temperature:** None reported	**LEL:** None reported*	**UEL:** None reported*

Extinguishing Media: Use extinguishing agents suitable for surrounding fire.
Unusual Fire or Explosion Hazards: *Extreme heat or contact with many metals liberates hydrogen gas which has explosion limits of 4 to 75%.
Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing is *ineffective* for fires involving hydrochloric acid. Stay away from ends of tanks. Cool tanks with water spray until well after fire is out. *Do not* release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Hydrochloric acid has high thermal stability (decomposes at 3239.6 °F/1782 °C). Hazardous polymerization does not occur unless exposed to aldehydes or epoxides.
Chemical Incompatibilities: Polymerizes on contact with aldehydes or epoxides; attacks most metals (except mercury, silver, gold, platinum, tantalum, and some alloys), some plastics, rubber, and coatings; reacts explosively with alcohols + hydrogen cyanide, potassium permanganate, tetraselenium tetranitride; ignites on contact with fluorine, hexalithium disilicide, metal acetylides or carbides (cesium acetylide, rubidium acetylide); and is incompatible with acetic anhydride, 2-amino ethanol, ammonium hydroxide, calcium phosphide, chlorosulfonic acid, 1,1-difluoroethylene, ethylene diamine, ethylene imine, oleum, perchloric acid, ß-propiolacetone, propylene oxide, sodium hydroxide, silver perchlorate + carbon tetrachloride, sulfuric acid, uranium phosphide, acetate, calcium carbide, magnesium bromide, mercuric sulfate, and chlorine + dinitroaniline.
Conditions to Avoid: Avoid contact with incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition of HCl produces toxic chloride fumes and explosive hydrogen gas.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list HCl as a carcinogen.
Summary of Risks: HCl is a highly corrosive liquid and depending on concentration and duration of exposure, symptoms range from irritation to ulcerations and permanent injury. **Target Organs:** Eyes, skin, respiratory tract, and liver (in animals). **Primary Entry Routes:** Inhalation, skin and eye contact. **Medical Conditions Aggravated by Long-Term Exposure:** Respiratory disorders.

Continue on next page

Section 6. Health Hazard Data, *continued*

Acute Effects: Inhalation of vapors or mists is corrosive to the respiratory tract and can cause tracheal and bronchial epithelium necrosis (tissue death), cough, choking, ulceration. Liquid aspiration can cause pulmonary edema, lung collapse, emphysema and damage to the pulmonary blood vessels. Skin contact with HCl solutions causes burns and ulcerations. Permanent eye damage may result from splashes. Ingestion is unlikely but if it occurs, symptoms include gray tongue color, corrosion of mucous membranes, esophagus, and stomach, nausea, vomiting, intense thirst, diarrhea, difficulty swallowing, circulatory collapse and possible death. **Chronic Effects:** Repeated or prolonged exposure can cause dermatitis, conjunctivitis, gastritis, photosensitization, tooth erosion, and repeated exposure to mists from heated-metal pickling solutions can cause nose and gum bleeds, ulceration of oral or nasal mucosa, and "renders facial skin so tender that shaving is painful."(133)

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Treat skin with a 5% triethanolamine solution. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting!

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Consider a chest x-ray in acute overexposure.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Neutralize spills with crushed limestone, soda ash, lime, or sodium bicarbonate. After neutralizing, take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for disposal; flush large spills to containment area and reclaim (if possible) or await disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** In soil, HCl will infiltrate moving faster in the presence of moisture. It may dissolve some soil matter, particularly those of a carbonate base will be neutralized to some degree and will be transported to groundwater. **Ecotoxicity Values:** Chronic plant toxicity = 100 ppm; injurious to irrigatable crops at 350 mg/L; trout, LC_{100}, 10 mg/L/24 hr shrimp, LC_{50}, 100 to 330 ppm/starfish, LC_{50}, 100 to 330 mg/L/48 hr; shore crab, LC_{50}, 240 mg/L/48 hr. **Disposal:** Neutralize to between 5.5 & 8.5 before disposal. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.23, *0.01N solution or higher*): No. D002, Characteristic of corrosivity
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 5000 lb (2270 kg) [* per CWA, Sec. 311 (b)(4)]
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 50 ppm, use a cartridge respirator with acid gas cartridges, or any supplied-air respirator (SAR) or SCBA. For < 100 ppm, use any chemical cartridge respirator with a full facepiece and cartridge that protects against HCl inhalation, or any SAR or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polycarbonate, butyl rubber, polyvinyl chloride, and chlorinated polyethylene are recommended materials for PPE. Polyvinyl alcohol is not recommended. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area on a cement floor away from direct sunlight and heat sources. Use decanting pumps or pouring frames to minimize spillage during loading and unloading operations.

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. HCl should be manufactured in closed systems. Pay close attention to leak detection. Aqueous scrubbers are used to control hydrogen chloride emissions from vent stacks and other sources. Workers shouldn't enter tanks previously containing HCl until they have been cleaned.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the eyes, skin, and respiratory tract. Pulmonary function tests (FEV, FVC) are useful in determining lung disorders. Conduct difficult operations in fume hoods.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Hydrochloric acid, solution
DOT Hazard Class: 8
ID No.: UN1789
DOT Label: Corrosive
DOT Packing Group: II
Special provisions (172.102): A3, A6, B2, B15, N41, T9, T27

Packaging Authorizations
a) Exceptions: 173.154
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity limitations
a) Passenger, Aircraft, or Railcar: 1 L
b) Cargo Aircraft Only: 30 L

Vessel Stowage Requirements
a) Vessel Stowage: C
b) Other: 8

***MSDS Collection* References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 148, 149, 153, 159, 163, 164, 167, 168, 171, 174, 180

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MPH, MD

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Material Safety Data Sheets Collection:

Sheet No. 300
Acetone

Issued: 11/77 Revision: F, 9/92

Section 1. Material Identification

Acetone (CH_3COCH_3) Description: Derived by the dehydrogenation or oxidation of isopropyl alcohol with a metallic catalyst, the oxidation of cumene, the vapor phase oxidation of butane; and as a by-product of synthetic glycerol production. Used as a solvent for paint, varnish, lacquer, fat, oil, wax, resin, rubber, plastic, and rubber cement; to clean and dry parts of precision equipment; in the manufacture of chemicals (methyl isobutyl ketone, methyl isobutyl carbinol, methyl methacrylate, bisphenol-A, acetic acid (ketene process), mesityl oxide, diacetone alcohol, chloroform, iodoform, bromoform), explosives, aeroplane dopes, rayon, photographic films, isoprene; acetylene gas storage cylinders; in purifying paraffin; in nail polish remover; in the extraction of various principles from animal and plant substances; in hardening and dehydrating tissues; in cellulose acetate (especially as spinning solvent); as a solvent for potassium iodide and permanganate; as a delusterant for cellulose acetate fibers; in the specification testing of vulcanized rubber products.

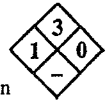
Other Designations: CAS No. 67-64-1, AI3-01238, Chevron acetone, dimethylformaldehyde, dimethylketal, dimethyl ketone, β-ketopropane, methyl ketone, propanone, 2-propanone, pyroacetic acid, pyroacetic ether.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

Cautions: Acetone vapor is a dangerous fire and explosion hazard. High vapor concentrations may produce narcosis (unconsciousness). Prolonged or repeated skin contact causes dryness, irritation, and mild dermatitis.

R 1
I 1
S 1*
K 3
* Slight skin absorption

NFPA



HMIS
H 1
F 3
R 0
PPE*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Acetone, 99.5% plus 0.5% water

1991 OSHA PELs *
8-hr TWA: 750 ppm (1800 mg/m³)
15-min STEL: 1000 ppm (2400 mg/m³)

1990 IDLH Level
20,000 ppm

1990 NIOSH REL
TWA: 250 ppm (590 mg/m³)

1992-93 ACGIH TLVs
TWA: 750 ppm (1780 mg/m³)
STEL: 1000 ppm (2380 mg/m³)

1990 DFG (Germany) MAK
1000 ppm (2400 mg/m³)
Category IV: Substances eliciting very weak effects (MAK >500 mL/m³)
Peak: 2000 ppm, 60 min, momentary value†, 3 peaks/shift

1985-86 Toxicity Data ‡
Human, eye: 500 ppm
Human, inhalation, TC_{Lo}: 500 ppm produced olfaction effects, conjunctival irritation, and other changes involving the lungs, thorax, or respiration.
Rat, oral, LD_{50}: 5800 mg/kg altered sleep time and produced tremors.
Mammal, inhalation, TC_{Lo}: 31500 µg/m³/24 hr administered to pregnant female from the 1st to 13th day of gestation produced effects on fertility (post-implantation mortality).

* In the cellulose acetate fiber industry, enforcement of the OSHA TWA for "doffers" was stayed on 9/5/89 until 9/1/90; the OSHA STEL *does not* apply to that industry.
† Momentary value is a level which the concentration should never exceed.
‡ See NIOSH, *RTECS* (AL3150000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 133.2 °F (56.2 °C) at 760 mm Hg
Freezing Point: -139.6 °F (-95.35 °C)
Vapor Pressure: 180 mm Hg at 68 °F (20 °C), 400 mm Hg at 103.1 °F (39.5 °C)
Saturated Vapor Density (Air = 1.2 kg/m³, 0.075 lb/ft³): 1.48 kg/m³, .093 lb/ft³
Refractive Index: 1.3588 at 20 °C
Appearance and Odor: Colorless, highly volatile liquid; sweetish odor.

Molecular Weight: 58.08
Specific Gravity: 0.7899 at 20 °C/4 °C
Water Solubility: Soluble
Other Solubilities: Alcohol, benzene, dimethyl formamide, chloroform, ether, and most oils.
Odor Threshold: 47.5 mg/m³ (low), 1613.9 mg/m³ (high)*

* Odor thresholds recorded as a range from the lowest to the highest concentration.

Section 4. Fire and Explosion Data

Flash Point: 0 °F (-18 °C), CC	**Autoignition Temperature:** 869 °F (465 °C)	**LEL:** 2.6% v/v	**UEL:** 12.8% v/v

Extinguishing Media: *Do not* extinguish fire unless flow can be stopped. For small fires, use dry chemical, carbon dioxide (CO_2), water spray or alcohol-resistant foam. For large fires, use water spray, fog, or alcohol-resistant foam. Use water in flooding quantities as fog because solid streams may be ineffective. **Unusual Fire or Explosion Hazards:** Acetone is a dangerous fire and explosion hazard; it is a Class IB flammable liquid. Vapors may travel to a source of ignition and flash back, fire-exposed containers may explode, and a vapor explosion hazard may exist indoors, outdoors, or in sewers. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides limited protection. If feasible, remove all fire-exposed containers. Otherwise, apply cooling water to sides of containers until well after fire is extinguished. If the fire becomes uncontrollable or container is exposed to direct flame, consider evacuation of a one-third mile radius. In case of rising sound from venting safety device or any discoloration of tank during fire, withdraw immediately. For massive cargo fires, use unmanned hose holder or monitor nozzles. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Acetone is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Acetone may form explosive mixtures with hydrogen peroxide, acetic acid, nitric acid, nitric acid + sulfuric acid, chromic anhydride, chromyl chloride, nitrosyl chloride, hexachloromelamine, nitrosyl perchlorate, nitryl perchlorate, permonosulfuric acid, thiodiglycol + hydrogen peroxide. Acetone reacts vigorously with oxidizing materials and ignites on contact with activated carbon, chromium trioxide, dioxygen difluoride + carbon dioxide, and potassium-*tert*-butoxide. Other incompatibles include air, bromoform, bromine, chloroform + alkalies, trichloromelamine, and sulfur dichloride. **Conditions to Avoid:** Keep acetone away from plastic eyeglass frames, jewelry, pens, pencils, and rayon garments. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of acetone can produce CO_2 and carbon monoxide (CO).

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list acetone as a carcinogen. **Summary of Risks:** Acetone has been placed among solvents of comparatively low acute and chronic toxicities. In industry, the most common effects reported are headache from prolonged vapor inhalation and skin irritation resulting from its defatting action. Exposures to less than 1000 ppm acetone vapor produces only slight eye, nose, and throat irritation. Acetone does not have sufficient warning properties to prevent repeated exposures. It is narcotic at high concentrations, i.e., above 2000 ppm. Concentrations above 12000 ppm cause loss of consciousness.

Continue on next page

Section 6. Health Hazard Data,*continued*

Medical Conditions Aggravated by Long-Term Exposure: None reported. **Target Organs:** Respiratory and central nervous systems, skin. **Primary Entry Routes:** Inhalation, skin and eye contact, ingestion. Liquid acetone is slowly absorbed through the skin. **Acute Effects:** Human systemic effects by inhalation include eye, nose and throat irritation; nausea and vomiting; changes in EEG (electroencephalogram) and carbohydrate metabolism; muscle weakness; drunken behavior; mental confusion and visual disturbance. In extreme cases, breathing high concentrations may produce coma. Human systemic effects by ingestion include gastrointestinal irritation, kidney damage (often indicated by albumin and red and white blood cells in the urine), liver damage (indicated by high levels of urobilin and early appearance of bilirubin), coma, metabolic changes, and systemic effects described for inhalation. Direct eye contact by liquid acetone may produce painful burning and stinging; watering of eyes; conjuctival inflammation; and corneal injury. Skin contact produces a cold feeling, dryness, and mild irritation. **Chronic Effects:** Cases of chronic poisoning resulting from prolonged exposure to low concentrations of acetone are rare. Workers exposed to 1000 ppm, 3 hrs per day for 7-15 yrs, complained of dizziness, asthenia (lack or loss of strength), and chronic inflammation of the airways, stomach, and duodenum. Prolonged or repeated skin contact with liquid acetone may defat the skin and cause eczematoid dermatitis.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. Carefully dispose of contaminated clothing because it may pose a fire hazard. **Inhalation:** Remove exposed person to fresh air, monitor for respiratory distress, and administer 100% humidified supplemental oxygen as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. **After first aid, get appropriate in-plant, paramedic, or community medical support.**
Note to Physicians: In symptomatic patients, monitor serum and urine acetone, fluid intake, blood glucose, and arterial pH. Because of the prolonged elimination half-life of acetone, the symptomatic patient may need medical supervision for many hours (up to 30 hrs). Patients may develop hyperglycemia and ketosis mimicking acute diabetic coma. The hyperglycemia may persist for several days following acute exposure.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against inhalation and skin or eye contact. If feasible and without risk, stop leak. Use water spray to reduce vapor, but it may not prevent ignition in closed spaces. For small spills, take up with sand or other noncombustible absorbent material and using nonsparking tools, place into containers for later disposal. For large spills, dike far ahead of liquid spill for later disposal. Do not release to sewers or waterways. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Toxicity:** LC_{50} *Salmo gairdneri* (rainbow trout): 5540 mg/L/96 hr at 54 °F (12 °C). LC_{50} (oral) Ring-necked pheasant: >40,000 ppm. **Environmental Degradation:** Acetone biodegrades when released into the environment. The biological oxygen demand for 5 days (BOD5) is 46-55%. **Soil Absorption/Mobility:** Acetone volatilizes, leaches, and biodegrades if released on soil. **Disposal:** Acetone is a good candidate for fluidized bed, rotary kiln incineration, or catalytic oxidation. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): Hazardous Waste No. U002 (Ignitability), (40 CFR 261.31): F003 (spent solvent)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 5000 lb (2270 kg) [* per Clean Water Act, Sec. 311(b)(4)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For concentrations < 1000 ppm, wear any chemical cartridge respirator with organic vapor cartridge(s) and wear eye protection to avoid irritation or damage. For concentrations <6250 ppm, wear any supplied-air respirator operated in a continuous-flow mode. For concentrations < 12,500 ppm, wear any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister. For concentrations < 20,000 ppm, wear any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Polyethylene/ethylene vinyl alcohol, Teflon, or butyl rubber with breakthrough times > 8 hr is recommended for PPE . **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry well-ventilated area away from heat, sparks, flames, and other incompatibles. Keep large stocks away from inhabited buildings. Use non-sparking tools to open containers. Keep dry chemical or CO_2 extinguishers on hand in case of fire. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. To prevent static sparks, electrically ground and bond all containers and equipment during fluid transfer. For bulk storage rooms, install electrical equipment, Class I, Group D. **Administrative Controls:** Consider preplacement and periodic medical examinations with emphasis on the skin and respiratory tract. Also consider liver and kidney function tests and urinalysis.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Acetone
DOT Hazard Class: 3
ID No.: UN1090
DOT Packaging Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T8

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Storage Requirements
Vessel Stowage: B
Other: --

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 168, 171, 174, 176, 180
Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** AC Darlington, MPH, MD

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Material Safety Data Sheets Collection:
Sheet No. 337
***n*-Butyl Alcohol**

Issued: 10/78 Revision: D, 1/93

Section 1. Material Identification

40

R 1
I 2
S 2*
K 3

*Skin absorption

NFPA
3
1 0
–

HMIS
H 1
F 3
R 0
PPE†
† Sec. 8

***n*-Butyl Alcohol ($C_2H_5CH_2CH_2OH$) Description:** Naturally occurring in Brazilian peppermint oil. Derived by several processes including reduction of butyraldehyde with sodium borohydride, from ethylene oxide and triethylaluminum, oxidation of tributyl borane, carbohydrate fermentation, condensation of acetaldehyde to crotonaldehyde with subsequent hydrogenation, or by passing ethyl alcohol over magnesium oxide/copper oxide at 617 °F (325 °C) and 128 atm. Used as a solvent for fats, oils, waxes, resins, shellac, varnish, gums, vegetable oils, alkaloids, and dyes; in manufacture of lacquers, rayon, detergents, other butyl compounds, and pharmaceuticals (extractant for antibiotics, vitamins, and hormones); in microscopy preparing paraffin imbedding materials; as a dehydrating agent; in medicine for control of post-operative otolaryngeal pain and for an anti-hemorrhagic effect in advanced cancer patients; in veterinary medicine as a bactericide.
Other Designations: CAS No. 71-36-3, *n*-butanol, 1-butanol, butyl hydroxide, butyric alcohol, CCS 203, Henostyp, 1-hydroxybutane, methylolpropane, propylcarbinol, propyl methanol.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: *n*-Butyl alcohol is irritating to the eyes and skin and can cause dermatitis. Central nervous system depression may occur at high concentrations. It is a highly flammable liquid.

Section 2. Ingredients and Occupational Exposure Limits

n-Butyl alcohol, ca 99.9%. May contain 0.1% water by wt.

1992 OSHA PEL
Transitional Limit:
TWA, 100 ppm (300 mg/m^3)
Final Rule Limit:
Ceiling, 50 ppm (150 mg/m^3), *skin*

1990 IDLH Level
8000 ppm

1990 NIOSH REL
Ceiling: 50 ppm (150 mg/m^3), *skin*

1992-93 ACGIH TLV
Ceiling: 50 ppm (152 mg/m^3), *skin*

1990 DFG (Germany) MAK
TWA: 100 ppm (300 mg/m^3)
Category II: substances with systemic effects
Half-life: < 2 hr
Peak Exposure Limit: 200 ppm, 30 min average value, 4/shift

1992 Toxicity Data*
Human, eye, 50 ppm caused irritation.
Human, inhalation, TC_{Lo}: 25 ppm caused conjunctival and respiratory irritation.
Rat, oral, LD_{50}: 790 mg/kg; toxic effects not yet reviewed
Rabbit, skin, LD_{50}: 3400 mg/kg; no toxic effect noted

* See NIOSH, *RTECS* (EO1400000), for additional irritation, mutation, and toxicity data.

Section 3. Physical Data

Boiling Point: 243 °F (117 °C)
Freezing Point: -130 °F (-90 °C)
Vapor Pressure: 6.5 mm Hg at 77 °F (25 °C)
Ionization Potential: 10.04 eV
Relative Evaporation Rate (BuAc = 1): 0.46
Refraction Index: 1.3993 at 68 °F (20 °C)
Saturated Vapor Density (Air = 1.2 kg/m^3): 1.216 kg/m^3
Liquid Surface Tension: 69.3 dyne/cm
Molecular Weight: 74.12
Specific Gravity: 0.8109 at 68 °F (20 °C)
Water Solubility: Soluble, 9.1 mL/100 mL water
Other Solubilities: Soluble (10%) in acetone, benzene, ethanol, and ether.
log Octanol Water Partition Coefficient: 0.88
Viscosity: 36.1 cP at -50.6 °F (-50.9 °C), 5.18 cP at 32 °F (0 °C), 2.94 cP at 68 °F (20 °C), 0.54 cP at 212 °F (100 °C).
Critical Temperature and Pressure: 289.8 °C and 43.6 atm

Appearance and Odor: Colorless liquid with a harsh fuel oil and banana smell. The odor threshold is 0.12 to 11 ppm.

Section 4. Fire and Explosion Data

Flash Point: 84 °F (28.9 °C) CC, 98 °F (37 °C) OC	**Autoignition Temperature:** 650 °F (343 °C)	**LEL:** 1.4% v/v	**UEL:** 11.2% v/v

Extinguishing Media: A Class I C Flammable Liquid. For small fires, use dry chemical, carbon dioxide, water spray, or 'alcohol-resistant' foam. For large fires, use water spray, fog, or 'alcohol-resistant' foam. **Unusual Fire or Explosion Hazards:** Burning Rate = 3.2 mm/min. Vapors may travel to an ignition source and flash back. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection. Cool container sides with water until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw and let burn. Withdraw immediately if you hear a rising sound from venting safety device or notice tank discoloration due to fire because a BLEVE may be imminent. Do not release runoff from fire control methods to sewers or waterways; dike for proper disposal.

Section 5. Reactivity Data

Stability/Polymerization: *n*-Butyl alcohol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include aluminum, chromium trioxide, organic peroxides, and strong oxidizers. Attacks some forms of plastic, rubber, coatings. **Conditions to Avoid:** Exposure to heat, ignition sources, and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of *n*-butyl alcohol can produce carbon monoxide and acrid smoke.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(183) NTP,(169) and OSHA(183) do not list *n*-butyl alcohol as a carcinogen. **Summary of Risks:** *n*-Butyl alcohol is potentially more toxic (seen in animal studies) than its lower homologues but its airborne hazards are substantially reduced due to a low vapor pressure. The estimated human lethal oral dose is 3 to 7 ounces. Vapor inhalation is irritating to the eyes and respiratory tract. Skin contact is irritating and may lead to dermatitis. *n*-Butyl alcohol can be absorbed through the skin; direct hand contact for 1 hr resulted in a body burden 4x that from inhalation of 50 ppm/1 hr. The average odor threshold is ~ 15 ppm but because of rapid olfactory fatigue it rises to 10,000 ppm after adaptation.

Continue on next page

Section 6. Health Hazard Data, *continued*

Two studies suggest unprotected noise exposure concurrent with exposure to butyl alcohol (~ 80 ppm) increased hearing loss beyond that occurring from noise exposure alone. Animal studies show lowered white blood cell counts, lymphocytosis, lung hemorrhage, albuminuria (albumin in urine), early degenerative liver changes, and cortical/tubular degeneration of the kidneys. **Medical Conditions Aggravated by Long-Term Exposure:** Dermatitis. **Target Organs:** Eyes, ears, skin, respiratory tract. **Primary Entry Routes:** Inhalation, eye contact, skin contact/absorption. **Acute Effects:** Skin contact produces drying and cracking due to its defatting action. Vapor inhalation is irritating to respiratory tract and eyes. Conjuctival edema (swelling), headache, dizziness, and drowsiness may also occur. **Chronic Effects:** Repeated exposure to 50 to 200 ppm leads to blurred vision, burning, and sensitivity to light. Symptoms become more severe toward week's end and decrease over the weekend. Hearing loss and vestibular damage resulting in vertigo may occur from current exposure to *n*-butyl alcohol and noise pollution.

FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water. If pain, photophobia, or lacrimation persists after 15 min. of flushing, consult an ophthalmologist. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting. **Note to Physicians:** Treatment is symptomatic and supportive.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers. Dike far ahead of large spill for later disposal or reclamation. Prevent entry into sewers, drains, and waterways. Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** *Pseudomas putida* (bacteria), 650 mg/L inhibited cell multiplication; fathead minnow, LC_{50} = 1940 mg/L/1 hr; aquatic plant toxicity = 8500 ppm. **Environmental Degradation:** In air, *n*-butyl alcohol will react with photochemically produced hydroxyl radicals with an estimated half-life of 2.3 days. In a sunlit urban atmosphere the half-life is reduced to 5 hr. In water, some butyl alcohol will biodegrade and the rest will volatilize with estimated half-lives of 2.4 hr, 3.9 hr, and 125.9 days in streams, rivers, and lakes, respectively. The ability to volatilize depends on temperature, turbulence, wind speed, current velocity, and water depth. If released to soil, *n*-butyl alcohol may volatilize, biodegrade, or leach into groundwater. **Soil Absorption/Mobility:** A soil absorption coefficient (Koc) of 71.6 indicates moderate to high mobility. **Disposal:** A good candidate *for* liquid injection incineration, with a temperature range of 650 to 1600 °C and a residence time of 0.1 to 2 sec; *for* rotary kiln incineration at 820 to 1600 °C for a few seconds, and *for* fluidized bed incineration at 450 to 980 °C for a few seconds. Land disposal is limited because sub-surface dilution does not adequately keep groundwater concentrations below regulated levels. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33): U031
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 5000 lb (2270 kg) [* per RCRA, Sec. 3001]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use any powdered air purifying respirator with organic vapor cartridges. For < 1250 ppm, use any supplied-air respirator (SAR) operated in continuous-flow mode. For < 2500 ppm, use any air-purifying, full face respirator (gas mask) with a chin style, front or back mounted organic vapor canister, or any SAR or SCBA with a full facepiece. For < 8000 ppm, use any SAR with a full facepiece and operated in pressure-demand or positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Teflon and chlorosulphonated ethylene rubber with a breakthrough time (BT) of > 8 hr; and butyl rubber, polyethylene, neoprene, and nitrile rubber with a BT of > 4 hr are suitable materials for protective gear. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage/Handling Requirements: Prevent physical damage to containers. Store in a cool, dry, dark, well-ventilated area away from heat, ignition sources, and incompatibles. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Use electrical equipment of Class I, Group D. Use non-sparking tools during maintenance operations and electrically ground and bond equipment. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers with emphasis on the eyes, skin and respiratory tract.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Butanols
DOT Hazard Class: 3
ID No.: UN1120
DOT Packing Group: III
DOT Label: Flammable Liquid
Special Provisions (172.102): B1, T1

Packaging Authorizations
a) **Exceptions:** 173.150
b) **Non-bulk Packaging:** 173.203
c) **Bulk Packaging:** 173.242

Quantity Limitations
a) **Passenger Aircraft or Railcar:** 60 L
b) **Cargo Aircraft Only:** 220 L

Vessel Stowage Requirements
a) **Vessel Stowage:** A
b) **Other:** —

MSDS Collection **References:** 23, 54, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 148, 153, 159, 167, 168, 169, 171, 176, 183
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** AC Darlington, MD

MATERIAL SAFETY DATA SHEET

THE WESTFORD CHEMICAL CORPORATION®
P.O. Box 798
Westford, Massachusetts 01886 USA

Ref. No.: 2001
Date: 10/6/2000

Phone: 01 (978) 392-0689
Phone: 01 (508) 885-1113
Emergency Phone-24 Hours: 1-800-225-3909

Fax: 01 (978) 692-3487 / 01 (508) 885-1114
Web Site: http://www.BioSolve.com
E-Mail: info@BioSolve.com

SECTION I - IDENTITY

Name:	**BioSolve®**
CAS #:	138757-63-8
Formula:	Proprietary
Chemical Family:	Water Based, Biodegradable, Wetting Agents & Surfactants
HMIS Code:	Health 1, Fire 0, Reactivity 0
HMIS Key:	4 = Extreme, 3 = High, 2 = Moderate, 1 = Slight, 0 = Insignificant

SECTION II - HAZARDOUS INGREDIENTS

Massachusetts Right to Know Law or 29 C.F.R. (Code of Federal Regulations) 1910.1000 require listing of hazardous ingredients.

This product does not contain any hazardous ingredients as defined by CERCLA, Massachusetts Right to Know Law and California's Prop. 65.

SECTION III - PHYSICAL - CHEMICAL CHARACTERISTICS

Boiling Point : 265°F Specific Gravity : 1.006 +/-.01

Melting Point	: 32°F	Vapor Pressure mm/Hg	: NA
Surface Tension- 6% Solution	: 29.1 Dyne/cm at 25°C	Vapor Density Air = 1	: NA
Reactivity with Water	: No	Viscosity - Concentrate	: 490 Centipoise
Evaporation Rate	: >1 as compared to Water	Viscosity - 6% Solution	: 15 Centipoise
Appearance	: Clear Liquid unless Dyed	Solubility in Water	: Complete
Odor	: Pleasant Fragrance	pH	: 8.81+/-.5
Pounds per Gallon	: 8.37		

SECTION IV - FIRE AND EXPLOSION DATA

Special Fire Fighting Procedures : NA
Unusual Fire and Explosion Hazards : None
Solvent for Clean-Up : Water

Percent Volatile by Volume : NA
Flammable Limit : NA
Auto Ignite Temperature : NA

Flash Point	: NA	Fire Extinguisher Media	: NA

SECTION V - SPECIAL PRECAUTIONS AND SPILL/LEAK PROCEDURES

Precautions to be taken in Handling and Storage: Use good normal hygiene.

Precautions to be taken in case of Spill or Leak -

Small spills, in an undiluted form, contain. Soak up with absorbent materials.

Large spills, in an undiluted form, dike and contain. Remove with vacuum truck or pump to storage/salvage vessel. Soak up residue with absorbent materials.

Waste Disposal Procedures -

Dispose in an approved disposal area or in a manner which complies with all local, state, and federal regulations.

SECTION VI - HEALTH HAZARDS

Threshold Limit Values: NA

Signs and Symptoms of Over Exposure-

Acute : Moderate eye irritation. Skin: Causes redness, edema, drying of skin.

Chronic: Pre-existing skin and eye disorders may be aggravated by contact with this product.

Medical Conditions Generally Aggravated by Exposure: Unknown

Carcinogen: No

Emergency First Aid Procedures -

Eyes: Flush thoroughly with water for 15 minutes. Get medical attention.

Skin: Remove contaminated clothing. Wash exposed areas with soap and water. Wash clothing before reuse. Get medical attention if irritation develops.

Ingestion: Get medical attention.

Inhalation: None considered necessary.

SECTION VII - SPECIAL PROTECTION INFORMATION

Respiratory Protection	: Not necessary	Local Exhaust Required	: No
Ventilation Required	: Normal	Protective Clothing	: Gloves, safety glasses Wash clothing before reuse.

SECTION VIII - PHYSICAL HAZARDS

Stability	: Stable	Incompatible Substances	: None Known
Polymerization	: No	Hazardous Decomposition Products	: NA

SECTION IX - TRANSPORT & STORAGE

DOT Class	: Not Regulated/Non Hazardous		
Freeze Temperature	: 28°F	Storage	: 35°F-120°F
Freeze Harm	: None	Shelf Life	: Unlimited Unopened

SECTION X - REGULATORY INFORMATION

The Information on this Material Safety Data Sheet reflects the latest information and data that we have on hazards, properties, and handling of this product under the recommended conditions of use. Any use of this product or method of application, which is not described on the Product label or in this Material Safety Data Sheet, is the sole responsibility of the user. This Material Safety Data Sheet was prepared to comply with the OSHA Hazardous Communication Regulation and Massachusetts Right to Know Law.

MATERIAL SAFETY DATA SHEET: SIMPLE GREEN®

I. PRODUCT & COMPANY INFORMATION

PRODUCT NAME: **SIMPLE GREEN® CLEANER / DEGREASER / DEODORIZER**

COMPANY NAME: **SUNSHINE MAKERS, INC.**
15922 Pacific Coast Highway
Huntington Harbour, CA 92649 USA
Telephone: 800-228-0709 • 562-795-6000
Fax: 562-592-3034
Website: www.simplegreen.com

Version No. 1007
Issue Date: January, 2002

For 24-hour emergency, call Chem-Tel, Inc.: 800-255-3924

USE OF PRODUCT: An all purpose cleaner and degreaser used undiluted or diluted in water for direct, spray, and dip tank procedures.

II. INGREDIENT INFORMATION

The only ingredient of Simple Green® with established exposure limits is undiluted 2-butoxyethanol (<6%) (Butyl Cellosolve; CAS No. 111-76-2): the OSHA PEL and ACGIH TLV is 25 ppm (skin). Note, however, that Butyl Cellosolve is only one of the raw material ingredients that undergo processing and dilution during the manufacture of Simple Green®. Upon completion of the manufacturing process, Simple Green® does not possess the occupational health risks associated with exposure to undiluted Butyl Cellosolve. Verification of this is contained in the independent test results detailed under "Toxicological Information" on Page 3 of this MSDS.

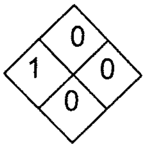
The Butyl Cellosolve in Simple Green® is part of a chemical category (glycol ethers) regulated by the Emergency Planning and Community Right-to-Know Act (SARA, Title III, section 313); therefore, a reporting requirement exists. Based upon chemical analysis, Simple Green® contains no known EPA priority pollutants, heavy metals, or chemicals listed under RCRA, CERCLA, or CWA. Analysis by TCLP (Toxicity Characteristic Leaching Procedure) according to RCRA revealed no toxic organic or inorganic constituents.

All components of Simple Green® are listed on the TSCA Chemical Substance Inventory.

III. HAZARDS IDENTIFICATION

UN Number:	Not required
Dangerous Goods Class:	Nonhazardous

Hazard Rating (NFPA/HMIS)
Health = 1*
Reactivity = 0
Fire = 0
Special = 0



Rating Scale
0 = minimal
1 = slight
2 = moderate
3 = serious
4 = severe

*Mild eye irritant, non-mutagenic and non-carcinogenic. **None of the ingredients in Simple Green® are regulated or listed as potential cancer agents by Federal OSHA, NTP, or IARC.**

IV. FIRST AID MEASURES

SYMPTOMS OF OVEREXPOSURE AND FIRST AID TREATMENT

Eye contact:	Reddening may develop. Immediately rinse the eye with large quantities of cool water; continue 10-15 minutes or until the material has been removed; be sure to remove contact lenses, if present, and to lift upper and lower lids during rinsing. Get medical attention if irritation persists.
Skin contact:	Minimal effects, if any; rinse skin with water, rinse shoes and launder clothing before reuse. Reversible reddening may occur in some dermal-sensitive users; thoroughly rinse area and get medical attention if reaction persists.
Swallowing:	Essentially non-toxic. Give several glasses of water to dilute; do not induce vomiting. If stomach upset occurs, consult physician.
Inhalation:	Non-toxic. Exposures to concentrate-mist may cause mild irritation of nasal passages or throat; remove to fresh air. Get medical attention if irritation persists.

V. FIRE FIGHTING MEASURES

Simple Green® is stable, not flammable, and will not burn.

Flash Point/Auto-Ignition:	Not flammable.
Flammability Limits:	Not flammable.
Extinguishing Media:	Not flammable/nonexplosive. No special procedures required.
Special Fire Fighting Procedures:	None required.

VI. ACCIDENTAL RELEASE MEASURES

Recover usable material by convenient method; residual may be removed by wipe or wet mop. If necessary, unrecoverable material may be washed to drain with large quantities of water.

VII. HANDLING, STORAGE & TRANSPORT INFORMATION

No special precautions are required. **This product is non-hazardous for storage and transport according to the U.S. Department of Transportation Regulations.** Simple Green® requires no special labeling or placarding to meet U.S. Department of Transportation requirements.

UN Number: Not required

Dangerous Goods Class: Non-hazardous

VIII. EXPOSURE CONTROLS

Exposure Limits: The Simple Green® formulation presents no health hazards to the user when used according to label directions for its intended purposes. Mild skin and eye irritation is possible (please see Eye contact and Skin contact in Section IV.).

Ventilation: No special ventilation is required during use.

Human Health Effects or Risks from Exposure: Adverse effects on human health are not expected from Simple Green®, based upon twenty years of use without reported adverse health incidence in diverse population groups, including extensive use by inmates of U.S. Federal prisons in cleaning operations.

Simple Green® is a mild eye irritant; mucous membranes may become irritated by concentrate-mist.

Simple Green® is not likely to irritate the skin in the majority of users. Repeated daily application to the skin without rinsing, or continuous contact of Simple Green® on the skin may lead to temporary, but reversible, irritation.

Medical Conditions Aggravated by Exposure: No aggravation of existing medical conditions is expected; dermal sensitive users may react to dermal contact by Simple Green®.

IX. PERSONAL PROTECTION

Precautionary Measures:	No special requirements under normal use conditions.
Eye Protection:	**Caution, including reasonable eye protection, should always be used to avoid eye contact where splashing may occur.**
Skin Protection:	No special precautions required; rinse completely from skin after contact.
Respiratory Protection:	No special precautions required.
Work and Hygienic Practices:	No special requirements. Wash or rinse hands before touching eyes or contact lenses.

X. PHYSICAL AND CHEMICAL PROPERTIES

Appearance/odor: Translucent green liquid with characteristic sassafras odor.

Specific Gravity:	1.0257	**Vapor Pressure:**	17 mm Hg @ 20 °C; 22 mm Hg @ 25 °C
pH of concentrate:	9.5	**Vapor Density:**	1.3 (air = 1)
Evaporation:	>1 (butyl acetate = 1)	**Density:**	8.5 lbs./gallon
Boiling Point:	110 °C (231 °F)		

Freezing Point: -9 °C (16 °F) If product freezes, it will reconstitute without loss of efficacy when brought back to room temperature and agitated.

VOC Composite Partial Pressure: 0.006 mm Hg @ 20 °C

Volatile Organic Compounds (VOCs): 7.96 g/L per ASTM Method 3960-90. Per California AQMD's VOC test method, product must be diluted at least 2 parts of water to 1 part Simple Green® in order to meet SCAQMD Rule 1171 & Rule 1122 and BAAQMD Regulation 8-16 VOC requirements for solvent cleaning operations.

Water Solubility: Completely soluble in water. The higher salt concentrations in marine ecosystems will lead to complexes with Simple Green® that may become visible at ratios above one part Simple Green® to 99 parts seawater.

Ash Content: At 600 °F: 1.86% by weight.

Nutrient Content: Nitrogen: <1.0% by weight (fusion and qualitative test for ammonia).
Phosphorus: 0.3% by formula.
Sulfur: 0.6% by weight (barium chloride precipitation method).

Detection: Simple Green® has a characteristic sassafras odor that is not indicative of any hazardous situation.

XI. STABILITY AND REACTIVITY INFORMATION

Nonreactive. Simple Green® is stable, even under fire conditions, and will not react with water or oxidizers. Hazardous polymerization will not occur.

XII. TOXICOLOGICAL INFORMATION

Nonhuman Toxicity

Acute Mortality Studies:

Oral LD_{50} (rat): >5.0 g/kg body weight // Dermal LD_{50} (rabbit): >2.0 g/kg body weight

Dermal Irritation: Only mild, but reversible, irritation was found in a standard 72-hr test on rabbits. A value of 0.2 (non-irritating) was found on a scale of 8.

Eye Irritation: With or without rinsing with water, the irritation scores in rabbits at 24 hours did not exceed 15 (mild irritant) on a scale of 110.

Subchronic dermal effects: No adverse effects, except reversible dermal irritation, were found in rabbits exposed to Simple Green® (up to 2.0 g/kg/day for 13 weeks) applied to the skin of 25 males and 25 females. Only female body weight gain was affected. Detailed microscopic examination of all major tissues showed no adverse changes.

Fertility Assessment by Continuous Breeding: The Simple Green® formulation had no adverse effect on fertility and reproduction in CD-1 mice with continuous administration for 18 weeks, and had no adverse effect on the reproductive performance of their offspring.

XIII. BIODEGRADABILITY AND ENVIRONMENTAL TOXICITY INFORMATION

Biodegradability:

Simple Green® is readily decomposed by naturally occurring microorganisms. The biological oxygen demand (BOD), as a percentage of the chemical oxygen demand (COD), after 4, 7, and 11 days was 56%, 60%, and 70%, respectively. Per OECD Closed Bottle Test, Simple Green® meets OECD and EPA recommendations for ready biodegradability.
In a standard biodegradation test with soils from three different countries, Butyl Cellosolve reached 50% degradation in 6 to 23 days, depending upon soil type, and exceeded the rate of degradation for glucose which was used as a control for comparison.

Environmental Toxicity Information:

Simple Green® is considered practically non-toxic per EPA's aquatic toxicity scale. Simple Green® is non-lethal to any of the marine and estuarine test animals listed in the following table at concentrations below 200 mg/L (0.02%). This table shows the Simple Green® concentrations that are likely to be lethal to 50% of the exposed organisms.

	LC_{50} in mg/L (ppm)	
	48-hour	96-hour
Marine Fish:		
Mud minnow *(Fundulus heteroclitus)*	1690	1574
Whitebait *(Galaxias maculatus)*	210	210
Marine/Estuarine Invertebrates:		
Brine Shrimp *(Artemia salina)*	610	399
Grass Shrimp *(Palaemonetes pugio)*	270	220
Green-lipped Mussel *(Perna canaliculus)*	220	220
Mud Snail *(Potamopyrgus estuarinus)*	410	350

XIV. DISPOSAL CONSIDERATIONS

Simple Green® is fully water soluble and biodegradable and will not harm sewage-treatment microorganisms if disposal by sewer or drain is necessary. Dispose of in accordance with all applicable local, state, and federal laws.

XV. OTHER INFORMATION

Containers:	Simple Green® residues can be completely removed by rinsing with water; the container may be recycled or applied to other uses.
Electrical Wiring Compatibility:	Polyimide insulated wiring is not affected by exposure to Simple Green®. After immersion in Simple Green® for 14 days at 74°F, the 61 cm piece of polyimide insulated wire passed a one minute dielectric proof test at 2500 volts (ASTM D-149).
Contact Point:	Sunshine Makers, Inc., Research and Development Division: 562-795-6000.

*** NOTICE ***

All information appearing herein is based upon data obtained by the manufacturer and recognized technical sources. Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of this information, Sunshine Makers, Inc. or its distributors extends no warranties, makes no representations and assumes no responsibility as to the suitability of such information for application to purchaser's intended purposes or for consequences of its use.

Attachment D

Standard Safe Work Practices and Con Edison's EH&S Work Plan Guides

STANDARD SAFE WORK PRACTICES

1) Eating, drinking, chewing tobacco, smoking and carrying matches or lighters is prohibited in a contaminated or potentially contaminated area or where the possibility for the transfer of contamination exists.

2) Avoid contact with potentially contaminated substances. Do not walk through puddles, pools, mud, etc. Avoid, whenever possible, kneeling on the ground, leaning or sitting on equipment or ground. Do not place monitoring equipment on potentially contaminated surfaces (i.e., ground, etc.).

3) All field crew members should make use of their senses to alert them to potentially dangerous situations in which they should not become involved; i.e., presence of strong and irritating or nauseating odors.

4) Prevent, to the extent possible, spills. In the event that a spillage occurs, contain liquid if possible.

5) Field crew members shall be familiar with the physical characteristics of investigations, including:

   - Wind direction
   - Accessibility to associates, equipment, vehicles
   - Communication
   - Hot zone (areas of known or suspected contamination)
   - Site access
   - Nearest water sources

6) All wastes generated during activities on-site should be disposed of as directed by the project manager or his on-site representative.

7) Protective equipment as specified in the section on personnel protection will be utilized by workers during the initial site reconnaissance, and other activities.

8) Employees shall follow procedures to avoid at-risk behaviors that could result in an incident.

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5.0 - CHEMICAL SAFETY AND HANDLING

Overview

Federal and State laws as well as Con Edison require that specific procedures are followed to properly handle chemicals to protect workers and prevent spills. These procedures include those for storing, handling, transferring, and processing chemicals.

Minimum Chemical Safety and Handling Requirements

Prior to working in any Con Edison facility or on any Con Edison project, all contractors must, at a minimum, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific work plan submitted to Con Edison and include a process to meet these requirements.

- The contractor must assure that the equipment brought into a Con Edison site to deliver or store hazardous chemicals is in good condition and that all equipment required is operating. This includes, but is not limited to all deadman switches, valves, hoses, pumps, lights, etc.
- Contractor personnel must be licensed and/or have the necessary handling permits or certifications. Documentation must be present with the driver or on the vehicle at all times for inspection by Con Edison representative. Incomplete documentation will prevent chemicals/shipment from being permitted in a Con Edison facility or site.
- Contractor personnel must be thoroughly familiar with operation of equipment and the use of materials or chemicals used in the Con Edison facility.
- Contractor personnel should have knowledge of the physical properties, hazards, and personnel protective equipment (PPE) required. All contractor personnel shall be provided with appropriate PPE for the chemicals or hazards present.
- Spill response equipment shall be available on location to contain or control a reasonably anticipated release or spill. All chemical spills in a Con Edison facility or location must be reported to a Con Edison authorized representative immediately upon discovery.
- Contractor will provide to Con Ed a complete inventory of chemicals brought onto a Con Ed facility or location. Contractor must have all material safety data sheets (MSDS) for the material carried or at Con Ed facilities or locations and available on request.
- The reportable quantity of each hazardous substance and the amount that exceeds the reportable quantity shall be known regardless of the units used (pounds vs. gallons).
- At the end of the project the contractor shall remove any chemicals that were not used.

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5.0 - CHEMICAL SAFETY AND HANDLING

- If quantities of chemicals brought on-site exceed the threshold planning quantities (TPQs) or threshold reporting quantities (TRQs), the contractor shall identify how the Community Right-To-Know reporting requirements will be met, including the procedures for:
  - Retaining of Material Safety Data Sheets (MSDS).
  - Filing an annual chemical inventory form with the NYSDEC.
  - Coordinating with the local emergency planning committee (LEPC) and the fire department with jurisdiction over the job area.
  - Preparing Risk Management Plans, as required.

Regulatory Citations

A complete text of the requirements for chemical safety and handling can be found in:

- Title 29 Code of Federal Regulations (CFR) Part 1910; Title 33 CFR Part 153.
- Title 40 CFR Parts 68, 117, 280, 302, 355 and 370.
- Title 6 New York Code of Rule and Regulations (NYCRR), Parts 595 through 599.
- The New York City Administrative Code Chapter 4, Subchapter 9.
- Title 3 Rules of New York City (RCNY) Chapter 1; Title 15 RCNY Chapters 11 and 41.
- Article 22 Westchester County Sanitary Code, Articles 1&3 Rockland Sanitary Code.

Contacts

For additional information or clarification of these requirements, contact the following agencies:

- Projects in the five boroughs, contact Region 2 NYSDEC office located at Hunters Point Plaza, 47-40 21st St, Long Island City, NY 11101 (718-482-4900). www.dec.state.ny.us.
- For projects in Westchester, Rockland and Dutchess Counties, contact the NYSDEC Region 3 office at 21 South Putt Corners Road, New Paltz, NY 12561 (914-256-3000).
- Projects in the five boroughs, contact the NYCDEP at 59-17 Junction Boulevard, 10th Floor, Corona, NY 11368 (718-337-4375). NYCEP's web is www.ci.nyc.ny.us.
- Westchester County projects, contact Westchester Department of Environmental Facilities at 207 North Avenue, New Rochelle, NY 10810 (914-637-3000). www.co.westchester.ny.us.
- For projects located in Rockland County, contact the Rockland County Department of Health on Sanatorium Road, Pamona, NY 10970 (914-634-2500). www.co.rockland.ny.us.
- Region II office of the Environmental Protection Agency (EPA) is located at 290 Broadway, New York, New York 10007 (212-637-3000). The EPA's website is www.EPA.gov.

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7.0 - ELECTRICAL SAFETY

Overview

Electrical safety is an important component to any safety program. To minimize personal injury from contact with energized sources, workers must be trained in the fundamentals of electrical safety and all electrical hazards on a project must be identified and corrected. Only properly licensed electricians may perform any electrical work on Con Edison projects.

Minimum Electrical Safety Requirements

In order to perform work on any Con Edison facility or project, all contractors must, at least, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific Environmental, Health and Safety Plan submitted to Con Edison and include a process to meet these requirements.

- Before work begins, all electric circuits, exposed or concealed, that may be contacted by workers must be posted with warning signs.
- All workers must be notified of the location and hazard involved with nearby electrical circuits and protective measures taken.
- Workers must not work near any part of an electrical circuit unless they are protected against shock by guarding or by de-energizing and grounding the circuit.
- Workspaces, walkways, and similar locations must be kept free of electric cords and tools.
- Equipment must not be stored around electrical cabinets to prevent access.
- Workers must inspect all electrical equipment, including extension cords, for the following hazards:
  - Missing ground pins on plugs (except double-insulated);
  - Insulation pulled free from plugs or support connections;
  - Damaged insulation;
  - Exposed wires; and
  - Evidence of arcing, sparking, or smoking.
- When any conditions are identified on equipment that make it unsafe to operate, the equipment must be removed from the site until repaired by a qualified person.
- Portable lamps must be covered by a fixed, grounded (if metal) guard and equipped with an insulated handle.
- All underground utilities must be marked prior to any groundbreaking activities.

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- Flexible cords must be suitable for the condition and location of use and must be used as appropriate.
- Three-wire extension cords must be used and must be rated for hard or extra-hard use.
- Splices and/or taps are prohibited in extension cords.
- Extension cords must not be fastened with staples, hung on nails, or suspended on wires.
- Workers must be trained in the safety-related work practices that pertain to their job and cannot work near electrical hazards without training to recognize and avoid the hazard.
- Electrical workers must test all equipment to verify if energy is present.
- Only qualified, trained workers may test electrical equipment.
- Workers must properly lockout and tagout any circuit or equipment being worked on and verify the equipment is de-energized.
- Personal protective equipment used by electrical workers must be appropriate and in good condition.
- Portable metal ladders and ladders with metal reinforcement are prohibited near energized electrical equipment.
- ALL electrical equipment used on a project (hand tools, etc.) must be protected with a ground-fault circuit interrupter (GFCI).
- Materials must not be stored in transformer vaults.
- AC and DC wiring systems must be properly grounded.
- Proper clearance from overhead power lines must be maintained at all times.

Regulatory Citations

A complete text of the requirements for Electrical Safety can be found in Title 29 Code of Federal Regulations, Part 1910, Section 147 and Subpart S, and Part 1926, Subpart K.

Contacts

For additional information regarding Electrical Safety requirements or clarification of these requirements, contact the New York regional OSHA office located at 201 Varick Street, Room 670, New York, New York 10014 (212-337-2378). The OSHA website can be found at www.OSHA.gov.

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9.0 – EXCAVATION AND TRENCHING

Overview

Excavation operations are among the first actions taken at a project site. Accidental cave-ins of earth that has been excavated account for a large majority of fatalities each year. In many cases, workers receive no warnings when excavated ground collapses and are suddenly trapped under tons of soil.

Minimum Excavation Requirements

In order to perform work on any Con Edison facility or project, all contractors must, at least, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific Environmental Health and Safety Plan submitted to Con Edison and include a process to meet these requirements.

- ALL UTILITIES MUST BE MARKED-OUT BY APPROPRIATE AUTHORITIES PRIOR TO ANY EXCAVATION.
- A trench is considered an excavation.
- All underground hazards (electric lines, gas/water lines, boulders, etc.) must be de-energized or removed/supported appropriately.
- Hand digging must be conducted near known or suspected underground systems.
- Ramps or runways used as a means of entry/exit for excavations must be designed by a competent person.
- A ladder or other safe means of exit must be used in excavations greater than four feet deep and cannot be greater than 25 feet from all workers in the excavation.
- Entering an excavation during digging is prohibited.
- When the atmosphere in an excavation is/can become hazardous, Proper atmospheric testing must be conducted as required by the Confined Space Program, Section 6 in this manual.
- Daily inspections of the excavation and surrounding areas must be conducted by a competent person before work begins and as needed during the shift.
- Excavations must be shored or braced if nearby structures (buildings, sidewalks, etc.) may become unstable.
- All material, including excavated soil, must be stored at least two feet from the side of the excavation.

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- Workers may only pass over an excavation on properly constructed walkways/bridges with guardrails in place.
- Adequate physical barriers must be provided around all excavations.
- Adequate protective systems must be used in excavations unless:
  - The excavation is entirely in stable bedrock; or
  - The excavation is less than five feet deep **AND** has been examined by a competent person who has found no signs of potential cave-ins.
- All excavations greater than five feet deep must be properly sloped, shored, braced, shielded, or protected by a system designed by a professional engineer.
- If a potentially hazardous material is encountered during excavation, all work must stop until the material can be evaluated by an industrial hygienist, or equivalent.

Regulatory Citations

A complete text of the requirements for Excavations can be found in Title 29 Code of Federal Regulations, Part 1926, Subpart P.

Contacts

For additional information regarding Excavation requirements or clarification of these requirements, contact the New York regional OSHA office located at 201 Varick Street, Room 670, New York, New York 10014 (212-337-2378). The OSHA website can be found at www.OSHA.gov.

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11.0 - FIRE PROTECTION AND PREVENTION

Overview

Fire safety and prevention is critical to the effective operations of Con Edison facilities. Con Edison focuses on responsibly safeguarding human and business assets to avoid a fire or explosion that may cause injury or disrupt operations. All contractors performing construction and maintenance operations must implement measures to prevent and control fires, if one occurs.

Fire Prevention and Fire Control Requirements

Prior to working in a Con Edison facility or on a Con Edison project, all contractors must, at a minimum, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific Environmental, Health and Safety (EH&S) Plan submitted to Con Edison and a process to meet these requirements.

- The contractor program must identify the fire protection requirements and procedures.
- The contractor must identify personnel who are trained in the use of fire extinguishers and fire fighting techniques personnel and can fight a fire during the early or incipient stage.
- A Con Edison Rep will be informed of all fire or explosion occurrences.
- Ensure all field offices, shanties, and storage facilities are constructed in accordance with applicable codes, and fabricated noncombustible material for protection against fire.
- The contractor must identify operations that present a potential fire hazard, for example hotwork (welding, grinding and cutting) and the use of flammable liquids and gases.
- Contractor must identify procedures to eliminate and control fire hazards including housekeeping, electrical safety, safety procedures for hot work, storage and handling of flammable and combustible liquids and compressed gases.
- Good housekeeping standards must be enforced in the work area, including the requirements that waste, rubbish and flammable materials and rags be removed from the area daily.
- All waste, rubbish, and flammable materials must be stored in approved containers.
- Handling procedures will address safe transport, use, and storage of flammable materials.
- Noncombustible tables or shelves, or protected work area will be used for hot work.
- Storing flammable liquids in approved safety cans that are painted red with a yellow band around the can and labeled to identify the contents.

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- Storing combustible liquids in green safety cans that are labeled to identify the contents.
- Storing all FCL in closed approved metal cabinets and only storing quantities of these liquids on-site that do not exceed the minimum amount required for efficient operation.
- Storing bulk drum quantities of FCL liquids in storage rooms specially designed for fire and spill protection.
- Prohibit the use of gasoline and other highly flammable liquids for cleaning.
- Using approved pumps, or approved self-closing faucets and drip pans when dispensing FCL from drums or portable tanks.
- Class B/C rated fire extinguishers will be located in close proximity to FCL areas and monthly and annual inspections will be performed to ensure that the units are ready for use.
- In the event of a fire involving compressed gases, the gases will be permitted to burn and not extinguished, under any circumstances, unless it is possible to control the gas flow.
- Oil, grease, and highly volatile liquids must not be stored near oxygen cylinders.
- Smoking is prohibited in the vicinity of flammable or combustible liquids and gases.
- Using liquefied petroleum gas (LPG) indoors for cutting and/or welding operations shall be limited to small quantities and no more than a one-pound bottle shall be stored in the building.
- Open flames or spark-producing tools must not be used in any enclosure where an explosion concern may exist until testing indicates that an explosion hazard does not exist.

Regulatory Citations

A complete text of the requirements for Hot Work can be found in Title 29 Code of Federal Regulations, Part 1910, Subpart Q and Part 1926, Subpart J.

Contacts: For additional information or clarification of these requirements, contact:

- The New York regional OSHA office located at 201 Varick Street, Room 670, New York, New York (212-337-2378), or visit the OSHA web site at: www.OSHA.gov.
- The NYC Fire Department located at 250 Livingston Blvd, Brooklyn, NY (718-694-2000).

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13.0 - HAZARD COMMUNICATION PROGRAM

Overview

OSHA requires that the hazards associated with all chemicals used or stored at a job site be evaluated. This information must be communicated to employees who may be exposed to these chemicals or use them in their daily jobs. The process for informing employees about the chemicals, their locations, and potential hazards is called a Hazard Communication (HAZCOM) program. In general, this program includes requirements and procedures for container labeling and other forms of warning, procedures for obtaining and retaining material safety data sheets (MSDSs) and employee training.

Minimum HAZCOM Requirements

In order to work in any Con Edison facility or on any project, all contractors must, at least, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific Environmental Health and Safety Plan submitted to Con Edison and include a process to meet these requirements.

- If any hazardous material is used or stored at the job site, the contractor's **written** HAZCOM program must be available to all contractor and Con Edison personnel for review upon request.
- The HAZCOM program must include procedures for:
  - Labeling containers and the use of warning forms;
  - Obtaining and retaining MSDSs;
  - Specific worker training requirements;
  - Documentation that these training requirements have been completed by each worker;
  - A list or inventory of hazardous material at the job site.
- The supervisor must inform all workers about the hazardous materials at the job site when they first are first assigned to a project and whenever a new hazardous material is brought to the site.
- Workers must be informed of the location of:
  - The HAZCOM program;
  - The list/inventory of hazardous substances;
  - The locations of MSDSs and the procedures for obtaining a copy of an MSDS;
  - These must all be available for each worker to review during their work period.
- The Con Edison representative must be informed of all chemicals brought to the site.

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13.0 - HAZARD COMMUNICATION PROGRAM

- Each contractor must obtain information from the Con Edison representative regarding chemicals that Con Edison uses or stores at the site.
- When more than one contractor is working at a job site, each contractor must inform the other(s) concerning the location of their MSDSs and procedures for labeling and worker protection.
- **THE PRIME CONTRACTOR IS RESPONSIBLE FOR COORDINATING THE HAZCOM PROGRAM ON THE JOB SITE.**
- ALL containers will be labeled.
  - Labels on hazardous material containers will not be defaced or removed.
  - The labels will identify the substance in the container and appropriate warnings about the substance.
  - The material identity will match the material currently in the container, its MSDS, and the overall list/inventory.
- An MSDS must be available at the job site for every chemical that is present at that site.
- A documented training program will be provided to every worker at the job site. This training will include:
  - Information regarding the HAZCOM program;
  - Health and environmental hazards of every chemical used at the job site;
  - Ways to detect the presence of hazardous materials at a job site (including monitoring methods and devices used);
  - How to read and understand the information contained on an MSDS; and
  - How workers can protect themselves from harmful exposure (e.g., safe work practices, personal hygiene, and protective equipment).

Regulatory Citations

A complete text of the requirements for HAZCOM can be found in Title 29 Code of Federal Regulations, Part 1910, Section 1200, and Title 29 Code of Federal Regulations, Part 1926, Section 59.

Contacts

For additional information regarding HAZCOM requirements or clarification of these requirements, contact the New York regional OSHA office located at 201 Varick Street, Room 670, New York, New York 10014 (212-337-2378). The OSHA web site can be found at www.OSHA.gov.

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14.0 - HEARING CONSERVATION

Overview

Noise is defined as unwanted sound. Noise can cause sudden traumatic temporary hearing loss, long-term slowly occurring hearing loss that is irreversible, disruption of communication, and masking of warning devices and alarms. These long-term effects may occur at noise levels lower that are constant and daily.

Minimum Hearing Conservation Requirements

In order to perform work on any Con Edison facility or project, all contractors must, at least, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific Environmental, Health and Safety Plan submitted to Con Edison and include a process to meet these requirements.

- Workers must not be exposed to noise levels above those stated in the regulations.
- All noise levels must be measured on the A-weighted scale by a trained person.
- When noise exposure includes two or more periods at different noise levels, the combined noise exposure must be calculated.
- When noise levels exceed the permissible limits, worker exposure must be controlled through engineering controls, administrative controls, personal protective equipment (PPE), or a combination of these.
- Engineering controls consist of isolating, enclosing, or insulating equipment or operations or substituting quieter equipment or operations.
- Engineering controls are always preferred over other controls.
- Administrative controls involve rotating workers to jobs having lower noise exposures and reducing the time that each worker is exposed.
- PPE, for example earplugs and earmuffs, must be rated to reduce the noise exposure to within acceptable limits.
- A noise exposure at or above 85 decibels on the A-weighted scale (dBA) averaged over an eight hour time period (with or without PPE) requires a formal written hearing conservation program.
- A hearing conservation program must include:
  - Noise monitoring;

14.0 - HEARING CONSERVATION

- Procedures for employee notification;
- Provisions to permit employees to observe monitoring;
- Initial and annual audiometric testing, and an evaluation of the audiogram by a qualified professional;
- A noise training program for all affected workers; and
- Formal record keeping.

- The following table is a guide to common noise levels:

Permissible Duration	**dBA**	**Examples of Noise Sources**
No protection or time exposure calculation required.	15	Wooded Forest
	25	Quiet Bedroom
	35	Library
	65	Normal Speaking
	75	General Office Area
Action Level for Hearing Conservation Program	85	Average Machine Shop
8 Hours	90	
6 Hours	92	
4 Hours	95	
3 Hours	97	
2 Hours	100	Air Spray Operation
1.5 Hours	102	
30 Minutes	110	Power Table Saw
15 Minutes	115	
7.5 Minutes	120	
4 Minutes	125	Rock-n-Roll Concert
2 Minutes	130	Aircraft Jet Engine/Ear Pain Threshold
NOT TO EXCEED	140	

- A standard rule-of-thumb for noise states that when standing face-to-face at a distance of 1 to 2 feet, if it is necessary to raise your voice to be heard, the background noise exceeds 85 dBA.

Regulatory Citations

A complete text of the requirements for Hearing Conservation can be found in Title 29 Code of Federal Regulations, Part 1910, Section 95 and Part 1926, Section 52.

Contacts

For additional information regarding Hearing Conservation requirements or clarification of these requirements, contact the New York regional OSHA office located at 201 Varick Street, Room 670, New York, New York 10014 (212-337-2378). The OSHA website can be found at www.OSHA.gov.

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18.0 - MATERIALS HANDLING

Overview

Materials handling can be accomplished in a variety of ways, lifted and moved both manually or using a mechanical means, such as a fork truck or crane. All types of material handling operations require safety planning and practices that are clearly defined.

Minimum Materials Handling Requirements

In order to perform work in any Con Edison facility or on any project, all contractors must, at least, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific Environmental, Health and Safety Plan submitted to Con Edison and include a process to meet these requirements.

- Whenever possible, objects will be lifted and moved by mechanical devices (cranes, manually operated chain hoists, fork trucks, etc.) rather than by manual effort.
- The mechanical devices will be appropriate for the lifting or moving task and will be operated only by trained and authorized personnel.
- Objects that require special handling or rigging will only be moved under the guidance of a person who has been specifically trained to move such objects.
- Lifting devices will be inspected, certified, and labeled to confirm their weight capacities.
- All devices shall be inspected by a trained and qualified individual at least once a year and will be inspected prior to each use by the user.
- Defective equipment will be taken out of service immediately and repaired or destroyed.
- Personnel will not pass under a raised load, nor will a suspended load be left unattended.
- Personnel will not be carried on lifting equipment, unless it is specifically designed to carry passengers.
- The wheels of the truck being loaded or unloaded will be chocked to prevent movement.
- The lift and swing path of a crane will be watched and maintained clear of obstructions.
- Accessible areas within the swing radius of a crane will be guarded or barricaded.
- All reciprocating, rotating, or other moving parts will be guarded at all times.
- Accessible fire extinguishers will be available in all mechanical lifting devices.

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- Lifting devices will never be left near the edge of excavations or unstable areas.
- Mobile lifting equipment, equipped with outriggers will be set before any work is begun.
- Operations near overhead power lines are prohibited unless the power source has been shut off and locked out/tagged out or the appropriate clearance distances are maintained.
- Cranes may only be moved when directed by a signal person.
- Wire ropes will be removed from service when any abrasion, scrubbing, peening, evidences of corrosion, kinking, crushing, bird caging, or other damage exists.
- Unsafe behavior while driving a fork truck is not permitted.
- Each fork truck will be provided with an overhead guard.
- All mobile lifting devices shall be equipped with an audible backup warning device.
- All traffic regulations shall be observed when a lifting device is in operation.
- Only authorized personnel shall refill liquefied petroleum gas (LPG) tanks on fork trucks.
- Employees involved in heavy lifting will be properly trained in lifting procedures and should be physically qualified to protect the person and the material.
- Tiered or stacked material will be stored within acceptable height limits to avoid falling. Only material that will be immediately used may be stored on scaffolds or runways.
- Personnel will be trained in the procedures used for material handling. This training will address the requirements of applicable regulations, for example the training of personnel who operate powered industrial trucks.

Regulatory Citations

A complete text of the requirements for Materials Handling can be found in Title 29 Code of Federal Regulations, Part 1910, Subpart N and Part 1926, Subparts H and O.

Contacts

For additional information regarding Materials Handling requirements or clarification of these requirements, contact the New York regional OSHA office located at 201 Varick Street, Room 670, New York, New York 10014 (212-337-2378), or visit the OSHA web site at: www.OSHA.gov.

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24.0 - PERSONAL PROTECTIVE EQUIPMENT

Overview

For many tasks, personal protective equipment (PPE) is as essential to the job as any tool. OSHA requires that every employer evaluate all tasks associated with a project to determine the hazards associated with these tasks and the appropriate PPE to be worn by each affected employee. This hazard assessment must be documented.

Minimum PPE Requirements

In order to perform work on any Con Edison facility or project, all contractors must, at least, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific Environmental, Health and Safety Plan submitted to Con Edison and include a process to meet these requirements.

- All employers must conduct a hazard assessment prior to the start of every project and as conditions change on the project to determine the types of PPE necessary for each task.
- The results of the hazard assessment must be communicated to every employee on the project prior to the start of work and as conditions change.
- All workers must be trained to recognize the need for and types of PPE necessary, the proper use of PPE, the limitations of PPE, and proper care and disposal of PPE.
- All workers must be trained in the procedures for inspecting PPE prior to use to ensure it provides the required protection.
- All PPE used must meet applicable American National Standards Institute (ANSI) standards.
- All PPE must be maintained in a sanitary and reliable condition.
- Where employees supply their own PPE, the employer is responsible for ensuring the adequacy, maintenance, and sanitation of this PPE.
- Hard hats must never be changed or modified in any way and must be appropriate for the type of work being performed. White hard hats are not permitted on any Con Edison site.
- Eye protection must be appropriate for the type of work being performed, and must be equipped with side shields.
- Burning goggles must be equipped with appropriate filtering lenses for the work being performed.

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- Gloves must provide adequate wrist and hand protection based on the tasks being performed, and must be compatible with and resistant to any potential hazard (sharps, chemical, electrical, etc.).
- Safety shoes or boots must be fitted with protective toe guards.
- Additional PPE may be necessary for certain situations, for example overboots or rubber boots should be worn for wet conditions or chemical spills, etc.
- Protective clothing (reusable or disposable) must be appropriate for the type of work being performed.
- Orange reflective vests, approved by the U.S. Department of Transportation, must be worn when working in areas exposed to or adjacent to vehicle traffic.
- Fall protection devices must meet the requirements defined in the Con Edison EHS Work Plan Guide for ***Working at Elevation*** which is in Section 33 of this manual.
- Workers required to wear hearing protection must be allowed to select the type of device they wish to wear from a number of suitable devices.
- Flame resistant garments are required in areas where there is a potential for arc or flash.

Regulatory Citations

A complete text of the requirements for Personal Protective Equipment can be found in Title 29 Code of Federal Regulations, Part 1910, Subpart I, and Part 1926, Section 28 and Subpart E.

Contacts

For additional information regarding Personal Protective Equipment requirements or clarification of these requirements, contact the New York regional OSHA office located at 201 Varick Street, Room 670, New York, New York 10014 (212-337-2378). The OSHA website can be found at www.OSHA.gov.

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26.0 - RESPIRATORY PROTECTION PROGRAM

Overview

Respiratory protection is often necessary to allow employees to work safely in hazardous environments. When an airborne contaminant or oxygen-deficient atmosphere exceeds the regulated exposure limits, an employer must eliminate the hazard through engineering and administrative controls or use of the proper respiratory protective equipment.

Minimum Respiratory Protection Requirements

In order to perform work on any Con Edison facility or project, all contractors must, at least, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific Environmental, Health and Safety Plan submitted to Con Edison and to include a procedure to meet these requirements.

- Contractor must have available a written Respiratory Protection Program (RPP).
- Perform Exposure Assessments to assess the need for respiratory protection based on limits established by OSHA, American Conference of Governmental Industrial Hygienist, National Institute of Occupational Safety and Health or Con Edison.
- Selection of the proper Air Purifying Respirators (APR) or Supplied Air Respirators (SAR) will depend on the characteristics of the workplace and the level of protection necessary. Characteristics include the concentration of airborne contaminants, immediately dangerous to life or health (IDLH) conditions, oxygen-deficient atmospheres, and the protection factor (PF) of each respirator.
- APR's will not be worn in oxygen-deficient atmospheres, IDLH conditions, when the contaminant exceeds the PF of the respirator, or when cartridges do not exist for a particular contaminant.
- Breathing air quality must meet the Compressed Gas Association's definition of "Grade D" air for all supplied air respirator use. This includes breathing air cylinders and five-minute escape cylinders. Compressors shall meet applicable OSHA standards.
- In IDLH atmospheres prior to entry, a rescue plan shall be conveyed to crew members.
- The contractor will follow OSHA regulations regarding maintenance, inspection, proper use of cylinders, fittings, hoses, manifolds, etc., and recordkeeping.
- Self-Contained Breathing Apparatus (SCBA) shall be used in situations where the contaminant or concentration of a contaminant is unknown.

26.0 - RESPIRATORY PROTECTION PROGRAM

- Respirator use requires training with the properly selected respirator, medical evaluation to wear the respirator, and proper fit-testing of the respirator.
- Respirators shall be inspected, maintained, cleaned, disinfected, and stored according to the manufacturers' directions and applicable OSHA guidelines..
- Emergency equipment shall be inspected monthly and all records will be kept on file.
- The RPP administrator shall maintain results of periodic program review, and shall identify, based on the results of the review, any necessary changes which may need to be made to the respiratory program. Records shall identify the name of the person conducting the review, the date, and any observations made during the review.
- Based on the RPP outlined in this work plan guide, the program manager shall maintain the following records at all times:
  - Hazard Assessments.
  - Employee Training.
  - Fit-Testing.
  - Medical Surveillance.
  - Respirator and Fit-Test Equipment Maintenance and Repair.

Regulatory Citations

A complete text of the requirements for Respiratory Protection can be found in Title 29 Code of Federal Regulations, Part 1910, Section 134.

Contacts

For additional information regarding Confined Space requirements or clarification of these requirements, contact the New York regional OSHA office located at 201 Varick Street, Room 670, New York, New York 10014 (212-337-2378), or visit the OSHA web site at: www.OSHA.gov.

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27.0 - SAMPLING

Overview

Samples may be required to characterize a material or waste, to confirm the presence or absence of hazardous substances, to determine the extent of a spill or release, to confirm that cleanup standards have been met, and/or to comply with permit or regulatory criteria or standards. It is the contractor's responsibility to ensure that samples are properly managed and analyzed, collection methods are consistent with all regulatory protocols and good sampling practice and samples are representative of the material.

Minimum Sampling Requirements

Prior to working in any Con Edison facility or on a Con Edison project, all contractors must, at a minimum, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific Environmental, Health and Safety (EH&S) Plan submitted to Con Edison and include a process to meet these requirements.

- The contractor must have a Sampling Plan including:
  - Sampling techniques that will be used.
  - A sampling summary, including sample matrices, parameters analyzed for, sample preparation, analytical method numbers, volumes and types of sample containers, sample preservation methods if required, and holding times allowed for the samples.
  - Sample handling procedures.
  - Quality Assurance /Quality Control procedures and Chain-of-Custody procedures. Equipment and personnel decontamination procedures.
  - How wastes generated during the sampling effort will be managed.
  - Method detection limits, method quantification limits, and reporting limits.
  - Data validation procedures and record keeping and documentation procedures.

- The contractor shall identify the procedures used to ensure that representative samples will be collected, including the procedures to prevent cross-contamination of samples, to prevent the loss of volatile constituents when samples are handled and placed in jars, and collect homogeneous samples of materials.

- If composite samples are identified for collection in the EH&S Plan, the Contractor shall specify how many aliquots will be used to make up each composite sample.

- The contractor must identify how many and what types of quality assurance/quality control (QA/QC) samples (i.e., duplicate, field blank, rinsate blank, and trip blank samples) will be collected during the sampling event.

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27.0 - SAMPLING

- The contractor must identify whether the laboratory that will analyze the samples is approved under New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) for the methods proposed. If the laboratory is ELAP-certified, the Contractor must provide the laboratory ELAP certification number.
- For asbestos sampling requirements, see the Con Edison Contractor EH&S Work Plan Guide for Asbestos.

Regulatory Citations

Documents prepared by United States Environmental Protection Agency (USEPA) and the New York State Department of Environmental Control (NYSDEC) governing the collection and analysis of environmental samples include:

- *The Region II CERCLA Quality Assurance Manual, Revision 1*, USEPA, October 1989,
- The NYSDEC *Sampling Guidelines and Protocols*, Division of Water, Bureau of Spill Prevention and Response, March 1991.

Contacts

For additional information regarding sampling requirements or clarification of these requirements, contact the following agencies:

- For projects within the five boroughs, contact the Region 2 NYSDEC office located at Hunters Point Plaza, 47-40 21st Street, Long Island City, New York 11101 (718-482-4900) "www.dec.state.ny.us".
- For projects located in Dutchess, Orange, Rockland, or Westchester Counties, contact the Region 3 NYSDEC office at 21 South Putt Corners Road, New Paltz, NY 12561 (914-256-3000) "www.dec.state.ny.us".
- For information on NYSDOH's ELAP program, contact the New York State Department of Health office in the Wadsworth Center, Empire State Plaza, Albany, NY 12201-0509 (518-485-5570) "www.health.state.ny.us".
- For all projects, also contact the Region II office of the EPA located at 290 Broadway, New York, New York 10007 (212-637-3000) "www.EPA.gov".

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28.0 - VEHICLE MANAGEMENT

Overview

Vehicles may be used for personnel transport, equipment or soil hauling, earthmoving, and pile driving. OSHA has specific requirements designed to ensure that vehicles are maintained and operated in a safe condition to protect workers and the public. In addition, state licenses and department of motor vehicles regulations address the proper operation and maintenance of vehicles.

Minimum Vehicle Management Requirements

In order to perform work on any Con Edison facility or project, all contractors must, at least, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific Environmental, Health and Safety Plan submitted to Con Edison and include a process to meet these requirements.

- Only properly trained personnel may operate the vehicles for which they are trained.
- All applicable personnel must possess valid Commercial Drivers Licenses.
- All vehicles must have a functioning service, emergency, and parking brake system and functioning brake lights.
- Vehicles will be inspected prior to use and removed from service if deficiencies exist.
- Vehicles used on public roads must have U.S. Department of Transportation approved flares, triangles, or other warning devices in the vehicle.
- Tools and materials carried in passenger compartments must be secured.
- Vehicles with cabs must have windshields and functioning powered wipers.
- All vehicles must have proper seats with seat belts for each person.
- Vehicles loaded by crane, loader, or similar equipment must have a cab shield or canopy. Equipment cabs must have safety glass that does not distort the driver's vision.
- All vehicles left near a highway at night must have appropriate warning devices.
- Workers must not work under or between equipment or vehicles suspended from slings, hoists, or jacks until the equipment is blocked or otherwise supported.
- All vehicles must be fully lowered and blocked during repair or when not in use.
- Parking brake must be set and wheels chocked when parked and on an incline.

28.0 - VEHICLE MANAGEMENT

- All vehicles must have functional backup alarms.
- Loads/Material must be secured and covered if disturbed by winds while in transit.
- Vehicles and equipment designed to move slowly over public roads must display an appropriate slow-moving traffic identification symbol (orange triangle).
- Roadway weight limits will be adhered to.
- The following equipment must have Roll-Over Protection Structures (ROPS):
  - Rubber-tired scrapers, loaders, and dozers, Wheeled tractors;
  - Crawler tractors and loaders, and Motor graders.
- ROPS must be labeled appropriately.
- Fueling operations must be conducted in accordance with the requirements of the Con Edison EHS Work Plan Guide for ***Fire Protection and Prevention*** in this manual.

Regulatory Citations

A complete text of the requirements for Vehicle Management can be found in Title 29 Code of Federal Regulations, Part 1926, Subparts F and O.

Contacts

For additional information regarding Vehicle Management requirements or clarification of these requirements, contact the New York regional OSHA office located at 201 Varick Street, Room 670, New York, New York 10014 (212-337-2378), or visit the OSHA web site at: www.OSHA.gov.

CON EDISON
ENVIRONMENT, HEALTH, AND SAFETY
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29.0 - WASTE MANAGEMENT

Overview

Federal and State laws require that wastes be properly classified and managed as hazardous waste, solid waste, or universal waste. Waste classification will define the requirements for managing the materials. In general, waste management includes characterization, labeling, storage, transportation, disposal, personnel training, and reporting and recordkeeping.

Minimum Waste Management Requirements

Prior to working in any Con Edison facility or on any Con Edison project, all contractors must, at a minimum, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific Environmental, Health and Safety Plan submitted to Con Edison, and include a process to meet these requirements.

- Contractors take title to all wastes generated if so stated in the specifications; however, CON EDISON RESERVES THE RIGHT TO TAKE TITLE TO ALL WASTES GENERATED BY THE CONTRACTOR'S ACTIVITIES AT CON EDISON FACILITIES AND WORK SITES.
- Contractor must have an active EPA waste generator identification for waste disposal.
- Contractor will comply with all applicable requirements for hazardous wastes generated, including:
  - Characterizing the waste, managing accumulated and stored waste.
  - Labeling of containers, storing the waste, inspecting the storage areas.
  - Filling out manifests and Land Disposal Restriction (LDR) forms.
  - Training of personnel concerning the proper procedures to use.
  - Ensuring that waste is disposed at a permitted facility.
  - Ensuring that reports and records are maintained.
- Contractor shall identify the procedures to classify wastes generated at the job site.
- Wastes shall be segregated when stored to prevent mixing of waste types.
- Storing of solid waste dumpsters will be properly maintained, able to store 150% of expected generation, and covered (with lids, doors, and/or tarps).
- Security measures will avoid non-authorized personnel from tampering with wastes.
- Contractor must evaluate the waste generated for recycling, instead of disposing of waste.

29.0 - WASTE MANAGEMENT

- Contractor must identify the transportation/disposal firms and their permit numbers to manage and transport Con Edison waste. Only permitted treatment/disposal facilities may be used to receive solid and hazardous wastes generated from a Con Edison job site.
- Department of Transportation (DOT) requirements will be adhered to for waste packaging, shipping, and transport, including container selection and vehicle placards.
- All hazardous and solid waste transporters must have the appropriate permits and certifications prior to hauling waste.
- The contractor shall provide copies of all shipping papers and certificates of disposal that are obtained and prepared for wastes generated at the job site.

Regulatory Citations

A complete text of the requirements for waste management can be found in:

- Title 40 CFR, US EPA, Parts 172, 173, 260 through 262, 264, 265, and 268;
- Title 6 NYCRR, Parts 360, 364, 367, 370 through 374, and 376;
- Title 6 Rules of the City of New York (RCNY) Chapter 2; Title 16 RCNY Chapter 1;
- Westchester County, Chapter 825 and Westchester County Local Law No. 14-1992;
- Dutchess County Local Law No. 4 of 1990.

Contacts For additional information contact the following agencies:

- In five boroughs, contact the NYC Department of Sanitation at 125 Worth Street, NYC, NY 10013 (212-219-8090) www.ci.nyc.ny.us and Region 2 NYSDEC at 47-40 21st Street, Long Island City, NY 11101 (718-482-4900) "www.dec.state.ny.us".
- Projects in Westchester, Rockland and Dutchess Counties, contact the Region 3 NYSDEC office at 21 South Putt Corners Road, New Paltz, NY 12561 (914-256-3000). Projects in Westchester County, contact the local municipality. Projects in Rockland County, contact the Rockland County Department of Health on Sanatorium Road, Pamona, NY 10970 (914-634-2500) "www.co.rockland.ny.us". Projects in Dutchess County, contact the Dutchess County Health Department, Division of Environmental Health Services in Poughkeepsie, NY 12601 (914-486-3404) "www.dutchessny.gov".

CON EDISON
ENVIRONMENT, HEALTH, AND SAFETY
WORK PLAN GUIDE

32.0 - WORK AREA PROTECTION

Overview

Workers must not only be protected from hazards on the project site but also from hazards generated by nearby operations. Members of the public passing near work areas must also be protected from any site-generated hazards. It is therefore important that all work areas be properly barricaded and posted with warning signs and that signals be used to control nearby vehicle traffic. In addition to OSHA, local agencies may have specific requirements for work conducted in roadways or near pedestrian traffic.

Minimum Work Area Protection Requirements

In order to perform work on any Con Edison facility or project, all contractors must, at least, meet the following requirements. Please note that additional requirements may be necessary based on job-specific activities. It is the responsibility of each contractor to identify these requirements in the job-specific Environmental, Health and Safety Plan submitted to Con Edison and include a process to meet these requirements.

- All work areas must be sufficiently barricaded to prevent unauthorized access and limit exposure of the public to work area hazards.
- Accident prevention signs (e.g., "Danger – Keep Out") must be visible when work is being performed and must be covered when hazards no longer exist.
- All signs must conform to the requirements specified by OSHA and be used only for their intended purpose.
- Traffic signs must be placed appropriately to control vehicle traffic on or near project sites and must conform to applicable American National Standards Institute (ANSI) standards.
- Flaggers must be used to control traffic when signs, signals and barricades do not provide the necessary protection.
- Flaggers and workers working near traffic must wear a reflective orange vest approved by the U.S. Department of Transportation.
- Only appropriately trained personnel may act as flaggers.
- Flashing warning lights must be placed on barriers during hours of darkness.
- Caution, warning, and construction information traffic signs must be displayed, as appropriate.

32.0 - WORK AREA PROTECTION

- Construction vehicles or equipment left or parked near a roadway must have appropriate warnings displayed or barricades positioned.
- Disabled vehicles must display reflective triangles, warning lights, flags, or flares to warn traffic of their position.
- The arrangement of traffic control devices must be inspected periodically to ensure their effectiveness.
- Barricades must be weighted or supported to prevent their displacement.
- Workers responsible for placing traffic control devices must be trained in the use and placement of these devices.

Regulatory Citations

A complete text of the requirements for Work Area Protection can be found in Title 29 Code of Federal Regulations, Part 1910, Sections 144 and 145, and Part 1926, Subpart G.

Contacts

For additional information regarding Work Area Protection requirements or clarification of these requirements, contact:

- The New York regional OSHA office located at 201 Varick Street, Room 670, New York, New York (212-337-2378). The OSHA website can be found at www.OSHA.gov.
- The New York City Department of Transportation located at 40 Worth Street, Manhattan, New York (212-442-7070).
- The New York State Department of Transportation located at 47-40 21st Street, Long Island City, New York (718-482-4600).

Con Edison
Consolidated Edison Company of New York, Inc.
31-01 20th Avenue, L.I.C., New York 11105-2048

December 30, 2002

VIA AIRBORNE EXPRESS

Joseph Moloughney, P.E.
NYSDEC
MGP Remedial Section
Division of Environmental Remediation
625 Broadway, 11th Floor
Albany, NY 12233-7017

RE: Investigation Derived Waste Handling
Consolidated Edison Voluntary Cleanup Agreement
Index No. D2-0003-02-08

Dear Mr. Moloughney:

Consolidated Edison Company of New York, Inc. (Con Edison) has reviewed the comments provided in the NYSDEC's letter dated November 1, 2002, regarding additional investigation derived waste handling requirements. Con Edison has revised the procedure to reflect those comments. The revised waste handling summary and supporting flow diagram are enclosed. As stated in the Department's November 1, 2002, letter the waste handling procedures are acceptable upon incorporating these additional requirements.

If you have any questions or require additional information please do not hesitate to contact me at (718) 204-4146.

Very truly yours,

Glen H. Katz
Environment, Health & Safety
Remediation

Enc.

C: Eddy Louie, Con Edison
Jane O'Connell, NYSDEC Region 2
Sam Arakhan, NYSDEC Region 2
Tom Killeen, NYSDEC Region 3

Handling of Investigation Derived Waste At Manufactured Gas Plant Sites

1) **Investigation Derived Waste (IDW) generated at Manufactured Gas Plant (MGP) locations not owned by Con Edison**

    a) The intent of this protocol is to establish a procedure that will allow Con Edison to avoid staging IDW "pending analysis" at third-party locations, where said staging is not feasible. Rather, the wastes will be transported and held at a properly permitted commercial, RCRA TSDF pending the receipt of waste characterization analysis results and the subsequent disposal of the waste.

    b) Con Edison will act as the generator of the MGP waste derived at each site.

    c) The IDW will likely be comprised of personal protective equipment (PPE), plastic sheeting, sorbents/rags, soil cuttings, well development and purge water, and decontamination liquids.

2) **Waste Characterization**

    a) Appropriate waste characterization samples will be collected and submitted to a fixed-base laboratory for analysis.

        i) Data should be available within 5-7 days.
        ii) Waste characterization parameters will be dictated by the requirements of the disposal facility, but will likely include TCLP organics and heavy metals.
        iii) Once the fixed-base analytical data is received and evaluated, arrangements will be made for final disposal of the wastes.

    b) In order to expedite shipping the waste from the MGP site to a commercial TSDF:

        i) Generator knowledge will be used in combination with field test kits (e.g., BTEX and total metals) to make a determination as to the appropriate RCRA waste classification for the material; and
        ii) Samples will be collected and submitted to Con Edison's ChemLab for PCB analysis by EPA Method 8080 using the ASE extraction method. The results will determine TSCA applicability and help characterize the IDW for transit.

            (1) The turn-around-time for PCB analysis is expected to be within 4 hours.

3) Waste Tracking, Transportation and Disposal

a) The data generated by the ChemLab PCB analysis and by the field test kits will be used to make a determination as to the appropriate waste classification (PCB or non-PCB, hazardous or non-hazardous) for the materials. The waste will then be placed in transit to an approved TSDF.

b) Regardless of the TSCA or RCRA status, a hazardous waste manifest will be used for waste shipments.

   i) Wastes identified as non-hazardous and non-PCB by field-testing and ChemLab PCB analysis will be shipped as non-regulated waste. Should a hazardous exceedence for any parameter be detected by the fixed-base waste characterization analysis (possibly contradicting the field test kit results), the manifest will be modified at the TSDF to reflect this change in classification.

   ii) Materials identified as hazardous and/or PCB waste by field-testing and/or ChemLab PCB analysis will be shipped as hazardous and/or PCB waste, as appropriate.

c) If any data (field test kit, ChemLab PCB analysis, or fixed-base laboratory analysis) indicate that the waste is hazardous, it will be properly disposed within 10 days of generation.

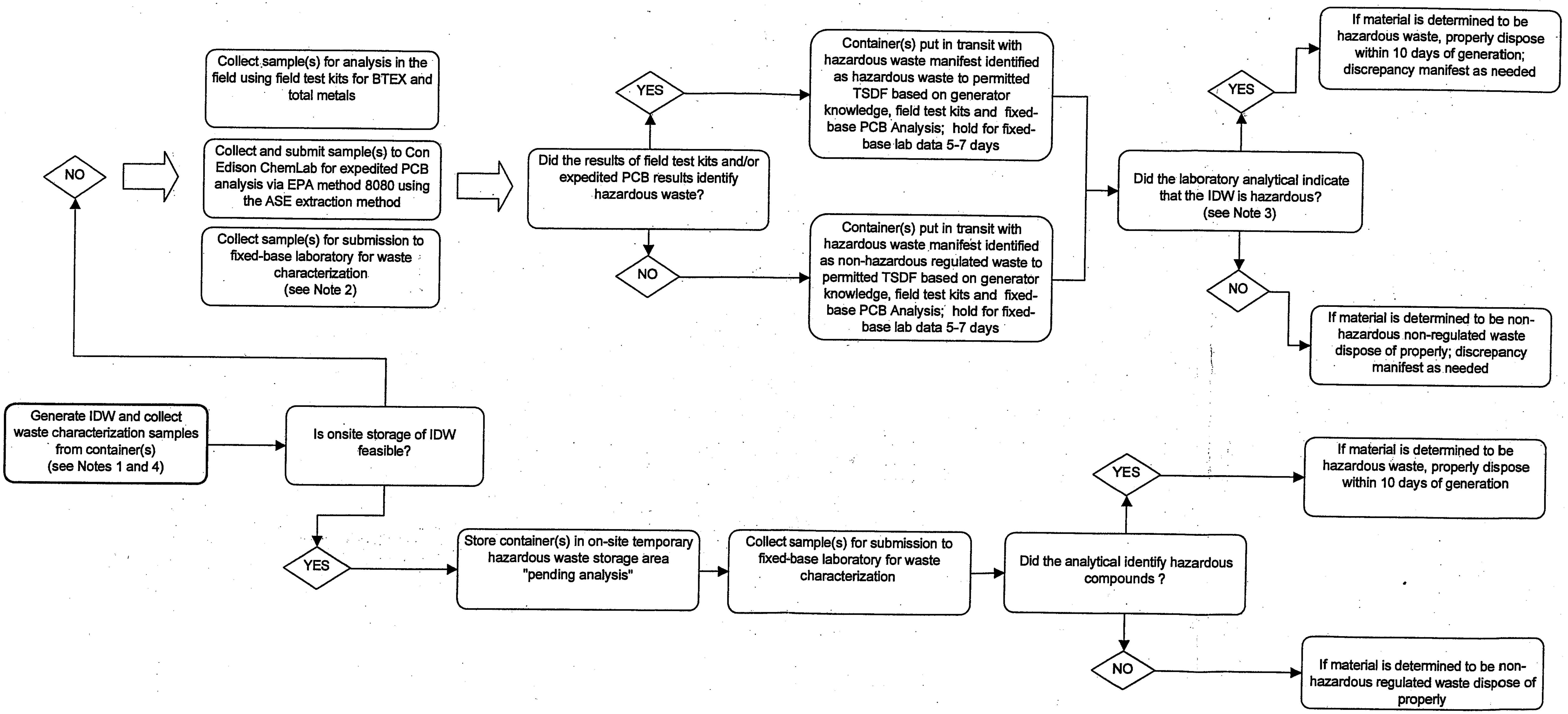
4) EPA ID Numbers

a) Prior to implementing the MGP Site Characterization Work Plan, Con Edison will obtain a separate permanent or temporary EPA ID number for each affected parcel in the event that hazardous wastes are generated. Upon the completion of the investigation and remediation activities at a site (i.e., upon site closure), the ID number for the site will be delisted.

Consolidated Edison Company of New York, Inc.

HANDLING OF IDW AT MANUFACTURED GAS PLANT SITES

December 30, 2002



Generate IDW and collect waste characterization samples from container(s) (see Notes 1 and 4)

Is onsite storage of IDW feasible?

Collect sample(s) for analysis in the field using field test kits for BTEX and total metals

Collect and submit sample(s) to Con Edison ChemLab for expedited PCB analysis via EPA method 8080 using the ASE extraction method

Collect sample(s) for submission to fixed-base laboratory for waste characterization (see Note 2)

Did the results of field test kits and/or expedited PCB results identify hazardous waste?

Container(s) put in transit with hazardous waste manifest identified as hazardous waste to permitted TSDF based on generator knowledge, field test kits and fixed-base PCB Analysis; hold for fixed-base lab data 5-7 days

Container(s) put in transit with hazardous waste manifest identified as non-hazardous regulated waste to permitted TSDF based on generator knowledge, field test kits and fixed-base PCB Analysis; hold for fixed-base lab data 5-7 days

Did the laboratory analytical indicate that the IDW is hazardous? (see Note 3)

If material is determined to be hazardous waste, properly dispose within 10 days of generation; discrepancy manifest as needed

If material is determined to be non-hazardous non-regulated waste dispose of properly; discrepancy manifest as needed

Store container(s) in on-site temporary hazardous waste storage area "pending analysis"

Collect sample(s) for submission to fixed-base laboratory for waste characterization

Did the analytical identify hazardous compounds ?

If material is determined to be hazardous waste, properly dispose within 10 days of generation

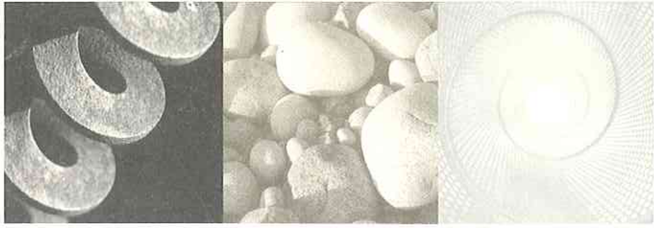
If material is determined to be non-hazardous regulated waste dispose of properly

Notes:

1. To the extent possible, generator knowledge of the site will be used to assist in waste characterization.
2. Laboratory analytical parameters for waste characterization will include TCLP VOCs, SVOCs, metals, RCRA characteristics.
3. If fixed-base analytical data contradicts field test kits, fixed-base data will supercede field kits.
4. Each affected parcel will have temporary or permanent EPA ID number assigned prior to the commencement of work.

Appendix B

Field Sampling Plan



Geotechnical
Environmental
Water Resources
Ecological

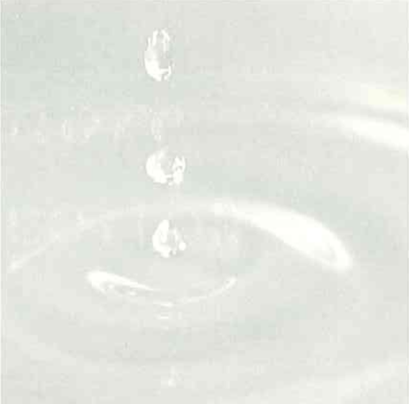
Operable Unit 1 Field Sampling Plan
East 173rd Street Works Former MGP Site

Starlight Park, Bronx, New York
VCA Index No. D2-0003-02-08
Site #: V00552

Prepared for:
Consolidated Edison Company
of New York, Inc.
31-01 20th Avenue
Astoria, NY 11105

Prepared by:
GEI Consultants, Inc.
1 Greenwood Avenue Suite 210
Montclair, NJ 07042
(973) 509-9650

March 16, 2010
013943-3-1103



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Figures

Abbreviations and Acronyms

CAMP	Community Air Monitoring Plan
CMS	Chip Measuring System
COC	Chain-of-Custody
DNAPL	Dense Nonaqueous Phase Liquids
FSP	Field Sampling Plan
HASP	Health and Safety Plan
ID	Inner Diameter
MGP	Manufactured Gas Plant
MS/MSDs	matrix spike/matrix spike duplicates
NYCDEP	New York City Department of Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NIST	National Institute of Standards and Technology
OU	Operable Unit
PID	Photoionization Detector
PPE	Personal Protective Equipment
ppm	Parts per Million
PQAM	Project Quality Assurance Manager
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
RA	Remedial Action
SMP	Site Management Plan
SVOC	Semivolatile Organic Compound
TCL	Target Compound List
UFPO	Underground Facilities Protective Organization
USCS	United Soil Classification Systems
VOC	Volatile Organic Compound

1. Introduction

This Field Sampling Plan (FSP) has been prepared to specify procedures that need to be followed during the implementation of post-Remedial Action (RA) groundwater monitoring and excavation activities conducted below the clean cover and demarcation barrier that will be installed at the Site as part of required Operable Unit 1 (OU-1) RA construction activities. The numbers and types of environmental samples to be collected for excavation activities will be described in a project Work Plan that will be submitted for Con Edison for New York State Department of Environmental Conservation (NYSDEC) approval prior to the start of work.

1.1 Overview of Field Activities

The following field activities may be performed as part of post-RA groundwater monitoring and excavation activities at the Site:

- Air monitoring
- Subsurface soil sampling
- Excavation and soil sampling
- Soil borings, monitoring well installation, and well development
- Groundwater sampling
- Contaminated soil/material load out and transport activities
- Clean Cover and Demarcation Barrier repair
- Site surveying
- Other work as applicable

2. General Field Guidelines

2.1 Site Hazards

Potential on-Site surface hazards, such as sharp objects, overhead power lines, energized areas, and building hazards will be identified prior to initiation of fieldwork. Generally, such hazards will be identified during a site visit prior to the first day of fieldwork.

2.2 Underground Utilities

All underground utilities, including electric lines, gas lines, and communication lines will be identified prior to initiation of drilling and other subsurface work. This will be accomplished as follows:

- All on-Site underground utilities in the vicinity of proposed drilling or excavation locations will be located.

- Any off-Site underground utilities in the vicinity of proposed drilling or excavation locations will be located and marked by a representative of the Underground Facilities Protective Organization (UFPO): (800) 272-4480. New York State law requires that UFPO be notified at least three working days, and not more than ten working days, before subsurface work is conducted. Sewer and water will be marked out by the New York City Department of Environmental Protection (NYCDEP).

2.3 Field Log Books

All field activities will be carefully documented in field log books. Entries will be of sufficient detail that a complete daily record of significant events, observations, and measurements is obtained. The field log book will provide a legal record of the activities conducted at the Site. Accordingly:

- Field books will be assigned a unique identification number.
- Field books will be bound with consecutively numbered pages.
- Field books will be controlled by the Field Team Leader while field work is in progress.
- Entries will be written with waterproof ink.
- Entries will be signed and dated at the conclusion of each day of fieldwork.

- Erroneous entries made while fieldwork is in progress will be corrected by the person that made the entries. Corrections will be made by drawing a line through the error, entering the correct information, and initialing the correction.
- Corrections made after departing the field will be made by the person who made the original entries. Corrections will be made by drawing a line through the error, entering the correct information, and initialing and dating the time of the correction.

At a minimum, daily field book entries will include the following information:

- Location of field activity;
- Date and time of entry;
- Names and titles of field team members;
- Names and titles of any site visitors and site contacts;
- Weather information, for example: temperature, cloud coverage, wind speed and direction;
- Purpose of field activity;
- A detailed description of the fieldwork conducted;
- Sample media (soil, groundwater, etc.);
- Sample collection method;
- Number and volume of sample(s) taken;
- Description of sampling point(s);
- Volume of groundwater removed before sampling;
- Preservatives used;
- Analytical parameters;
- Date and time of collection;
- Sample identification number(s);
- Sample distribution (e.g., laboratory);
- Field observations;
- Any field measurements made, such as pH, temperature, 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;
  - Federal Express Air Bill Number.

3. Field Equipment Decontamination and Management of Excavation Derived Wastes

3.1 Decontamination Area

A temporary decontamination area lined with polyethylene sheeting will be constructed on-Site for steam-cleaning drilling and excavation equipment. Water collected from the steam-cleaning activities will be collected in 55-gallon drums or other container and managed as described in Section 3.3.

3.2 Equipment Decontamination

The following procedures will be used to decontaminate equipment used during drilling and excavation activities.

- All drilling and excavation equipment including the drilling rig, augers, bits, rods, tools, split-spoon samplers and tremie pipe will be cleaned with a high-pressure steam cleaning unit before beginning work.

- 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.

- All augers, rods, and tools will be decontaminated between each drilling location according to the above procedures.

- The back of drilling rig, backhoe/excavator bucket and all tools, augers, and rods will be decontaminated at the completion of the work and prior to leaving the site.

3.2.1 Sampling Equipment Decontamination

Suggested Materials:

- Potable water
- Simple Green®
- Reagent-grade methanol or isopropanol
- Distilled water
- Aluminum foil
- Plastic/polyethylene sheeting

- Plastic buckets and brushes
- Personal protective equipment in accordance with the Site Management HASP

Procedures

- Prior to sampling, all non-dedicated sampling equipment (bowls, spoons, interface probes, etc.) will be either steam cleaned or washed with potable water and Simple Green®. Decontamination may take place at the sampling location as long as all liquids are contained in pails, buckets, etc.

- The sampling equipment will then be rinsed with potable water followed by a deionized water rinse.

- Between rinses, equipment will be placed on polyethylene sheets or aluminum foil if necessary. At no time will washed 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.

3.3 Management of Excavation Derived Wastes

3.3.1 Decontamination Fluids

Steam-cleaning and decontamination fluids will be collected in 55-gallon drums or other containers. The containers will be labeled as investigation derived wastewater and temporarily stored on wooden pallets in a plastic-lined containment area pending characterization and proper disposal.

3.3.2 Drill Cuttings, Excavated Soil/Fill and Groundwater

Soil excavated from below the demarcation barrier may be reused as on-Site backfill material provided that soil contains no visible evidence of DNAPL tar, has concentrations of total volatile organic compounds (VOCs) that do not exceed 10 parts per million (ppm), has concentrations of total semivolatile organic compounds (SVOCs) that do not exceed 5000 ppm, and is placed beneath the demarcation-warning barrier. Soil of fill that contains evidence of DNAPL tar, and/or does not meet the 500 ppm total SVOC/10 ppm total VOC criteria, must be transported off Site for disposal at a permitted facility.

Site soil or fill that is excavated below the demarcation/warning barrier and that is transported off Site for disposal must be managed, characterized, and properly disposed of in accordance with NYSDEC regulations and directives.

Any groundwater that is uncounted during excavation work below the clean cover, and that must be removed from the excavation to accommodate this work, will be containerized and characterized for off-Site treatment and disposal in accordance with applicable NYSDEC rules and regulations.

3.3.3 Development and Purge Water

All development and purge water will be contained in 55-gallon drums or other container. The containers will be labeled as investigation derived wastewater and temporarily stored on wooden pallets in a plastic-lined containment area pending characterization for off-Site treatment and disposal in accordance with applicable NYSDEC rules and regulations

3.3.4 Personal Protective Equipment

All personal protective equipment (PPE) will be placed in 55-gallon drums or other container for proper disposal in accordance with applicable NYSDEC rules and regulations.

3.3.5 Dedicated Sampling Equipment

All dedicated groundwater sampling equipment (dedicated disposable polyethylene bailer and dedicated polypropylene line) will be placed in 55-gallon drums or other container for disposal in accordance with applicable NYSDEC rules and regulations.

4. Drilling/Excavation/Soil Sampling Procedures

4.1 Introduction

Drilling and excavation activities that may be conducted at the Site consist of:

- Backhoe/excavator digging;
- Soil borings;
- Monitoring well installations; and.
- Other work as applicable

These procedures are described in the following section. Equipment decontamination procedures are described in Section 3.

4.2 Excavation, Soil Borings and Subsurface soil Sampling

The following suggested methods can be used for conducting excavations and soil borings.

Suggested Equipment

- Field book
- Project plans
- Personal protective equipment in accordance with the HASP
- Metal detector
- Stakes and flagging
- One pint containers for lithology samples
- Tape measure
- Decontamination supplies
- Water level indicator
- PID (such as RaeSystems Mini Rae 2000)
- Camera
- Clear tape, duct tape
- Aluminum foil
- Laboratory sample bottles
- Coolers and ice
- Shipping supplies

Drilling, Excavation and Geologic Logging Method

- Soil borings advanced using a direct push and/or hollow-stem auger drilling methods and/or similar drilling equipment.

- Soil samples will be collected continuously from the demarcation barrier to the bottom of the borings using 2-foot long, 2-inch diameter discrete samplers, a 48-inch long, 1-5/8-inch diameter Macro-core®, and/or 2-foot long split-spoon sampler, and/or similar sampling equipment. Soil samples will be collected from excavations from the bucket of the backhoe/excavator or from the sidewalls of the excavation using remote sampling equipment.

- Soil samples retrieved from boreholes and excavations will be visually described for: 1) percent recovery, 2) soil type, 3) color, 4) moisture content, 5) texture, 6) grain size and shape, 7) consistency, 8) visible evidence of staining, and 9) any other observations. The descriptions will be in accordance with the Unified Soil Classification System (USCS).

- Soil samples will be immediately screened for the evolution of organic vapors with a photoionization detector (PID).

- A representative portion of the sample will be placed in a plastic "ziplock" bag or an eight-ounce sample jar filled approximately half full. The container will be labeled with the boring number or excavation number and interval sampled. The cap will be screwed on tightly. Bags will be closed completely.

- After a minimum of 10 minutes, the lid will be unscrewed or bag unzipped and the tip of the PID will be inserted under the cap or into the bag to measure the headspace for organic vapors.

- Remaining soil will be disposed of in accordance with methods specified in Section 3.3.

- All drilling and excavation equipment will be decontaminated between each boring and/or excavation in accordance with methods specified in Section 3.2.

- The designated field geologist will log geology and headspace measurements in the field book and the Drilling Record shown in Figure 4.1, or similar form.

Soil Sampling

The number and frequency of samples to be collected from each boring or excavation will be described in a project Work Plan that will be submitted for Con Edison for NYSDEC approval prior to the start of work. Associated analytical parameters are summarized in Section 5 of the Site Management Plan (SMP).

- Samples for VOC analyses will be collected directly from the sampling equipment, placed into appropriate containers, and compacted to minimize head space and pore space. The remaining sample volume will be placed into a stainless steel bowl, homogenized, and placed in appropriate containers for the other analyses.

- The sample containers will be labeled, placed in a laboratory-supplied cooler, and packed on ice (to maintain a temperature of 4° C). The coolers will be shipped overnight to the laboratory for analysis.

- Chain-of-custody procedures will be followed as outlined in the SMP Quality Assurance Project Plan (QAPP).

- The sampling equipment will be decontaminated between samples in accordance with procedures described in Section 3.

- Excess soil remaining after sampling will be handled in accordance with methods specified in Section 3.3.

- The sample locations, descriptions, and depths will be recorded in the field book.

4.3 Monitoring Well Installation and Development

It's not anticipated that monitoring wells will be installed within the area of the clean fill cover and demarcation barrier. However, if any monitoring wells are required, the following methods will be used for drilling, installing, and developing the monitoring wells. Alternative methods may be used if approved by the NYSDEC.

Suggested Equipment

- Field book
- Project plans
- Personal protective equipment in accordance with the HASP
- Metal detector
- One pint containers for lithology samples
- Tape measure

- Decontamination supplies
- Water level indicator
- PID
- Camera
- Clear tape, duct tape
- Aluminum foil
- Laboratory sample bottles
- Coolers and ice
- Shipping supplies
- Polyethylene disposable bailers (development)
- Polypropylene rope (development)
- Waterra pump or other purge pump (development)
- Stainless steel or glass beakers (development)
- Turbidity meter (development)
- Temperature, conductivity, pH meter (development)

Monitoring Well Installation

Figure 4.2 shows a cross-section for a typical monitoring well. The monitoring wells will be installed in accordance with the following specifications:

- The monitoring well borings will be advanced with 4.25-inch inner diameter (ID) hollow stem augers.

- Wells will be constructed with two-inch ID, threaded, flush-joint, PVC casings and screens.

- Screens will be ten feet long with 0.02-inch slot openings and a two-foot sump at the base.

- The annulus around the screens will be backfilled with silica sand having appropriate size (e.g., Morie No. 1) to a minimum height of two feet above the top of the screen. Auger flights will be withdrawn as sand is poured in a manner that will minimize hole collapse and bridging.

- A bentonite pellet seal or slurry seal with a minimum thickness of two foot will be placed above the sand pack. The bentonite seal (pellets) will be allowed to hydrate before placement of grout above the seal.

- The remainder of the annular space will be filled with a cement-bentonite grout to ground surface. The grout will be pumped from the bottom up. The grout will be allowed to set for a minimum of 24 hours before wells are developed.

- Each monitoring well will have a vented cap and will be contained in a flush-mounted vault.

- The concrete seal or pad will be sloped to channel water away from the well, and be deep enough to remain stable during freezing and thawing of the ground.

- The top of the PVC well casing will be marked and surveyed to 0.01 foot, and the elevation will be determined relative to a fixed benchmark or datum.

- The measuring point on all wells will be on the innermost PVC casing.

- Monitoring well construction details will be recorded in the field book and on the Construction Log shown in Figure 4.3, or similar form.

Monitoring Well Development

- After a minimum of 24 hours after completion, the monitoring wells will be developed by surging, bailing, using a centrifugal or peristaltic pump and dedicated polyethylene tubing, using a Waterra positive displacement pump and dedicated polyethylene tubing, or other methods at the discretion of the NYSDEC.

- Water levels will be measured in each well to the nearest 0.01 foot prior to development.

- 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). A portable nephelometer will be used to make this measurement.

- Development water will be contained in accordance with methods specified in Section 3.3.

- Following development, wells will be allowed to recover for at least 24 hours before groundwater is purged and sampled. All monitoring well development will be and recorded in the field book.

5. Groundwater Sampling Procedures

5.1 Introduction

Groundwater sampling will be conducted at the Site: Procedures for obtaining samples of various environmental media are described in this section. Subsurface soil sampling procedures are described in Section 4. Air monitoring procedures are described in Section 6. Sample handling procedures are described in Section 8.

5.2 Groundwater Sampling

The following method will be used to collect groundwater samples from monitoring wells.

Suggested Equipment and Supplies

- Field book
- Project plans
- Personal protective equipment in accordance with the HASP
- Water level indicator
- Disposable polyethylene bailers
- Polypropylene rope
- Temp, conductivity, pH meters
- Turbidity meter
- 250-mL glass beaker
- Decontamination supplies
- Waterra pump or other purge pump
- Plastic tubing
- Plastic sheeting
- PID
- Clear tape, duct tape
- Coolers and ice
- Laboratory sample bottles
- Federal Express labels

Groundwater Sampling Method - Purging

- Prior to sampling, the static water level and thickness of any free product will be measured to the nearest 0.01 foot from the surveyed well elevation mark on the top of the PVC casing with a decontaminated oil/water interface probe. The measurement will be recorded in the field book.

- The probe will be decontaminated according to procedures outlined in Section 3.
- The well will be purged by removing a minimum of three well volumes of water. Purging will be conducted with either a bailer, a peristaltic pump, a Waterra positive displacement pump equipped with dedicated tubing, or a decontaminated submersible pump and dedicated tubing.
- If a well goes dry before the required volumes are removed, it will be allowed to recover, purged a second time until dry or the required volumes are removed, and sampled when it recovers sufficiently.
- Purge water will be managed and disposed of in accordance with procedures described in Section 3.

Groundwater Sampling Method – Sampling

- Samples will be collected with a dedicated disposable polyethylene bailer lowered with a dedicated polypropylene line or with low-flow sampling techniques.
- Prior to filling the sample bottles, one 250-mL beaker will be filled with water. The temperature, pH, and conductivity will be measured with a precalibrated probe and recorded in the field book.
- Sample containers for VOCs will be filled first. Sample containers for the other analytes will follow.
- The sample containers will be labeled, placed in a laboratory-supplied cooler and packed on ice (to maintain a temperature of 4° C). The cooler will be shipped overnight or delivered to the laboratory for analysis.
- Chain-of-custody procedures will be followed as outlined in the QAPP.
- After all samples are collected, the polypropylene rope and bailer will be disposed of in accordance with methods described in Section 3.3.
- Well sampling data will be recorded on the Groundwater Sampling Record shown in Figure 5.1, or similar form.

6. Air Monitoring

6.1 Breathing Zone Air Monitoring During Excavation, Drilling, and Sampling

Air monitoring of the breathing zone will be conducted periodically during all drilling, excavation, and sampling activities conducted below the clean fill cover and demarcation barrier to assure proper health and safety protection for field workers.

- RaeSystems Mini Rae 2000 photoionization detector (PID) or equivalent will be used to monitor for organic vapors in the breathing zone and borehole, and to screen the samples.
- Mini Ram™ PM-10 (or equivalent), particle detector will be used to count inhalable particles of dust during fieldwork.
- Chip Measuring System (CMS) electronic Draeger tubes will be used to monitor for hydrogen cyanide during fieldwork.

The readings will be recorded in the field book and on the boring log during drilling activities. The procedure for air monitoring equipment operation and calibration is included in Section 7 and the SMP Health and Safety Plan (HASP).

6.2 Community Air Monitoring Plan

In accordance with NYSDEC and New York State Department of Health (NYSDOH) requirements, a Community Air Monitoring Plan (CAMP) will be implemented at the Site during Drilling and excavation activities conducted below the clean cover and demarcation barrier. The objective of the CAMP is to provide a measure of protection for the downwind community (i.e., off-site receptors, including residences and businesses and on-site workers not involved with drilling and/or excavation activities) from potential airborne contaminant releases as a direct results of drilling and/or excavation activities. Two air-monitoring stations will be set up on Site. VOCs and respirable particulates (PM-10) will be monitored at the downwind perimeter of the immediate work area on a contiguous basis. Wind direction will be determined using a wind sock(s) and/or flagging poles installed on site. Upwind concentrations will also be measured continuously to establish background conditions. VOC vapors will be monitored using a PID. Particulate dust will be monitored using a MiniRAM™ PM-10 particulate meter. Fifteen-minute running average concentrations will be collected from each of the two air monitoring stations during work activities. A summary of air monitoring action levels and restrictions are presented in the SMP HASP.

7. Field Instruments and Calibration

All field analytical equipment will be calibrated immediately prior to each day's use and more frequently if required. 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. All instrument calibrations will be documented in the project field book and in an instrument calibration log. Records of all instrument calibration will be maintained by an assigned Field Team Leader and will be subject to audit by an assigned Project Quality Assurance Manager (PQAM). Copies of all of the instrument manuals will be maintained on-site by the Field Team Leader.

The following field instruments will be used during the investigation:

- RaeSystems Mini Rae 2000 PID (or equivalent);
- pH Meter;
- Specific Conductivity Meter and Temperature Probe;
- Turbidity Meter; and
- MiniRAM™ PM-10 Particulate Meter.

7.1 Portable Photoionization Analyzer

- The PID will be a RaeSystems Mini Rae 2000 (or equivalent), equipped with a 10.6 eV lamp. The Photovac is 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 Target Compound List (TCL).

- Calibration must be performed at the beginning and end of each day of use with a standard calibration gas having an approximate concentration of 100 parts per million of isobutylene. If the unit experiences abnormal perturbation or erratic readings, additional calibration will be required.

- All calibration data must be recorded in field notebooks and on calibration log sheets to be maintained on site.

- A battery check must be completed at the beginning and end of each working day.

7.2 pH Meter

- Calibration of the pH meter must be performed at the start of each day of use, and after very high or low readings as required by this plan, according to manufacturer's instructions.

- National Institute of Standards and Technology (NIST) - traceable standard buffer solutions which bracket the expected pH range will be used. The standards will be pH of 4.0, 7.0 and 10.0 standard units.

- The use of the pH calibration must be used to set the meter to display the value of the standard being checked.

- The calibration data must be recorded on calibration sheets maintained on site.

7.3 Specific Conductivity Meter and Temperature Probe

- Calibration checks using the conductivity standard must be performed at the start of each day of use, after five to ten readings or after very high or low readings as required by this plan, according to manufacturer's instructions.

- The portable conductivity meter must be calibrated using a reference solution of 200 uohms/cm on a daily basis. Readings must be within five percent to be acceptable.

- The thermometer of the meter must be calibrated against the field thermometer on a weekly basis.

7.4 Turbidity Meter

- The turbidity meter must be checked at the start of each day of use and at the end of the day according to manufacturer's instructions.

7.5 Particulate Meter

- The particulate meter must be calibrated at the start of each day of use in accordance with the manufacturer’s instructions.

8. Field Sample Identification and Custody

8.1 Sample Location Numbering System

- Subsurface soil borings and/or excavations will be numbered consecutively. Individual samples will also be designated with a depth code (see below).

- Monitoring wells will be numbered consecutively.

8.2 Sample Identification

Each sample will be given a unique alphanumeric identifier in accordance with the following classification system:

SAMPLE IDENTIFICATION

LL*	NN*	N-N	LL
Sample Type	Sample Number	Depth Code	QC Identifier

	Solid		Water
Sample Type:	MW - Monitoring Well Boring		MW - Monitoring Well
	SB – Soil Boring		
	EX - Excavation		
Sample Number:	Number referenced to a sample location map.		
Depth Code:	Depth in feet of sample interval (0-0.5, 2-4, 10-12, etc.)		
QC Identifier:	FB - Field Blank	MS - Matrix Spike	
	TB - Trip Blank	MD - Matrix Spike Duplicate	
	WB - Wash or Rinse Blank	MB - Matrix Blank	

* L = Letter
* N = Number

Field duplicate samples will be assigned identifiers that do not allow the laboratory to distinguish them as field duplicates. Each sample container will be labeled prior to packing for shipment. The sample identifier, site name, date, and time of sampling, and analytical parameters will be written on the label in waterproof ink and recorded in the field book.

8.3 Chain of Custody

- A Chain of Custody (COC) record (Figure 8.1 or similar) will accompany the sample containers during selection and preparation at the laboratory, during shipment to the field, and during return shipment to the laboratory.

- The COC will identify each sample container and the analytical parameters for each, and will list the field personnel that collected the samples, the project name and number, the name of the analytical laboratory that will receive the samples, and the method of sample shipment.

- If samples are split and sent to different laboratories, a copy of the COC record will be sent with each sample shipment.

- The COC will be completed by field personnel as samples are collected and packed for shipment.

- Erroneous markings will be crossed-out with a single line and initialed by the author.

- The REMARKS space will be used to indicate if the sample is a matrix spike, matrix spike duplicate (MS/MSD), or matrix duplicate.

- Trip and field blanks will be listed on separate rows.

- After the samples have been collected and sample information has been listed on the COC form, the method of shipment, the shipping cooler identification number(s), and the shipper airbill number will be entered on the COC.

- Finally, a member of the sampling team will write his/her signature, the date, and time on the first RELINQUISHED BY space. Duplicate copies of each COC must be completed.

- One copy of the COC will be retained by sampling personnel. The other copy and the original will be sealed in a plastic bag and taped inside the lid of the shipping cooler.

- Sample shipments will be refrigerated at 4°C, typically by packing with ice, to preserve the samples during shipment.

- After the shipping cooler is closed, custody seals provided by the laboratory will be affixed to the latch and across the front and back of the cooler lid, and signed by the person relinquishing the samples to the shipper.

- The seal will be covered with clear tape, and the cooler lid will be secured by wrapping with packing tape.

- The cooler will be relinquished to the shipper, typically an overnight carrier.

- The COC seal must be broken to open the container. Breakage of the seals before receipt at the laboratory may indicate tampering. If tampering is apparent, the laboratory will contact the Project Manager, and the samples will not be analyzed.

- The samples must be delivered to the laboratory within 48 hours of collection.

8.4 Sample Documentation

The field team leader will retaining a copy of the COC, and, in addition, the field team leader will ensure that the following information about each sample is recorded in the field book:

- Sample identifier;
- Identification of sampled media (e.g., soil, sediment, groundwater);
- Sample location with respect to known reference point;
- Physical description of sample location;
- Field measurements, (e.g., pH, temperature, conductivity, and water levels);
- Date and time of collection;
- Sample collection method;
- Volume of groundwater purged before sampling;
- Number of sample containers;
- Analytical parameters;
- Preservatives used; and
- Shipping information:
    - Dates and method of sample shipments;
    - Chain-of-Custody Record numbers;
    - Federal Express Air Bill numbers;
    - Sample recipient (e.g., laboratory name).

Figures

FIGURE 4.1

Contractor:	# DRILLING RECORD	**BORING/ WELL NO.**
Driller: Inspector: Rig Type: Method:	PROJECT NAME PROJECT NUMBER	Sheet 1 of Location Description:

GROUNDWATER OBSERVATIONS

Water Level				
Date				
Time				
Meas. From				

Weather

Date/Time Start

Date/Time Finish

Location Plan See Site Plan

PID Reading	**Sample I.D.**	**Sample Depth**	**Percent Recovery**	**Blow Cts**	**FIELD IDENTIFICATION OF MATERIAL**	**LITHOLOGIC SCHEMATIC**	**STAIN**	**SHEEN**	**FREE PRODUCT**
		0							
		2							
		4							
		6							
		8							
		10							
		12							
		14							
		16							
		18							
		20							

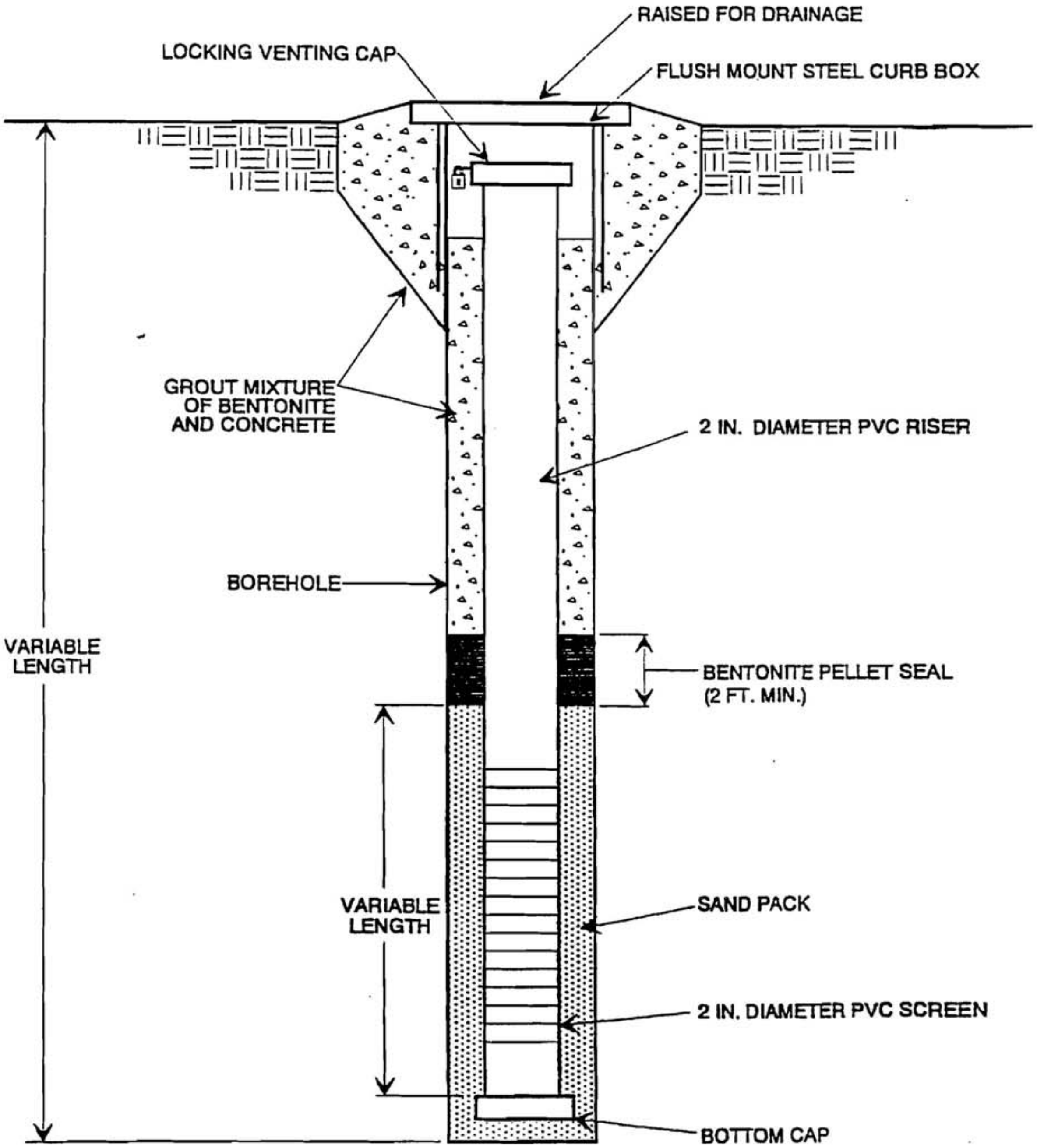
STANDARD PENETRATION TEST

SS = SPLIT SPOON
WOR = Weight of Rod
A = AUGER CUTTINGS
WOH = Weight of Hammer
C = CORED
RB = Roller Bit

COMMENTS

::::: sand AAAA asphalt
---- silt CCCC concrete
=== clay xxxxx fill

TYPICAL MONITORING WELL CROSS SECTION



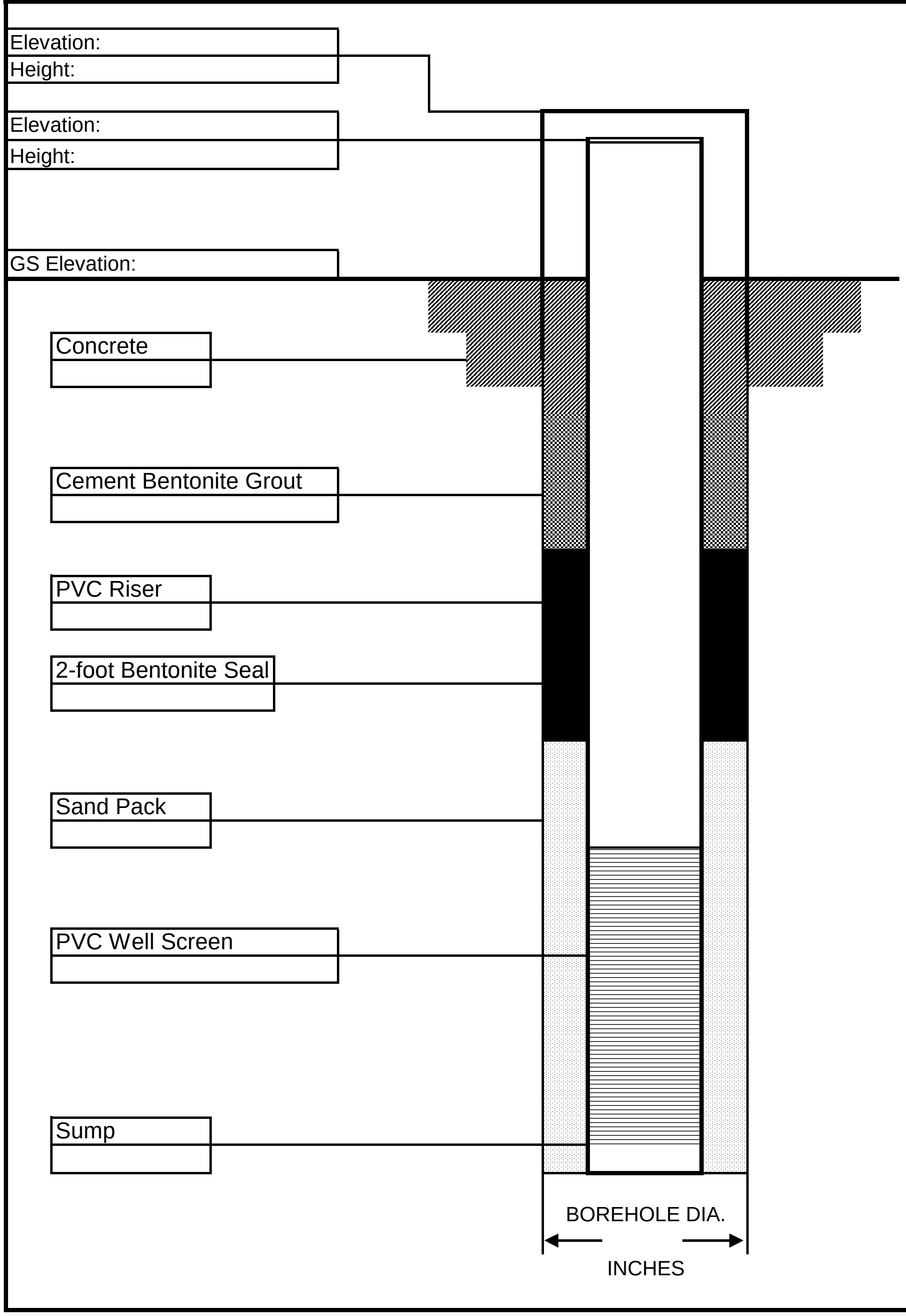
NOT TO SCALE

FIGURE 4.3

WELL CONSTRUCTION LOG

WELL NO.:
PROJ. NO.:
INSPECTOR:
DATE START:
LOCATION:

FACILITY/SITE NAME:
CLIENT:
DRILLING CONTACTOR:
DATE END:
DRILLING METHOD:



PROTECTIVE CASING

Material:
Diameter:
Depth BGS:
Water Tight Seal:
Flushmount:
Weep hole:

GUARD POSTS

Material:
No. & Size:

SURFACE PAD

Composition:
Size:

RISER PIPE

Material:
Schedule:
Joint Type:
O-ring:
Diameter:

GROUT

Amt cement:
Amt bentonite:
Amt water:
Tremied:
Interval:

SEAL

Material:
Type:
Amount Used:
Interval:

FILTER PACK

Material:
Brand Name:
Amount Used:
Grain Size Dist.:
Interval:
Tremied:

SCREEN

Material:
Diameter:
Slot Size & Type:
Interval BGS:

SUMP

Interval BGS:
Bottom Cap:

BACKFILL PLUG

Material:
Setup/Hydration Time:

FIGURE 5.1

GROUNDWATER SAMPLING RECORD

SITE NAME:
PROJECT NUMBER:

SAMPLE NUMBER: WEATHER:
DATE: TIME:

SAMPLERS: of
of

DESCRIPTION OF SAMPLING POINT

Sample Location: Monitoring well MW-
Screen/Sample Depth:
Sampling Method:

GROUNDWATER PURGING

Initial Static Water Level:

One Well Volume:					3 Volumes
2-Inch Casing:		Feet of Water x 0.16 Gallons/Foot =		Gallons	
3-Inch Casing:		Feet of Water x 0.36 Gallons/Foot =		Gallons	
4-Inch Casing:		Feet of Water x 0.65 Gallons/Foot =		Gallons	

Volume of groundwater purged: Gallons
Purging Device:
Purge Water Disposition (e.g., contained):

SAMPLE DESCRIPTION

Color:
Odor:
Other:
Sample Analyzed for:
QC Samples at this Location:
QC Samples Analyzed for:

FIELD MEASUREMENTS

Temperature (C/F):
pH:
Conductivity (µohms/cm):
Turbidity (NTU):
Dissolved Oxygen:
Eh (Redox Potential):

SAMPLE CUSTODY

Chain of Custody Number:
Shipped Via:
Laboratory:
Airbill Number:

COMMENTS

H:\WPROC\Project\CON-ED\East 173rd Street\2008 SMP\Appendix B\FSP Fig 8.1 COC.doc

CHAIN OF CUSTODY RECORD

WORK ORDER NO. ______ - ________ - _____

DUE DATE ______ - ________ - _____

COMPANY: ____

PHONE: (   ) ______________ FAX #: (   ) ______________

P.O.#: ____

CLIENT CONTACT: ____

PROJECT #: ____

SAMPLE TYPE

1. WATER
2. SOIL
3. SLUDGE
4. OIL
5. CHIPS
6. WIPES
7. AIR CASSETTE
8. OTHER

CONTAINER TYPE

P - PLASTIC
G - GLASS
V - VOA

SCILAB SAMPLE #	CLIENT SAMPLE IDENTIFICATION	SAMPLE TYPE	CONTAINER			SAMPLING INFORMATION			PRESERVATIVES										SAMPLE pH at Login
			SIZE	TYPE	#	DATE	TIME	TECH											

REPORT PACKAGES

- MWRA ☐
- MA DEP ☐
- RDR ☐
- ASP A ☐
- ASP B ☐
- QC LEVEL 1 ☐
- QC LEVEL 2 ☐

SAMPLED BY	DATE: TIME:	RECEIVED BY	DATE: TIME:
RELINQUISHED BY:	DATE: TIME:	RECEIVED BY	DATE: TIME:
RELINQUISHED BY:	DATE: TIME:	RECEIVED BY	DATE: TIME:

Temperature upon receipt ____________________

SPECIAL INSTRUCTIONS

- ☐ **24 HOUR TAT**
- ☐ **48 HOUR TAT**
- ☐ **72 HOUR TAT**
- ☐ **5 Day TAT**
- ☐ **7 DAY TAT**
- ☐ **10 DAY TAT**

Shade areas for laboratory use only.
Gold copy - Originator Retains
Pink copy - Shipper Retains

Submit White and Yellow copies to the laboratory.

FIGURE 8.1

Appendix C

Quality Assurance Project Plan

Geotechnical
Environmental and
Water Resources
Engineering

Quality Assurance Project Plan East 173rd Street Works Former MGP Site

Starlight Park, Bronx, New York
VCA Index No. D2-0003-02-08
Site #: V00552

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March 16, 2010

013943-3-1103

Table of Contents

Tables

Figures

Abbreviations and Acronyms

CAR	Corrective Action Request
COC	Chain-of-Custody
CRQLs	Contract Required Quantitation Limits
EDDs	Electronic Data Deliverables
EPA	Environmental Protection Agency
LQA	Laboratory Quality Assurance Officer
MGP	Manufactured Gas Plant
MS/MSDs	matrix spike/matrix spike duplicates
NYSASP	New York State Analytical Services Protocol
NYS ELAP	New York State Environmental Laboratory Approved Program
NIST	National Institute of Standards and Technology
OU	Operable Unit
PE	Performance Evaluation
QA/QC	Quality Assurance/Quality Control
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
RPD	Relative Percent Difference
SMP	Site Management Plan
SOP	Standard Operating Procedures
TCLP	Toxicity Characteristic Leaching Procedure
TCL	target compound list
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

1. Project Description

This Quality Assurance Project Plan (QAPP) specifies analytical methods to be used for Operable Unit 1 (OU-1) of the East 173rd Street Works Site (Site), Site No. V00552-2 to ensure that data from the post-remediation groundwater monitoring, and pre-characterization sampling and intrusive excavation sampling below the demarcation barrier and clean fill cover (installed at the Site as part of required OU-1 remedial action construction activities) are precise, accurate, representative, comparable, and complete.

1.1 Site Description

The East 173rd Street Works former Manufactured Gas Plant (MGP) Site is located between the Sheridan Expressway and the Bronx River in the neighborhood of West Farms, Borough of the Bronx, New York. The location of the Site is illustrated in Figure 1 of the Site Management Plan (SMP) dated June 24, 2005, taken from a portion of the United States Geological Survey (USGS) Topographic map of the Central Park, New York, the New Jersey Quadrangle, and the Flushing, New York Quadrangle.

The former MGP Site occupied a single parcel of land that is currently owned by the City of New York, and is operated by the New York City Department of Parks and Recreation (Parks Department). The Site is located within Starlight Park, a part of the Bronx River Park. The park is zoned R7-1, a general residential district. The current and intended future use of the Site is a city park. The former MGP Site is located in the middle portion of Starlight Park and was approximately 3 acres in size. The former MGP property boundary and former MGP structures are shown on Figure 2 of the SMP. Starlight Park is approximately 7.3 acres in size, and is currently designated by the Bronx Assessor’s Office as Block 03019 Lot 0100.

1.2 Scope of Work

The scope of work at the Site will be described in the project Work Plan. This work plan will be submitted for Con Edison approval prior to start of work. Samples may be collected from soil borings, soil stockpiles, and groundwater monitoring wells. These samples will be analyzed using the United States Environmental Protection Agency (USEPA) SW-846 “Test Methods for Evaluating Solid Waste,” November 1986, 3rd edition (and subsequent updates). All samples will be analyzed by a New York State Environmental Laboratory Approval Program (NYS ELAP)-certified laboratory.

2. Project Organization

The Site contractor or Con Edison designee will arrange for the utility mark outs, drilling and analytical services and provide an on-Site field representative to perform the soil logging, soil sampling, surveying, and groundwater sampling, as well as perform the data interpretation and reporting tasks that may be required for intrusive activities that extend beneath the clean fill cover and demarcation warning barrier installed at the Site as part of Remedial Action construction activities.

Key contacts for this project are as follows:

Con Edison Project Manager:	Mr. Richard Rienzo Telephone: (718) 204-4288 Fax: (718) 932-2687
Project Manager:	TBD
Laboratory Representative:	TBD

3. Quality Assurance/Quality Control Objectives for Measurement of Data

3.1 Introduction

The quality assurance and quality control (QA/QC) objectives for all measurement data include precision, accuracy, representativeness, completeness, and comparability. These objectives are defined in following subsections. They are formulated to meet the requirements of the USEPA SW-846. The analytical methods and their Contract Required Quantitation Limits (CRQLs) are given in Section 7.

3.2 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), relative range, and relative percent difference (RPD) are common.

For this project, field sampling precision will be determined by analyzing coded duplicate samples (labeled so that the laboratory does not recognize them as duplicates) for the same parameters, and then, during data validation (Section 8), calculating the RPD for duplicate sample results.

Analytical precision will be determined by the laboratory by calculating the RPD for the results of the analysis of internal QC duplicates and matrix spike duplicates. The formula for calculating RPD is as follows:

$$\text{RPD} = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where:

RPD = Relative Percent Difference.
V1, V2 = The two values to be compared.
|V1 - V2| = The absolute value of the difference between the two values.
(V1 + V2)/2 = The average of the two values.

The data quality objectives for analytical precision, calculated as the RPD between duplicate analyses, are presented in Tables 3.1 and 3.2.

3.3 Accuracy

Accuracy is a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern (Taylor, 1987), or 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 that 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, which are close to the detection limits, are less accurate because they are more affected by such factors as instrument “noise.” Higher concentrations will not be as affected by instrument noise or other variables and thus will be more accurate.

Sampling accuracy may be determined through the assessment of the analytical results of field blanks and trip blanks for each sample set. Analytical accuracy is typically assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks. Additionally, initial and continuing calibrations must be performed and accomplished within the established method control limits to define the instrument accuracy before analytical accuracy can be determined for any sample set.

Accuracy is normally measured as the percent recovery (%R) of a known amount of analyte, called a spike, added to a sample (matrix spike) or to a blank (blank spike). The %R is calculated as follows:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where:

%R = Percent recovery.
SSR = Spike sample result: concentration of analyte obtained by analyzing the sample with the spike added.
SR = Sample result: the background value, i.e., the concentration of the analyte obtained by analyzing the sample.
SA = Spiked analyte: concentration of the analyte spike added to the sample.

The acceptance limits for accuracy for each parameter are presented in Tables 3.1 and 3.2.

3.4 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 which is most concerned with the proper design of the sampling program (USEPA, 1987). 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, and analysis. Decontamination of sampling devices and digging equipment will be performed between samples as outlined in the Site Management Field Sampling Plan. 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 during data validation through the analysis of coded field duplicate samples. The analytical laboratory will also follow acceptable procedures to assure the samples are adequately homogenized prior to taking aliquots for analysis, so the reported results are representative of the sample received.

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 4 and 5.

3.5 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid (USEPA, 1987). The QC objective for completeness is generation of valid data for at least 90 percent of the analyses requested. Completeness is defined as follows for all sample measurements:

$$\%C = \frac{V}{T} \times 100$$

where:

%C = Percent completeness.
V = Number of measurements judged valid.
T = Total number of measurements.

3.6 Comparability

Comparability expresses the degree of confidence with which one data set can be compared to another (USEPA, 1987). 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;
- Requiring traceability of all analytical standards and/or source materials to the U.S. Environmental Protection Agency (USEPA) or National Institute of Standards and Technology (NIST);
- Requiring that all calibrations be verified with an independently prepared standard from a source other than that used for calibration (if applicable);
- Using standard reporting units and reporting formats including the reporting of QC data;
- Performing a complete data validation on a representative fraction of the analytical results, including the use of data qualifiers in all cases where appropriate; and
- Requiring that all validation qualifiers be used any time an analytical result is used for any purpose.

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.

4. Sampling Program

4.1 Introduction

Sampling program will provide data concerning the presence and the nature of contamination of groundwater and soil, if any. This section presents sample container preparation procedures, sample preservation procedures, sample holding times, and field QC sample requirements. The sampling procedures are presented in the Site Management Field Sampling Plan.

4.2 Sample Container Preparation and Sample Preservation

Sample containers will be properly washed and decontaminated prior to their use by either the analytical laboratory or the container vendor to the specifications required by the USEPA. Copies of the sample container QC analyses will be provided by the laboratory for each container lot used to obtain samples. The containers will be tagged, the appropriate preservatives will be added. The types of containers are shown in Tables 4.1 and 4.2.

Samples shall be preserved according to the preservation techniques given in Tables 4.1 and 4.2. Preservatives will be added to the sample bottles by the laboratory prior to their shipment in sufficient quantities to ensure that proper sample pH is met. Following sample collection, the sample bottles should be placed on ice in the shipping cooler, cooled to 4^{o}C with ice or "blue ice," and delivered to the laboratory within 48 hours of collection. Chain-of-custody procedures are described in Section 5.

4.3 Sample Holding Times

The sample holding times for organic and inorganic parameters are given in Tables 4.1 and 4.2 and must be in accordance with the NYSASP requirements. Holding times for Toxicity Characteristic Leaching Procedure (TCLP) samples are given in Table 4.3. The NYSASP holding times must be strictly adhered to by the laboratory. Any holding time exceedances must be reported to Con Edison.

4.4 Field QC Samples

To assess field sampling and decontamination performance, two types of "blanks" will be collected and submitted to the laboratory for analyses. In addition, the precision of field sampling procedures will be assessed by collecting coded field duplicates and matrix spike/matrix spike duplicates (MS/MSDs). The blanks will include:

a. Trip Blanks - A Trip Blank will be prepared before the sample containers are sent by the laboratory. The trip blank will consist of a 40-ml VOA vial containing distilled, deionized water, which accompanies the other water sample bottles into the field and back to the laboratory. A trip blank will be included with each shipment of water samples for target compound list (TCL) volatiles analysis. The Trip Blank will be analyzed for TCL volatile organic compounds to assess any contamination from sampling and transport, and internal laboratory procedures.

b. Field Blanks - Field Blanks will be taken at a minimum frequency of one per 20 field samples per sample matrix. Field 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 that has passed through a decontaminated bailer or other sampling apparatus. It is usually collected as a last step in the decontamination procedure, prior to taking an environmental sample. The field blank may be analyzed for all or some of the parameters of interest.

The duplicates will consist of:

a. Coded Field Duplicate - To determine the representativeness of the sampling methods, 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.

b. Matrix Spike/Matrix Spike Duplicate (MS/MSD) - MS/MSD samples (MS/MSD for organics; MS and laboratory duplicate for inorganics) will be taken at a frequency of one pair per 20 field samples. These samples are used to assess the effect of the sample matrix on the recovery of target compounds or target analytes. The percent recoveries and RPDs are given in Tables 3.1 and 3.2

5. Sample Tracking and Custody

5.1 Introduction

This section presents sample custody procedures for both the field and laboratory. Implementation of proper custody procedures for samples generated in the field is the responsibility of field personnel. Both laboratory and field personnel involved in the Chain-of-custody (COC) and transfer of samples will be trained as to the purpose and procedures prior to implementation.

Evidence of sample traceability and integrity is 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 5.1. A sample is 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.

5.2 Field Sample Custody

A COC record (Figure 5.2 or similar) accompanies the sample containers from selection and preparation at the laboratory, during shipment to the field for sample containment and preservation, and during return to the laboratory. Triplicate copies of the COC must be completed for each sample set collected.

The COC lists the field personnel responsible for taking samples, the project name and number, the name of the analytical laboratory to which the samples are sent, and the method of sample shipment. The COC also lists a unique description of every sample bottle in the set. If samples are split and sent to different laboratories, a copy of the COC record will be sent with each sample.

The REMARKS space on the COC is used to indicate if the sample is a matrix spike, matrix spike duplicate, or any other sample information for the laboratory. Since they are not specific to any one sample point, trip and field blanks are indicated on separate rows. Once all bottles are properly accounted for on the form, a sampler will write his or her signature and the date and time on the first RELINQUISHED BY space. The sampler will also write the method of shipment, the shipping cooler identification number, and the shipper airbill number on the top of the COC. Mistakes will be crossed out with a single line in ink and initialed by the author.

One copy of the COC is retained by sampling personnel and the other two copies are put into a sealable plastic bag and taped inside the lid of the shipping cooler. The cooler lid is closed, custody seals provided by the laboratory are affixed to the latch and across the back and front lids of the cooler, and the person relinquishing the samples signs their name across the seal. The seal is taped, and the cooler is wrapped tightly with clear packing tape. It is then relinquished by field personnel to personnel responsible for shipment, typically an overnight carrier. The COC seal must be broken to open the container. Breakage of the seals before receipt at the laboratory may indicate tampering. If tampering is apparent, the laboratory will contact the Project Manager, and the sample will not be analyzed.

5.3 Laboratory Sample Custody

The Project Manager or Field Team Leader will notify the laboratory of upcoming field sampling activities, and the subsequent shipment 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 following laboratory sample custody procedures will be used:

- The laboratory will designate a sample custodian who will be 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 cooler temperature, and check the original COC 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 discrepant documentation, the laboratory will immediately contact the Project Manager or Field Team Leader 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. This assessment will be recorded as part of the incoming chain-of-custody procedure.

- The samples will be stored in a secured area at a temperature of approximately 4 degrees Celsius until analyses commence.
- A laboratory tracking record will accompany the sample or sample fraction through final analysis for control.
- A copy of the tracking record will accompany the laboratory report and will become a permanent part of the project records.

6. Calibration Procedures

6.1 Field Instruments

All field analytical equipment will be calibrated immediately prior to each day's use. The calibration procedures will conform to manufacturer's standard instructions and are described in the Site Management Field Sampling Plan. This calibration will ensure that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. Records of all instrument calibration will be maintained by the Field Team Leader. Copies of all the instrument manuals will be maintained on Site by the Field Team Leader.

Calibration procedures for instruments used for monitoring health and safety hazards (e.g., photoionization detector and explosimeter) are provided in the Site Management Health and Safety Plan.

6.2 Laboratory Instruments

The laboratory will follow all calibration procedures and schedules as specified in the sections of the USEPA SW-846 and subsequent updates that apply to the instruments used for the analytical methods given in Section 7.

7. Analytical Procedures

7.1 Introduction

Samples will be analyzed according to the USEPA SW-846 “Test Methods for Evaluating Solid Waste,” November 1986, 3rd edition and subsequent updates. The methods to be used for the laboratory analysis of water and soil samples are presented in Tables 7.1 and 7.2. These methods were selected because they attain the quantitation limits which are compiled on Tables 7.1 and 7.2.

8. Data Reduction, Validation, and Reporting

8.1 Introduction

Data collected during the field investigation will be reduced and reviewed by the laboratory QA personnel, and a report on the findings will be tabulated in a standard format. The criteria used to identify and quantify the analytes will be those specified for the applicable methods in the USEPA SW-846 and subsequent updates. The data package provided by the laboratory will contain all items specified in the USEPA SW-846 appropriate for the analyses to be performed, and be reported in standard format.

The completed copies of the chain-of-custody records (both external and internal) accompanying each sample from time of initial bottle preparation to completion of analysis shall be attached to the analytical reports.

8.2 Data Reduction

Two copies of the analytical data packages will be provided by the laboratory. One copy of the package will be sent to the Con Edison Project Manager for filing; a second copy will be sent to the Project Manager and used to generate summary tables.

8.3 Data Validation

Data validation will be performed on all of the chemical results for work conducted under the direction of the East 173rd Street Works Site Management Plan. Data validation will be performed in accordance with the USEPA Contract Laboratory Program for Organic Data Review, EPA 540/R-99/008 (October 1999), and USEPA Contract Laboratory Program for Inorganic Data Review, EPA 540/R-94/013 (February 1994). Data validation for all samples will include a review of holding times, method blanks, surrogates, reporting limits, chain-of-custody records, and QC samples.

8.4 Data Reporting

Prior to release by the laboratory, the data must first meet all the specific QA/QC associated with the Standard Operating Procedure (SOP) that was used for the analysis. The laboratory quality assurance officer (LQA) at the laboratory is responsible for the final verification of the data.

The laboratory employs a system of sign-off sheets where each analyst must sign off after their respective part of the analysis is complete and the analysis meets the QA/QC requirements of the specific SOP. Any deviations must be noted and explained in the project narrative, which will be incorporated into the final report. The LQA has final sign off on the data package and is responsible for ensuring the overall quality of the data.

8.5 Data Management

An electronic database of all chemical data will be created and maintained for this project from the electronic data deliverables (EDDs) provided by the laboratory. The following data management procedure will be used for all laboratory analytical data.

- Data package, including data summaries (Form Is) and all laboratory QA/QC and other backup information, is sent to an independent data validator.
- Digital data disks are used to import electronic data into the database.
- When validation is complete, qualifiers are entered into the database.
- Original Form Is with qualifiers are filed in the project files. Copies of the Form Is with qualifiers are organized in three-ring binders in order of sample identification.
- Site data tables are generated from the database.
- Database tables are checked against validated Form Is for accuracy and completeness.
- Data is exported from the database to MS Excel for creation of tables.
- All Excel tables are spot-checked against Form Is after formatting or updating with new sample data.

9. Internal Quality Control Checks and Frequency

9.1 Quality Assurance Batching

Each set of samples will be analyzed concurrently with calibration standards, method blanks, matrix spikes (MS), matrix spike duplicates (MSD) or laboratory duplicates, and QC check samples (if required by the protocol). The MS/MSD samples will be designated by the field personnel. If no MS/MSD samples have been designated, the laboratory will contact the Con Edison Project Manager for corrective action.

9.2 Calibration Standards and Surrogates

All organic standard and surrogate compounds are checked by the method of mass spectrometry for correct identification and gas chromatography for degree of purity and concentration. All standards are traceable to a source of known quality certified by the USEPA or NIST, or other similar program. 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 more frequently, based upon data indicating deterioration.

9.3 Organic Blanks and Matrix Spike

Analysis of blank samples verifies that the analytical method does not introduce contaminants or detect "false positives.” The blank water can be generated by reverse osmosis and Super-Q filtration systems, or distillation of water containing $KMnO_4$. The matrix spike is generated by addition of surrogate standard to each sample.

9.4 Trip and Field Blanks

Trip blanks and field blanks will be utilized in accordance with the specifications in Section 4. These blanks will be analyzed to provide a check on sample bottle preparation and to evaluate the possibility of atmospheric or cross contamination of the samples.

10. Quality Assurance Performance Audits and System Audits

10.1 Introduction

Quality assurance audits may be performed by the project quality assurance group under the direction and approval of the project Quality Assurance Officer (QAO). These audits will be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). Functioning as an independent body and reporting directly to corporate quality assurance management, the QAO may plan, schedule, and approve system and performance audits based upon procedures customized to the project requirements. At times, the QAO may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits. However, these personnel will not have responsibility for the project work associated with the performance audit.

10.2 System Audits

System audits may be performed by the QAO or designated auditors, and encompass a qualitative 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 system audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or if the Project Manager requests, additional audits may occur.

10.3 Performance Audits

The laboratory may be required to conduct an analysis of Performance Evaluation (PE) samples or provide proof that Performance Evaluation samples submitted by USEPA or a state agency have been analyzed within the past twelve months.

10.4 Formal Audits

Formal audits refer to any system or performance audit that is documented and implemented by the QA group. These 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 auditors who have performed the Site audit after gathering and evaluating all data. Items, activities, and documents determined by lead auditors to be in noncompliance shall be identified at exit interviews conducted with the involved management. Noncompliances will be logged, and documented through audit findings which are attached to and are a part of the integral audit report. These audit finding forms are directed to management to satisfactorily resolve the noncompliance in a specified and timely manner.

The Project Manager has overall responsibility to ensure that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to the Project Manager within fifteen days of completion of the audit. Serious deficiencies will be reported to the Project Manager within 24 hours. All audit checklists, audit reports, audit findings, and acceptable resolutions are approved by the QAO prior to issue. Verification of acceptable resolutions may be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the QAO will close out the audit report and findings.

11. Preventive Maintenance Procedures and Schedules

11.1 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.

A list of critical spare parts will be established by the operator. These spare parts will be available for use in order to reduce the downtime. A service contract for rapid instrument repair or backup instruments may be substituted for the spare part inventory.

11.2 Schedules

Written procedures will establish the schedule for servicing critical items in order to minimize the downtime of the measurement system. The laboratory will adhere to the maintenance schedule, and arrange any necessary and prompt service. Required service will be performed by qualified personnel.

11.3 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. The QAO may audit these records to verify complete adherence to these procedures.

12. Corrective Action

12.1 Introduction

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

12.2 Procedure Description

When a significant condition adverse to quality is noted at the Site, laboratory, or subcontractor location, the cause of the condition will be determined and corrective action will be taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the QAO, Project Manager, Field Team Leader and involved contractor 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. Corrective actions will be initiated as follows:

- When predetermined acceptance standards are not attained;
- When procedure or data compiled are determined to be deficient;
- When equipment or instrumentation is found to be faulty;
- When samples and analytical test results are not clearly 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/field comparison studies; and
- As required by USEPA SW-846, and subsequent updates, or by the NYSASP.

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 the Sites, laboratories, or contractor locations. Activities, or documents ascertained to be noncompliant with quality assurance requirements will be documented. Corrective actions will be mandated through audit finding sheets attached to the audit report. Audit findings are logged, maintained, and controlled by the Task Manager.

Personnel assigned to quality assurance functions will have the responsibility to issue and control Corrective Action Request (CAR) Forms (Figure 12.1 or similar). The CAR identifies the out-of-compliance condition, reference document(s), and recommended corrective action(s) to be administered. The CAR is issued to the personnel responsible for the affected item or activity. A copy is also submitted to the Project Manager. The individual to whom the CAR is addressed returns the requested response promptly to the QA personnel, affixing his/her signature and date to the corrective action block, after stating the cause of the conditions and corrective action to be taken. The QA personnel maintain the log for status of CARs, confirms the adequacy of the intended corrective action, and verifies its implementation. CARs will be retained in the project file for the records.

Any project personnel may identify noncompliance issues; however, the designated QA personnel are responsible for documenting, numbering, logging, and verifying the close out action. The Project Manager will be responsible for ensuring that all recommended corrective actions are implemented, documented, and approved.

References

USEPA, 1986. *SW-846 "Test Method for Evaluating Solid Waste,*" dated November 1986. U.S. Environmental Protection Agency, Washington, D.C.

Taylor, J. K., 1987. *Quality Assurance of Chemical Measurements*. Lewis Publishers, Inc., Chelsea, Michigan

USEPA, 1987. *Data Quality Objectives for Remedial Response Actions Activities: Development Process*, EPA/540/G-87/003, OSWER Directive 9355.0-7- U.S. Environmental Protection Agency, Washington, D.C.

USEPA, 1992a. *CLP Organics Data Review and Preliminary Review*. SOP No. HW-6, Revision #8, dated January 1992. USEPA Region II.

USEPA, 1992b. *Evaluation of Metals Data for the Contract Laboratory Program (CLP) based on SOW 3/90*. SOP No. HW-2, Revision XI, dated January 1992. USEPA Region II.

Tables

TABLE 3.1
QUALITY CONTROL LIMITS FOR WATER SAMPLES

		Laboratory Accuracy and Precision					
Analytical Parameters	**Analytical Method (a)**	**Matrix Spike (MS) Compounds**	**MS/MSD (b) % Recovery**	**MS/MSD RPD (c)**	**LCS (d) % Recovery**	**Surrogate Compounds**	**Surrogate % Recovery**
VOCs (e)	SW8260B	1,1-Dichloroethane	61-145	14	NA	Toluene-d8	88-110
		Trichloroethene	71-120	14	NA	Bromofluorobenzene	86-115
		Benzene	76-127	11	NA	1,2-Dichloroethane-d4	76-114
		Toluene	76-125	13	NA		
		Chlorobenzene	75-130	13	NA		
SVOCs (f)	SW8270C	Phenol	12-110	42	NA	Nitrobenzene-d5	35-114
		2-Chlorophenol	27-123	40	NA	2-Fluorobiphenyl	43-116
		1,4-Dichlorobenzene	36-97	28	NA	Terphenyl-d14	33-141
		N-Nitroso-di-n-propylamine	41-116	38	NA	Phenol-d5	10-110
		1,2,4-Trichlorobenzene	39-98	28	NA	2-Fluorophenol	21-110
		4-Chloro-3-methylphenol	23-97	42	NA	2,4,6-Tribromophenol	10-123
		Acenaphthene	46-118	31	NA	2-Chlorophenol-d4	33-110 (g)
		4-Nitrophenol	10-80	50	NA	1,2-Dichlorobenzene-d4	16-110 (g)
		2,4-Dinitrotoluene	24-96	38	NA		
		Pentachlorophenol	9-103	50	NA		
		Pyrene	26-127	31	NA		
Pesticides/PCBs (h)	SW8082	Gamma-BHC (Lindane)	56-123	15	NA	Tetrachloro-m-xylene	60-150 (g)
		Heptachlor	40-131	20	NA	Decachlorobiphenyl	60-150 (g)
		Aldrin	40-120	20	NA		
		Dieldrin	52-126	18	NA		
		Endrin	56-121	21	NA		
		4,4'-DDT	38-127	27	NA		
Inorganics (i)	SW6010B, SW7470A/ 7471A, SW7841, SW9010A (Cyanide)	Inorganic Analyte	75-125 (j)	20 (k)	80-120	NA	NA

(a) Analytical Methods: USEPA SW-846, 3rd edition, Revision 1, November 1990; any subsequent revisions shall supersede this information
(b) Matrix Spike/Matrix Spike Duplicate
(c) Relative Percent Difference
(d) Laboratory Control Sample
(e) Target Compound List Volatile Organic Compounds
(f) Target Compound List Semivolatile Organic Compounds
(g) Limits are advisory only
(h) Polychlorinated Biphenyls
(i) Target Analyte List Inorganics (metals and cyanide)
(j) Matrix spike only
(k) Laboratory duplicate RPD
NA - Not Applicable

TABLE 3.2
QUALITY CONTROL LIMITS FOR SOIL SAMPLES

		Laboratory Accuracy and Precision					
Analytical Parameter	**Analytical Method (a)**	**Matrix Spike (MS) Compounds**	**MS/MSD (b) % Recovery**	**MS/MSD RPD (c)**	**LCS (d) % Recovery**	**Surrogate Compounds**	**Surrogate % Recovery**
VOCs (e)	SW8260B	1,1-Dichloroethane	59-172	22	NA	Toluene-d8	84-138
		Trichloroethene	62-137	24	NA	Bromofluorobenzene	59-113
		Benzene	66-142	21	NA	1,2-Dichloroethane-d4	70-121
		Toluene	59-139	21	NA		
		Chlorobenzene	60-133	21	NA		
SVOCs (f)	SW8270C	Phenol	26-90	35	NA	Nitrobenzene-d5	23-120
		2-Chlorophenol	25-102	50	NA	2-Fluorobiphenyl	30-115
		1,4-Dichlorobenzene	28-104	27	NA	Terphenyl-d14	18-137
		N-Nitroso-di-n-propylamine	41-126	38	NA	Phenol-d5	24-113
		1,2,4-Trichlorobenzene	38-107	23	NA	2-Fluorophenol	25-121
		4-Chloro-3-methylphenol	26-103	33	NA	2,4,6-Tribromophenol	19-122
		Acenaphthene	31-137	19	NA	2-Chlorophenol-d4	20-130 (g)
		4-Nitrophenol	11-114	50	NA	1,2-Dichlorobenzene-d4	20-130 (g)
		2,4-Dinitrotoluene	28-89	47	NA		
		Pentachlorophenol	17-109	47	NA		
		Pyrene	35-142	36	NA		
Pesticides/PCBs (h)	SW8082	Gamma-BHC (Lindane)	46-127	50	NA	Tetrachloro-m-xylene	60-150 (g)
		Heptachlor	35-130	31	NA	Decachlorobiphenyl	60-150 (g)
		Aldrin	34-132	43	NA		
		Dieldrin	31-134	38	NA		
		Endrin	42-139	45	NA		
		4,4'-DDT	23-134	50	NA		
Inorganics (i)	SW6010B, SW7470A/ 7471A, SW7841, SW9010A (Cyanide)	Inorganic Analyte	75-125 (j)	20 (k)	80-120	NA	NA

(a) Analytical Methods: USEPA SW-846, 3rd edition, Revision 1, November 1990, any subsequent revisions shall supersede this information
(b) Matrix Spike/Matrix Spike Duplicate
(c) Relative Percent Difference
(d) Laboratory Control Sample
(e) Target Compound List Volatile Organic Compounds
(f) Target Compound List Semivolatile Organic Compounds
(g) Limits are advisory only
(h) Polychlorinated Biphenyls
(i) Target Analyte List Inorganics (metals and cyanide)
(j) Matrix spike only
(k) Laboratory duplicate RPD
NA - Not Applicable

TABLE 4.1

WATER SAMPLE CONTAINERIZATION, PRESERVATION, AND HOLDING TIMES

Analysis	Bottle Type	Preservation (a)	Holding Time (b)
Volatile Organic Compounds (VOCs)	2-40 mL glass vial w/ Teflon septum	Cool to 4^{o}C	10 days
Semivolatile Organics Compounds (SVOCs)	1000 mL glass w/ Teflon lined cap	Cool to 4^{o}C	5 days*
PCBs	Glass w/teflon cap	Cool to 4^{o}C	5 days*
Metals	1000 mL plastic bottle	Nitric Acid to pH < 2 Cool to 4^{o}C	6 months, except mercury (26 days)
Cyanide	500 mL plastic bottle	NaOH to pH > 12 Cool to 4^{o}C	14 days

(a) All samples to be preserved in ice during collection and transport.

(b) Days from validated time of sample receipt (VTSR).

* Extraction of water samples for PCB analysis by separatory funnel must be completed within 7 days of VTSR. Continuous liquid-liquid extraction is the required extraction for water samples for SVOCs. Continuous liquid-liquid extraction and concentration of water samples for SVOCs analysis completed within 7 days of VTSR. Extracts of water samples must be analyzed within 40 days of extraction.

TABLE 4.2
SOIL AND WASTE SAMPLE CONTAINERIZATION AND HOLDING TIMES

Analysis	Bottle Type	Preservation (a)	Holding Time (b)
Volatile Organic Compounds (VOCs)	Wide-mouth glass w/ teflon lined cap	Cool to 4°C	10 days
Other Organic Compounds (c)	Wide-mouth glass w/ teflon lined cap	Cool to 4°C	10 days*
Metals	Wide-mouth plastic or glass	Cool to 4°C	6 months, except mercury (26 days)
Cyanide	Wide-mouth plastic	Cool to 4°C	14 days
TCLP Organic Compounds	Wide-mouth glass w/ teflon lined cap	Cool to 4°C	See Table 4.4
TCLP Metals	Wide-mouth plastic or glass	Cool to 4°C	See Table 4.4

(a) All samples to be preserved in ice during collection and transport.

(b) Days from date of sample collection.

(c) Semivolatile organic compounds or PCBs.

* Sohxlet or sonication procedures for extraction and concentration of soil/waste samples for SVOCs must be completed within 10 days of VTSR. Sohxlet or sonication procedures for extraction and concentration of soil/sediment/waste samples for PCBs must be completed within 10 days of VTSR. Extracts of soil samples must be analyzed within 40 days of extraction.

TABLE 4.3

TCLP(a) SAMPLE HOLDING TIMES

Analytical Parameter	**From: Sample Collection To: TCLP Extraction**	**From: TCLP Extraction To: Preparative Extraction**	**From: Preparative Extraction To: Determinative Analysis**
Volatiles	14 days	NA	14 days
Semivolatiles	14 days	7 days	40 days
Mercury	26 days	NA	26 days
Metals (except Mercury)	180 days	NA	180 days

(a) Toxicity Characteristic Leaching Procedure
NA - Not Applicable

TABLE 7.1
PROJECT QUANTITATION LIMITS

			Quantitation Limits		State of New York Standards	
	Analysis/Compound	Method	Water (ug/L)	Soil (ug/kg)	Water (ug/L) [(a)]	Soil (ug/kg) [(b)]
	Volatile Organics					
1	1,1,1-Trichloroethane	SW8260B	1	5	5	800
2	1,1,2,2-Tetrachloroethane	SW8260B	1	5	5	600
3	1,1,2-Trichloroethane	SW8260B	1	5	1	
4	1,1-Dichloroethane	SW8260B	1	5	5	200
5	1,1-Dichloroethene	SW8260B	1	5	5	400
6	1,2-Dichloroethane	SW8260B	1	5	0.6	100
7	1,2-Dichloroethene(total)	SW8260B	1	5	5	300
8	1,2-Dichloropropane	SW8260B	1	5	1	
9	2-Butanone (MEK)	SW8260B	10	20		300
10	2-Hexanone	SW8260B	10	20		
11	4-Methyl-2-pentanone(MIBK)	SW8260B	5	20		1000
12	Acetone	SW8260B	10	20		200
13	Benzene	SW8260B	1	5	1	60
14	Bromodichloromethane	SW8260B	1	5		
15	Bromoform	SW8260B	1	5		
16	Bromomethane	SW8260B	2	10	5	
17	Carbon Disulfide	SW8260B	1	5		2700
18	Carbon Tetrachloride	SW8260B	1	5	5	600
19	Chlorobenzene	SW8260B	1	5	5	1700
20	Chloroethane	SW8260B	2	10	5	1900
21	Chloroform	SW8260B	1	5	7	300
22	Chloromethane	SW8260B	2	10	5	
23	cis-1,3-Dichloropropene	SW8260B	1	5	0.4	
24	Dibromochloromethane	SW8260B	1	5	5	
25	Ethyl Benzene	SW8260B	1	5	5	5500
26	Methylene Chloride	SW8260B	1	5	5	100
27	Styrene	SW8260B	1	5	5	
28	Tetrachloroethene	SW8260B	1	5	5	1400
29	Toluene	SW8260B	1	5	5	1500
30	trans-1,3-Dichloropropene	SW8260B	1	5	0.4	
31	Trichloroethene	SW8260B	1	5	5	700
32	Vinyl Chloride	SW8260B	2	10	2	200
33	Xylenes(total)	SW8260B	1	5	5	1200
	Semivolatile Organics					
1	1,2,4-Trichlorobenzene	SW8270C	10	330	5	3400
2	1,2-Dichlorobenzene	SW8270C	10	330	3	7900
3	1,3-Dichlorobenzene	SW8270C	10	330	3	1600
4	1,4-Dichlorobenzene	SW8270C	10	330	3	8500
5	2,2'-oxybis(1-chloropropane)*	SW8270C	10	330	5	
6	2,4,5-Trichlorophenol	SW8270C	25	330	1	100
7	2,4,6-Trichlorophenol	SW8270C	10	330	1	
8	2,4-Dichlorophenol	SW8270C	10	330	1	400
9	2,4-Dimethylphenol	SW8270C	10	330	1	
10	2,4-Dinitrophenol	SW8270C	25	330	1	200
11	2,4-Dinitrotoluene	SW8270C	10	330	5	
12	2,6-Dinitrotoluene	SW8270C	10	330	5	1000
13	2-Chloronaphthalene	SW8270C	10	330		
14	2-Chlorophenol	SW8270C	10	330	1	800
15	2-methyl-4,6-Dinitrophenol	SW8270C	25	330		
16	2-Methylnaphthalene	SW8270C	10	330		36400
17	2-Methylphenol	SW8270C	10	330	1	100
18	2-Nitrolaniline	SW8270C	25	330	5	430
19	2-Nitrophenol	SW8270C	10	330	1	330
20	3,3'-Dichlorobenzidine	SW8270C	10	330	5	
21	3-Nitroaniline	SW8270C	25	330	5	500
22	4-Bromophenyl-phenyl ether	SW8270C	10	330		

TABLE 7.1
PROJECT QUANTITATION LIMITS

	Analysis/Compound	Method	Quantitation Limits Water (ug/L)	Soil (ug/kg)	State of New York Standards Water (ug/L) $^{(a)}$	Soil (ug/kg) $^{(b)}$
23	4-Chloro-3-methylphenol	SW8270C	10	330		240
24	4-Chloroaniline	SW8270C	10	330	5	220
25	4-Chlorophenyl-phenyl ether	SW8270C	10	330		
26	4-Methylphenol	SW8270C	10	330	1	900
27	4-Nitroaniline	SW8270C	25	330	5	
28	4-Nitrophenol	SW8270C	25	330	1	100
29	Acenaphthene	SW8270C	10	330		50000
30	Acenaphthylene	SW8270C	10	330		41000
31	Anthracene	SW8270C	10	330		50000
32	Benzo(a)anthracene	SW8270C	10	330		224
33	Benzo(a)pyrene	SW8270C	10	330		61
34	Benzo(b)fluoranthene	SW8270C	10	330		1100
35	Benzo(g,h,i)perylene	SW8270C	10	330		50000
36	Benzo(k)fluoranthene	SW8270C	10	330		1100
37	bis(2-Chloroethoxy) methane	SW8270C	10	330	5	
38	bis(2-Chloroethyl) ether	SW8270C	10	330	1	
39	bis(2-ethylhexyl)phthalate	SW8270C	10	330	5	50000
40	Butylbenzylphthalate	SW8270C	10	330		50000
41	Carbazole	SW8270C	10	330		
42	Chrysene	SW8270C	10	330		400
43	Di-n-butylphthalate	SW8270C	10	330	50	8100
44	Di-n-octylphthalate	SW8270C	10	330		50000
45	Dibenz(a,h)anthracene	SW8270C	10	330		14
46	Dibenzofuran	SW8270C	10	330		6200
47	Diethylphthalate	SW8270C	10	330		7100
48	Dimethylphthalate	SW8270C	10	330		2000
49	Fluoranthene	SW8270C	10	330		50000
50	Fluorene	SW8270C	10	330		50000
51	Hexachlorobenzene	SW8270C	NA (8081A)	330		410
52	Hexachlorobutadiene	SW8270C	10	330	0.5	
53	Hexachlorocyclopentadiene	SW8270C	10	330	5	
54	Hexachloroethane	SW8270C	10	330	5	
55	Indeno(1,2,3-cd)pyrene	SW8270C	10	330		3200
56	Isophorone	SW8270C	10	330		4400
57	N-Nitroso-di-n-propylamine	SW8270C	10	330		
58	N-nitrosodiphenylamine	SW8270C	10	330		
59	Naphthalene	SW8270C	10	330		13000
60	Nitrobenzene	SW8270C	10	330	0.4	200
61	Pentachlorophenol	SW8270C	25	330	1	1000
62	Phenanthrene	SW8270C	10	330		50000
63	Phenol	SW8270C	10	330	1	30
64	Pyrene	SW8270C	10	330		50000
	PCBs					
1	Aroclor-1016	SW8082	1.0	33	0.09	1000
2	Aroclor-1221	SW8082	2.0	33	0.09	1000
3	Aroclor-1232	SW8082	1.0	33	0.09	1000
4	Aroclor-1242	SW8082	1.0	33	0.09	1000
5	Aroclor-1248	SW8082	1.0	33	0.09	1000
6	Aroclor-1254	SW8082	1.0	33	0.09	1000
7	Aroclor-1260	SW8082	1.0	33	0.09	1000
	Metals					
1	Antimony	SW6010B	0.006	5.0	0.003	
2	Arsenic	SW6010B	0.01	1	0.025	7.5
3	Barium	SW6010B	0.01	1	1	300
4	Beryllium	SW6010B	0.005	0.5	0.003	0.16
5	Cadmium	SW6010B	0.005	0.5	0.005	1
6	Chromium	SW6010B	0.01	1	0.05	10
7	Copper	SW6010B	0.03	2.5	0.2	25

TABLE 7.1
PROJECT QUANTITATION LIMITS

		Quantitation Limits		State of New York Standards	
Analysis/Compound	**Method**	**Water (ug/L)**	**Soil (ug/kg)**	**Water (ug/L) (a)**	**Soil (ug/kg) (b)**
8 Lead	SW6010B	0.01	0.5	0.025	400(c)
9 Mercury	SW7470A/7471A	0.0002	0.01	0.0007	0.1
10 Nickel	SW6010B	0.04	4	0.1	13
11 Selenium	SW6010B	0.01	1	0.01	2
12 Silver	SW6010B	0.01	1	0.05	
13 Thallium	SW7841	0.002	1	0.0005	
14 Zinc	SW6010B	0.02	2	2	20
*15 Vanadium	SW6010B	0.05	1	0.0005	150
*16 Cobalt	SW6010B	0.05	1		30
*17 Aluminum	SW6010B	0.2	20		
*18 Calcium	SW6010B	5	500		
*19 Iron	SW6010B	0.1	10	0.3	2000
*20 Magnesium	SW6010B	5	500	35	
*21 Manganese	SW6010B	0.015	1.5	0.3	
*22 Potassium	SW6010B	5	500		
*23 Sodium	SW6010B	5	500	20	
*24 Cyanide	SW9010A	0.01	0.01	200	

Notes:
N/A - Not Applicable
(a) - Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, NYSDEC, October 1993
(b) - Determination of Soil Cleanup Objectives and Cleanup Levels, NYSDEC, January 24, 1994
(c) - EPA Guidance on Residential Lead-Based Paint, Lead Contaminated Dust, and Lead Contaminated Soil, July 14, 1994

TABLE 7.2
TCLP
PRACTICAL QUANTITATION LIMITS (PQLs)

TCLP VOLATILE	SW-846 Analysis	Water (ug/L)
Benzene	8240B	5
Carbon Tetrachloride	8240B	5
Chloroform	8240B	5
1,2-Dichlorethane	8240B	5
1,1-Dichloroethene	8240B	5
2-Butanone	8240B	100
Tetrachloroethene	8240B	5
Trichloroethene	8240B	5
Vinyl Chloride	8240B	100

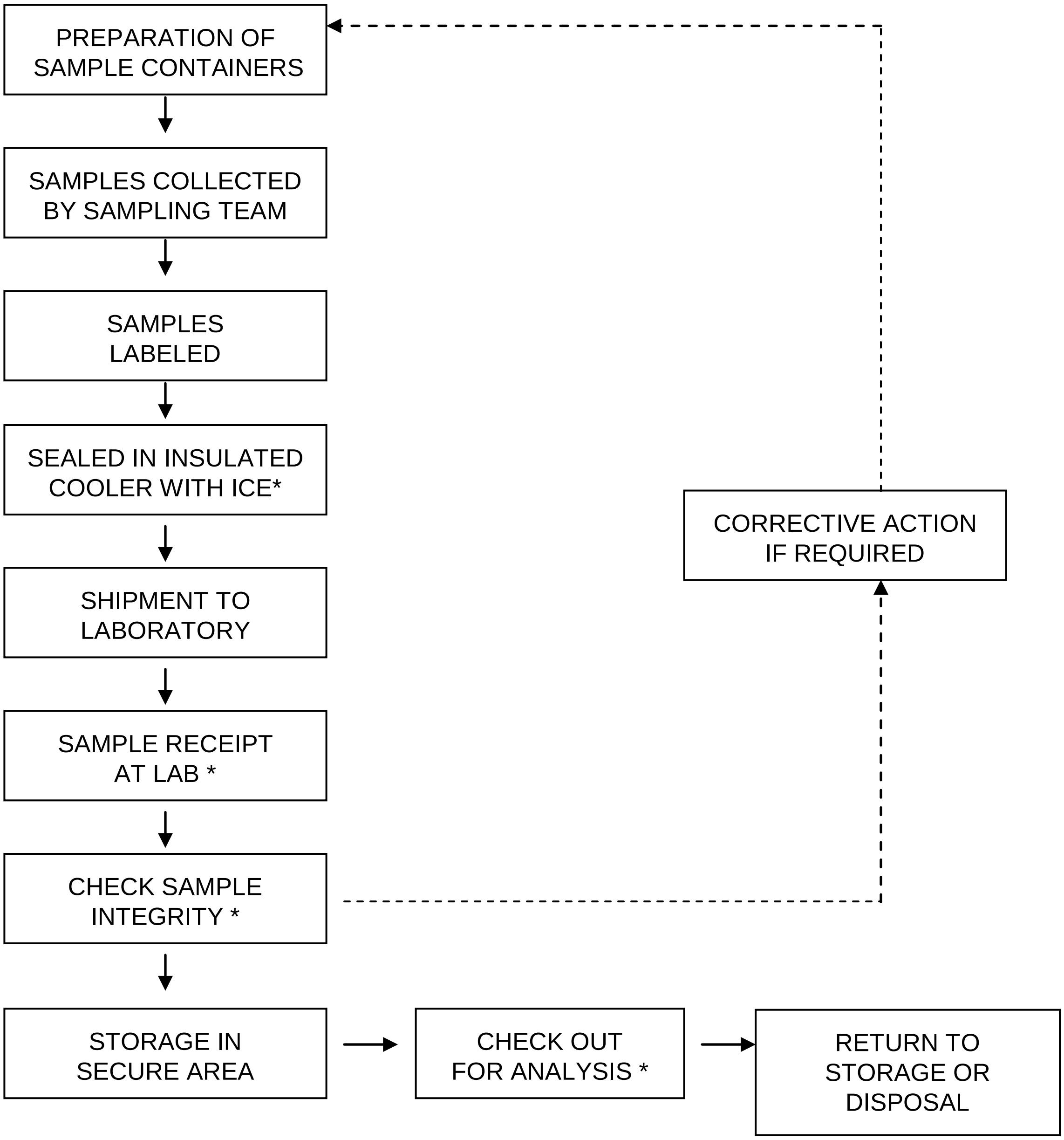
TCLP SEMIVOLATILE	SW-846 Analysis	Water (ug/L)
2-Methylphenol	3510 / 8270B	10
3 & 4-Methylphenol	3510 / 8270B	10
1,4-Dichlorobenzene	3510 / 8270B	10
2,4-Dinitrotoluene	3510 / 8270B	10
Hexachlorobutadiene	3510 / 8270B	10
Hexachloroethane	3510 / 8270B	10
Hexachlorobenzene	3510 / 8270B	10
Nitrobenzene	3510 / 8270B	10
Pentachlorophenol	3510 / 8270B	50
Pyridine	3510 / 8270B	ND
2,4,5-Trichlorophenol	3510 / 8270B	10
2,4,6-Trichlorophenol	3510 / 8270B	10

TCLP METALS	SW-846 Analysis	Water (mg/L)
Arsenic	3010 / 6010	0.05
Barium	3010 / 6010	0.002
Cadmium	3010 / 6010	0.004
Chromium	3010 / 6010	0.007
Lead	3010 / 6010	0.04
Selenium	3010 / 6010	0.07
Silver	7760 / 6010	0.007
Mercury	7470	0.0002

ND - Not Determined

Figures

SAMPLE CUSTODY FLOW CHART



REQUIRES SIGN-OFF ON CHAIN-OF-CUSTODY FORM

FIGURE 5.1

CHAIN OF CUSTODY RECORD

WORK ORDER NO. ______ - _________ - _____

DUE DATE ______ - _________ - _____

COMPANY: ____

____

____

PHONE: (   )______________ FAX #: (   )______________

P.O.#: ____

CLIENT CONTACT: ____

PROJECT #: ____

SAMPLE TYPE

1. WATER	6. WIPES
2. SOIL	7. AIR CASSETTE
3. SLUDGE	8. OTHER
4. OIL	
5. CHIPS	

CONTAINER TYPE

P - PLASTIC

G - GLASS

V - VOA

SCILAB SAMPLE #	CLIENT SAMPLE IDENTIFICATION	SAMPLE TYPE	CONTAINER			SAMPLING INFORMATION			PRESERVATIVES										SAMPLE pH at Login
			SIZE	TYPE	#	DATE	TIME	TECH											

REPORT PACKAGES

- MWRA ☐
- MA DEP ☐
- RDR ☐
- ASP A ☐
- ASP B ☐
- QC LEVEL 1 ☐
- QC LEVEL 2 ☐

SAMPLED BY	DATE: TIME:	RECEIVED BY	DATE: TIME:
RELINQUISHED BY:	DATE: TIME:	RECEIVED BY	DATE: TIME:
RELINQUISHED BY:	DATE: TIME:	RECEIVED BY	DATE: TIME:

Temperature upon receipt______________

SPECIAL INSTRUCTIONS

☐ **24 HOUR TAT** ☐ **5 Day TAT**

☐ **48 HOUR TAT** ☐ **7 DAY TAT**

☐ **72 HOUR TAT** ☐ **10 DAY TAT**

Shade areas for laboratory use only.
Gold copy - Originator Retains
Pink copy - Shipper Retains

Submit White and Yellow copies to the laboratory.

FIGURE 5.2

H:\WPROC\Project\CON-ED\East 173rd Street\RAR\March 2010 SMP\Appendix C - QAPP\QAPP Fig 5.2 COC.doc

CORRECTIVE ACTION REQUEST

Number: ___________________________ Date: ____________

TO: ____

You are hereby requested to take corrective actions indicated below and as otherwise determined by you to (a) resolve the noted condition and (b) to prevent it from recurring. Your written response is to be returned to the project quality assurance manager by _______________

CONDITION:

REFERENCE DOCUMENTS:

RECOMMENDED CORRECTIVE ACTIONS:

___________	______	___________	_________	____________	_________
Originator	Date	Approval	Date	Approval	Date

RESPONSE

CAUSE OF CONDITION:

CORRECTIVE ACTION

(A) RESOLUTION

(B) PREVENTION

(C) AFFECTED DOCUMENTS

C.A. FOLLOWUP:

CORRECTIVE ACTION VERIFIED BY: ______________________________ DATE:______________

GEI Consultants

FIGURE 12.1

Appendix D

November 9, 2007 Access Agreement Between NYCDPR and Con Edison

AGREEMENT

AGREEMENT (**"Agreement"**) made this ______ day of ________________, 2006, by and between:

THE CITY OF NEW YORK (the **"City"**), a municipal corporation having its principal office at City Hall in the County, City and State of New York, acting by and through the New York City Department of Parks and Recreation (**"Parks Department"**), an administrative agency of the City of New York having offices at The Arsenal, 830 Fifth Avenue, New York, New York; and

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC. (**"Con Edison"**), a New York corporation with offices at 4 Irving Place, New York, New York,

with respect to the institutional controls and Site Management Plan required by the New York State Department of Environmental Conservation (**"DEC"**) for the Operable Unit 1 Area of the Former East 173rd Street Gas Works Site located within Starlight Park (the **"Park"**) in the Borough of the Bronx, City and State of New York.

WITNESSETH:

WHEREAS, the City owns and the Parks Department has care, custody and control of the Park, a portion of which was once part of the grounds of the East 173rd Street Gas Works - a former manufactured gas plant (**"MGP"**) that was operated by Con Edison's corporate predecessors until the early 1920's; and

WHEREAS, Con Edison has completed a DEC-approved remedial investigation for the Park pursuant to DEC Voluntary Cleanup Agreement Index No. D2-0003-02-08 (**"VCA"**), a copy of which is annexed hereto as Exhibit "A", and as required by the VCA will implement for the portion of the Park where MGP contamination was found to be present (the **"Operable Unit 1 Area"** or **"OU1 Area"**) a DEC-approved Remedial Action Work Plan (the **"RAWP"**) that the DEC and New York State Department of Health (**"DOH"**) have determined is protective of human health and the environment considering the Parks Department's plan to reconstruct and use the OU1 Area for public park purposes after the remedial measures specified in the RAWP have been completed; and

WHEREAS, the RAWP requires Con Edison, among other things, to excavate and remove from the OU1 Area (the approximate boundaries of which are depicted in the figure annexed hereto as Exhibit "B") former MGP structures and soils that contain MGP source materials or elevated concentrations of volatile and/or semi-volatile organic compounds and to cap the resulting excavation with a containment/isolation structure (**"Isolation Cap"**) composed of: (i) a visible demarcation barrier (**"Demarcation Warning Barrier"**) covered by a layer of certified clean fill material (**"Clean Fill Cover"**) three feet in thickness in the section of the OU1 Area that the Park Department intends to reconstruct as a ball field after the DEC determines that

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the remedial measures specified in the RAWP have been properly completed; and (ii) a Demarcation Warning Barrier covered by a six-foot thick Clean Fill Cover in the remainder of the excavated section of the OU1 Area; and

WHEREAS, the Parks Department has granted Con Edison limited, non-exclusive access to the Park for the purpose of completing the remedial measures specified in the RAWP pursuant to an Access Agreement, a copy of which is annexed hereto as Exhibit "C"; and

WHEREAS, the DEC has also imposed for the OU1 Area institutional controls ("**Applicable Institutional Controls**") that, after remediation of the Park is complete, among other things: (i) prohibit the use of the OU1 Area for purposes other than as a public park without DEC's approval and consent; (ii) prohibit the use of the groundwater in and around the OU1 Area without DEC's approval and consent; (iii) require compliance with a DEC-approved Site Management Plan ("**SMP**") that will be annexed hereto as Exhibit "D" after it has been approved by the DEC and that contains a Soil Management Plan ("Soil Plan") for the OU1 Area; (iv) require the Parks Department and/or the City to notify the DEC before excavating or knowingly allowing any person or entity to excavate below the Demarcation Warning Barrier; and (v) require the City to notify the DEC before conveying any real property interest in the OU1 Area and to grant an environmental easement affecting the OU1 Area to the State of New York pursuant to Article 71, title 36 of the New York Environmental Conservation Law before conveying any such interest in the OU1 Area; and

WHEREAS, after completing the remedial measures specified in the RAWP, Con Edison is required under the VCA to implement the SMP, which plan is expected to call for among other things: (i) periodic groundwater monitoring in the OU1 Area; (ii) periodic inspection of the OU1 Area and the submission of annual certifications to the DEC regarding the continued effectiveness of the Isolation Cap and other remedial measures completed for the OU1 Area pursuant to the RAWP; and (iii) for construction work or other activities that disturb the Isolation Cap within the OU1 Area, the implementation of the Soil Plan contained in the SMP; and

WHEREAS, the City's and Park Department's compliance with the Applicable Institutional Controls and Con Edison's implementation of the SMP are necessary to protect human health and the environment and to ensure that the OU1 Area can be safely returned to active use for public park purposes; and

WHEREAS, Con Edison will from time to time need access to the Park to carry out the SMP for the OU1 Area; and

WHEREAS, subject to Con Edison's compliance with the terms and conditions of this Agreement, the City and the Parks Department are willing to enter into this Agreement and to grant Con Edison limited, non-exclusive access to the Park for the purpose of implementing the SMP, as specified herein.

NOW THEREFORE, in consideration of the covenants and promises set forth herein, the City, the Parks Department, and Con Edison (collectively referred to in this Agreement as the "**Parties**") agree as follows:

1. **Definitions**

As used in this Agreement, the terms referenced herein are defined as follows:

(a) The term "**change in use**" means any change in use, as defined in Section 27-1425 of the New York Environmental Conservation Law, except that the erection of a structure within the OU1 Area constitutes a change in use only if the structure to be erected is an enclosed structure into which persons are intended and able to enter.

(b) The term "**disturb the Isolation Cap**" means: (i) any excavation activities in the Clean Fill Cover of the Isolation Cap, other than the grounds maintenance and landscaping activities identified below; (ii) any excavation activities beneath the Demarcation Warning Barrier of the Isolation Cap; and (iii) any other activities that impair the effectiveness of the Isolation Cap, including any disposing, leaking, spilling, or releasing of hazardous substances (as defined below) or petroleum (as defined below). The term "disturb the Isolation Cap" does not encompass the following grounds maintenance and landscaping activities conducted by the Parks Department: (i) grass cutting/mowing; (ii) raking or vacuuming of grass clippings; (iii) leaf blowing, raking, or vacuuming; (iii) lawn spiking or the drilling of lawn aeration plugs, provided that the plug holes do not extend deeper than 12 inches into the Clean Fill Cover of the Isolation Cap; and (iv) the planting of small bushes or other plants; provided that, the depth of any required hole does not extend deeper than 12 inches into the Clean Fill Cover, only certified clean fill material that has been dug from the Clean Fill Cover is used to backfill the hole, and on or before January 5th of each year the Parks Department provides Con Edison with a list of each occasion on which small bushes or other plants were planted within the OU1 Area during the preceding year and confirmation that the foregoing conditions were met on each such occasion.

(c) The term "**public park**" means a public-owned park, beach, parkway, or roadway within the jurisdiction of the Commissioner of Parks and Recreation of the City of New York, as defined in section 533 of the New York City Charter.

(d) The term "**hazardous substances**" mean hazardous substances as defined in Section 40-0105 of the New York Environmental Conservation Law.

(e) The term "**petroleum**" means petroleum as defined in Section 172 of the New York Navigation Law.

2. **Cooperation**

The Parties shall make their best efforts to cooperate fully with each other in all matters pertaining to: (i) the implementation of this Agreement; (ii) the implementation of the SMP; (iii) the Applicable Institutional Controls; and (iv) ensuring the effectiveness of the remedial measures that were completed for the OU1 Area pursuant to the RAWP with respect to any landscaping, grounds maintenance, facility maintenance, construction, or other activities that may be performed within the OU1 Area, and which necessitate the implementation of the Soil Plan contained in the SMP, by the Parks Department and/or by persons or entities acting pursuant to permits issued by the Parks Department ("**Permit Holders**") .

3. OU1 Area Boundaries

The Parties acknowledge and agree that the boundaries of the OU1 Area depicted in Exhibit "B" to this Agreement may vary depending upon the extent of the excavation work that must be performed pursuant to the RAWP to achieve the remedial objectives and cleanup criteria specified in the RAWP. Within thirty (30) days after the DEC determines that the remedial measures specified in the RAWP have been properly completed, Con Edison shall cause a New York State-licensed land surveyor to prepare a metes and bounds description of the OU1 Area, which description shall be annexed to this Agreement as Exhibit "B-1". In the event of any conflict or inconsistency between the OU1 Area boundaries depicted in Exhibit "B" and the metes and bounds description of the OU1 Area set forth in Exhibit "B-1", the metes and boundaries description set forth in Exhibit "B-1" shall control.

4. Compliance Procedures

Each party to this Agreement is responsible for adopting such internal directives, instructions, rules, regulations, and procedures ("**Compliance Procedures**") as it deems necessary to ensure its compliance with its duties and obligations under this Agreement. Not later than nine (9) months after the effective date of this Agreement, the Parties will meet to discuss the nature and scope of the Compliance Procedures that each contemplates adopting hereunder. The Parties shall adopt such Compliance Procedures before the OU1 Area is returned to use for public park purposes. The Parks Department agrees that the Compliance Procedures it adopts will include posting at each entrance to the Park a sign informing the public that excavation of any kind within the Park is prohibited without a Parks Department permit. Con Edison agrees that it will reimburse the Parks Department, as specified below in Section 19 of this Agreement, for the necessary and reasonable costs that the Parks Department incurs procuring, installing, and maintaining such signs at the entrances to the Park.

5. Annual Information Presentations

Once each year, Con Edison shall give a presentation providing the following information to Parks Department officials and personnel, including Parks Department employees responsible for maintaining the grounds and/or facilities of the Park, planning or conducting construction projects within the Park, and/or granting permits authorizing any construction work or other activities within the Park that may impair the effectiveness of the remedial measures that were completed for the OU1 Area pursuant to the RAWP or that may disturb the Isolation Cap:

(a) Nature, extent, and potential health effects of the residual MGP contamination present beneath the Demarcation Warning Barrier;

(b) Scope and purpose of the remedial measures that were completed for the OU1 Area pursuant to the RAWP;

(c) Scope and purpose of the Applicable Institutional Controls;

(d) Scope and purpose of the SMP, including the DEC-approved Soil Plan contained in the SMP;

(e) Notification of Con Edison of construction work or other activities that will disturb the Isolation Cap and necessitate Con Edison's implementation of the DEC-approved Soil Plan contained in the SMP;

(f) Notification of the DEC and Con Edison of construction work or other activities that involve the excavation of soil beneath the Demarcation Warning Barrier; and

(g) Planning and scheduling construction work or other activities for which the DEC-approved Soil Plan contained in the SMP must be implemented by Con Edison as specified in this Agreement.

Con Edison shall give the annual information presentations required by this Section 5 at a City or Parks Department facility specified by the Parks Department. Con Edison shall give the first such information presentation at a mutually agreed upon time and date before the OU1 Area is returned to use for public park purposes. Thereafter, Con Edison shall give the annual information presentation at the time provided for below in Section 6 of this Agreement. Con Edison shall record the first annual information presentation and each subsequent presentation at which Con Edison presents new or revised information regarding the topics identified above and shall provide the Parks Department with a copy of such recordings for use in training Parks Department employees.

6. **Annual Meetings**

In addition to any communications, notifications, and/or meetings provided for in this Agreement, the Parties shall meet at least once each year at a mutually agreed upon time and date for the following purposes:

(a) To discuss any amendments that the Parties believe should be made to their respective compliance procedures under Section 4 of this Agreement to improve the effectiveness of those procedures;

(b) To discuss any amendments to the Applicable Institutional Controls that the City and/or the Parks Department anticipate requesting the DEC to consider and approve during the next 12-month period;

(c) To discuss any amendments to the SMP that the Parties believe Con Edison should request the DEC to consider and approve to enhance the effectiveness of that plan;

(d) To discuss any landscaping activities, grounds maintenance activities, facility maintenance activities, construction work, or other ground intrusive activities that the Parks Department anticipates performing or allowing Permit Holders to perform within the OU1 Area during the 12-month period following the meeting;

(e) To discuss the periodic groundwater monitoring activities that Con Edison plans to perform in the OU1 Area during the 12-month period following the meeting and to develop for those activities an implementation schedule that is mutually acceptable to the Parks Department and Con Edison and consistent with Con Edison's obligation under SMP to perform groundwater monitoring at the frequency specified in that plan;

(f) To discuss the inspection(s) of the OU1 Area that Con Edison plans to conduct during the 12-month period following the meeting for the purpose of preparing the annual certification that must be filed with the DEC for the OU1 Area under the SMP and to develop a mutually acceptable implementation schedule for such inspection or inspections.

(g) To schedule the annual information presentation provided for above in Section 5 of this Agreement.

The first such annual meeting shall be held before the OU1 Area is returned to use for public park purposes and, in addition to the matters specified above, shall include the development of a mutually acceptable implementation schedule for any work that Con Edison intends to undertake within the OU1 Area during the 12-month period following the meeting to repair and/or replace and develop any required groundwater monitoring wells that were damaged or destroyed during the Parks Department's planned reconstruction activities to return for the OU1 Area to use for public park purposes after the DEC determines that remedial measures specified in the RAWP have been properly completed.

7. Compliance with Applicable Institutional Controls

7.1 The City and the Parks Department covenant and agree that, at all times during which the OU1 Area is owned by the City and/or is under the care, custody and control of the Parks Department, they will comply with the terms and conditions of the Applicable Institutional Controls and any amendments or modifications that the DEC may lawfully make to the Applicable Institutional Controls, and that they will not authorize, request, suffer or allow any City agency or department to violate the terms and conditions of the Applicable Institutional Controls and any amendments or modifications that the DEC may lawfully make to the Applicable Institutional Controls, nor authorize, request, suffer or knowingly allow: (i) any contractor retained by the City, the Parks Department, or any agency or department of the City; (ii) any Permit Holder; and/or (iii) any contractor retained by a Permit Holder to violate the terms and conditions of the Applicable Institutional Controls and any amendments or modifications that the DEC may lawfully make to the Applicable Institutional Controls.

7.2 The City and the Parks Department covenant and agree that, at all times during which the OU1 Area is owned by the City and/or is under the care, custody and control of the Parks Department, the OU1 Area will be not be used for any purpose other than as a public park without the express written approval and consent of the DEC.

7.3 Except with respect to the reconstruction of the OU1 Area for use for public park purposes in accordance with the Parks Department plans filed with the DEC (which reconstruction activities shall not proceed until DEC determines that the remedial measures specified in the RAWP have been properly completed), the City and the Parks Department covenant and agree that, at all times during which the OU1 Area is owned by the City and/or is under the care, custody and control of the Parks Department, they will not affect any change in use, as defined herein, of the OU1 Area, and that they will not authorize, request, suffer or allow any City agency or department to affect any such change in use of the OU1 Area without the express written approval of the DEC, nor authorize, request, suffer or knowingly allow: (i) any contractor retained by the City, the Parks Department, or any agency or department of the City; (ii) any Permit Holder; or (iii) any contractor retained by a Permit Holder to affect any such change in use of the OU1 Area without the express written approval and consent of the DEC.

7.4 Except with respect to construction work or other activities that are conducted in accordance with the terms and conditions of this Agreement and the requirements of the SMP, including the DEC-approved Soil Plan contained in the SMP, the City and the Parks Department covenant and agree that, at all times during which the OU1 Area is owned by the City and/or is under the care, custody and control of the Parks Department, they will not intentionally disturb or impair the effectiveness of the Isolation Cap in the OU1 Area, and that they will not authorize, request, suffer or allow any City agency or department to intentionally disturb or impair the effectiveness of the Isolation Cap in the OU1 Area, nor authorize, request, suffer, or knowingly allow: (i) any contractor retained by the City, the Parks Department, or any agency or department of the City; (ii) any Permit Holder; or (iii) any contractor retained by a Permit Holder to intentionally disturb or impair the effectiveness of the Isolation Cap in the OU1 Area.

7.5 The City and the Parks Department covenant and agree that, at all times during which the OU1 Area is owned by the City and/or is under the care, custody and control of the Parks Department, they will not use the groundwater in the OU1 Area for any purpose without the express written approval and consent of the DEC, and that they will not authorize, request, suffer or allow any City agency or department to use the groundwater in the OU1 Area for any purpose without the express written approval and consent of the DEC; nor authorize, request, suffer, or knowingly allow: (i) any contractor retained by the City, the Parks Department, or any agency or department of the City; (ii) any Permit Holder; or (iii) any contractor retained by a Permit Holder to use the groundwater in the OU1 Area for any purpose without the express written approval and consent of the DEC.

7.6 The City covenants and agrees that before it conveys any real property interest in the OU1 Area: (i) it will provide the DEC with at least 90 days advance written notice of the proposed conveyance; (ii) it will grant to the State of New York in an instrument acceptable to the DEC an environmental easement affecting the OU1 Area in accordance with the requirements of Article 71, title 36 of the New York Environmental Conservation Law; (iii) it will duly execute and cause such environmental easement to be recorded by the Office of the New York City Register; and (iv) it will include in the instrument conveying the proposed real property interest in the OU1 Area notice of the environmental easement and will make the conveyance subject to the environmental easement.

7.7 The City and the Parks Department covenant and agree that, at all times during which the OU1 Area is owned by the City and/or is under the care, custody and control of the

Parks Department, they will comply with any additional Applicable Institutional Controls that the DEC lawfully determines are necessary for the OU1 Area to protect human health and the environment. Con Edison covenants and agrees that it will reimburse the City and the Parks Department, as provided below in Section 19 of this Agreement, for the necessary and reasonable costs that the City and the Parks Department incur in complying with the requirements of any such additional Applicable Institutional Controls, unless the DEC revises the Applicable Institutional Controls for one or more of the following reasons: (i) the City and/or the Parks Department have failed to comply with the Applicable Institutional Controls or have authorized or knowingly allowed any person or entity to violate the requirements of the Applicable Institutional Controls; (ii) the OU1 Area is changed from use for public park purposes to another use; or (iii) the additional Applicable Institutional Controls are deemed necessary by the DEC to address contamination of the OU1 Area that occurs after the effective date of this Agreement and that is caused by petroleum or one or more hazardous substances that were not spilled, leaked, disposed of, or otherwise released by Con Edison or the Con Edison Parties.

8. **Revisions to Institutional Controls**

Notwithstanding anything to the contrary in Section 7 of this Agreement, the City and the Parks Department reserve the right to request the DEC to amend, modify, or vacate the Applicable Institutional Controls, to challenge and seek judicial review of DEC's determination(s) with respect to any such request(s), and to challenge and seek judicial review of any amendments or modifications that the DEC may make to the Applicable Institutional Controls on its own motion. Con Edison agrees that it will not request the DEC to amend, modify or vacate the Applicable Institutional Controls without the express written consent of the City and the Parks Department. Con Edison further agrees that, if the DEC revises the Applicable Institutional Controls to impose additional requirements on the City and/or the Parks Department, Con Edison will reimburse the City and the Parks Department, as provided below in Section 19 of this Agreement, for the necessary and reasonable costs that the City and the Parks Department incur in complying with such additional requirements, unless the DEC revises the Applicable Institutional Controls for one or more of the following reasons: (i) the City and/or the Parks Department have failed to comply with the Applicable Institutional Controls or have authorized or knowingly allowed any person or entity to violate the requirements of the Applicable Institutional Controls; (ii) the OU1 Area is changed from use for public park purposes to another use; or (iii) the additional Applicable Institutional Controls are deemed necessary by the DEC to address contamination of the OU1 Area that occurs after the effective date of this Agreement and that is caused by petroleum or one or more hazardous substances that were not spilled, leaked, disposed of, or otherwise released by Con Edison or the Con Edison Parties.

9. **Revisions to SMP**

9.1 Con Edison shall confer with the City and the Parks Department before requesting the DEC to approve any amendments or modifications to the SMP and shall obtain the City's and the Park Department's written consent before requesting the DEC to approve any amendments or modifications to the SMP that alter Con Edison's obligation under this Agreement to implement the DEC-approved Soil Plan contained in the SMP.

9.2 Con Edison shall promptly notify the City and the Parks Department of any amendments or modifications that the DEC may direct Con Edison to make to the SMP and shall inform the City and the Parks Department whether Con Edison intends to exercise its right under the VCA to seek dispute resolution for any such DEC-required SMP amendment or modification. If Con Edison requests dispute resolution for a DEC-required SMP amendment or modification, Con Edison shall promptly notify the City and the Parks Department of the outcome of that administrative appeals process and shall inform the City and the Parks Department whether Con Edison intends to exercise its right under the VCA to seek judicial review of DEC's determination requiring that the SMP be amended or modified. Notwithstanding any efforts by Con Edison to seek administrative reconsideration or judicial review of the DEC-required SMP amendment or modification, the City and the Parks Department reserve whatever rights they may have under New York law to challenge and seek judicial review of DEC's determination requiring that the SMP be amended or modified. Con Edison agrees that it will reimburse the City and the Parks Department, as provided below in Section 19 of this Agreement, for the necessary and reasonable costs that the City and the Parks Department incur in complying with the additional requirements of revisions that the DEC directs Con Edison to make to the SMP, unless the DEC imposes those requirements for one or more of the following reasons: (i) the City and/or the Parks Department have failed to comply with the SMP or have authorized or knowingly allowed any person or entity to violate the requirements of the SMP; (ii) the additional requirements are necessary to address any change in use made in the OU1 Area; or (iii) the additional requirements are deemed necessary by the DEC to address contamination of the OU1 Area that occurs after the effective date of this Agreement and that is caused by petroleum or one or more hazardous substances that were not spilled, leaked, disposed of, or otherwise released by Con Edison or the Con Edison Parties.

9.3 In the event that the DEC approves any amendments or modifications to the SMP, or directs Con Edison to amend or modify the SMP and DEC's determination requiring that the SMP be amended or modified is not vacated by the DEC and/or by a court of competent jurisdiction, the DEC-approved SMP, as so amended or modified, shall constitute and comprise Exhibit "D" to this Agreement, and Con Edison shall promptly deliver to the City and the Parks Department a true and complete copy of the amended or modified SMP.

10. License to Enter/Risk of Loss

Subject to Con Edison's compliance with the terms of this Agreement, and subject further to Con Edison's compliance with any required Parks Department permits for any construction work of any kind or any work incidental thereto, including the storage of materials, disturbance of soils, and/or any work which would impact any trees in the Park, the City and the Parks Department hereby grant to Con Edison a limited and revocable license (the "**License**"), revocable at will upon 25 days prior notice to Con Edison, to enter the Park for the purpose of complying with the requirements of the SMP, including carrying out the following activities specified in the SMP: (i) periodic groundwater monitoring in the OU1 Area; (ii) repair and/or replacement and development of any required groundwater monitoring wells damaged during the Parks Department's planned reconstruction activities to return the OU1 Area to use for public park purposes after the DEC determines that remedial measures specified in the RAWP have been properly completed; (iii) repair and/or replacement and development of any required groundwater monitoring wells that are destroyed or damaged after the OU1 Area is returned to use for public park purposes; (iv) periodic inspection of the OU1 Area for the purpose of preparing annual certifications to the DEC regarding the continued effectiveness of the completed remedial measures for the OU1 Area; and (v) implementation of the DEC-approved Soil Plan contained in the SMP, as specified in this Agreement (hereinafter these activities are referred to collectively as "**Authorized Activities**" and individually as "**Authorized Activity**"). Con Edison acknowledges and agrees that: (a) the License does not constitute the granting of an easement or any other interest in the Park or the OU1 Area; (b) the City and the Parks Department have made no representations or warranties of any kind regarding the physical condition of the Park and the OU1 Area or the presence or absence of any conditions that might pose a danger to any employees, contractors, subcontractors, or representatives of Con Edison entering thereon; and (c) Con Edison has knowingly and intentionally assumed for itself and for its contractors, subcontractors, employees, and representatives (collectively the "**Con Edison Parties**"), all risk of loss or injury that might occur during the performance of any of its activities in the Park, whether they are Authorized Activities or otherwise, as a result of any such conditions or otherwise.

11. City/Parks Department Oversight

The City and the Parks Department and their respective employees, contractors, and consultants have the right, without the imposition of any obligations or responsibilities as a result thereof, to accompany and observe the Con Edison Parties' performance of the Authorized Activities. The City and the Parks Department agree that their employees, contractors, and consultants will comply with all applicable laws, ordinances, rules, regulations, the lawful directives or instructions given by any duly authorized DEC and/or DOH representative who may be monitoring the Con Edison Parties' performance of the Authorized Activities, and the requirements of the health and safety plan contained in the DEC-approved Site Plan while present within any section of the OU1 Area in which the Con Edison Parties are performing Authorized Activities.

12. Contractors/Liens

The Authorized Activities shall be performed in a good, orderly, safe and worker-like manner by Con Edison personnel and contractors reasonably acceptable to the City and the Parks Department. Con Edison shall keep the Park and the OU1 Area free of judgments and liens by the individuals and entities that it retains to perform the Authorized Activities and shall promptly bond such liens or cause them to be discharged.

13. Permits/Health and Safety/Manifests

13.1 Except as otherwise provided below in Section 13.3 of this Agreement, Con Edison is responsible for obtaining all necessary governmental and utility permits and approvals required for the Con Edison Parties' performance of the Authorized Activities, and Con Edison shall provide copies thereof to the Parks Department before the Con Edison Parties commence the Authorized Activities for which such permits and approvals are required.

13.2 The Parks Department shall promptly review all applications submitted by or on behalf of Con Edison for any Parks Department permits required for the Con Edison Parties' performance of the Authorized Activities and shall not unreasonably delay the issuance of those permits. The Parks Department agrees that it will not include in such permits any arbitrary requirements or any provisions that unreasonably alter the duties or rights of the parties under this Agreement.

13.3 The City and the Parks Department are responsible for notifying and obtaining from the DEC the approvals and consents required under the Applicable Institutional Controls for any construction work or other activities that constitute a change in use of the OU1 Area and that necessitate the implementation of the DEC-approved Soil Plan contained in the SMP.

13.4 Con Edison agrees that: (i) the Authorized Activities will be performed by the Con Edison Parties in full compliance with the requirements of the SMP and all applicable environmental, health and safety laws, standards, and regulations; (ii) all persons and entities used by Con Edison to perform the Authorized Activities will be appropriately trained, licensed and insured; (iii) during the Con Edison Parties' performance of the periodic groundwater monitoring activities specified in the SMP, the repair/replacement and development activities for any required groundwater monitoring wells in the OU1 Area, and/or the excavation of any soil beneath the Demarcation Warning Barrier pursuant to the DEC-approved Soil Plan, the Con Edison Parties shall be responsible for the security and safety of the work areas in which they are performing those Authorized Activities; (iv) Con Edison shall be responsible for the appropriate handling, storage and disposal of all waste materials generated by the Con Edison Parties' performance of the Authorized Activities and shall comply with all laws, ordinances, rules and regulations applicable thereto; and (v) to the extent permitted by law, Con Edison shall be listed as the "generator" of all such waste materials on any manifests and/or shipping papers required for the transportation of those materials.

14. Notice/Commencement of Authorized Activities

14.1 Con Edison shall give the Parks Department at least ten (10) business days advance written notice before commencing any periodic inspections of the OU1 Area for the purpose of preparing the DEC annual certifications required by the SMP and shall carry out and complete required periodic inspections in accordance with the implementation schedules provided for above in Section 6 of this Agreement.

14.2 Con Edison shall give the Parks Department at least ten (10) business days advance written notice and obtain any Parks Department permit that may be required under applicable Parks Department's Rules and Regulations before commencing the following Authorized Activities: (i) repair/replacement and development work for any required groundwater monitoring wells in the OU1 Area that are damaged or destroyed either during the Parks Department's planned reconstruction activities to return the OU1 Area to use for public park purposes or after the OU1 Area is returned to use for public park purposes; and (ii) periodic groundwater monitoring. Con Edison shall conduct the foregoing specified Authorized Activities in accordance with an implementation schedule that is mutually acceptable to the Parks Department and Con Edison and consistent with Con Edison's obligation under the SMP to conduct periodic groundwater monitoring at the frequency specified in that plan.

14.3 Except for unplanned emergency activities that disturb the Isolation Cap and necessitate Con Edison's implementation of the DEC-approved Soil Plan contained in the SMP, Con Edison shall give the Parks Department at least ten (10) business days advance written notice and obtain any Parks Department permit required under applicable Parks Department's

Rules and Regulations before commencing the implementation of the DEC-approved Soil Plan and shall carry out and complete the soil management plan activities specified below in Section 17 of this Agreement in accordance with the implementation schedule provided for in Section 17.1 hereof. For unplanned emergency activities that disturb the Isolation Cap and necessitate Con Edison's implementation of the DEC-approved Soil Plan contained in the SMP, Con Edison shall give the Parks Department such advance written notice as is reasonable under the circumstances and obtain any Parks Department permit required under applicable Parks Department's Rules and Regulations before commencing the implementation of the DEC-approved Soil Plan and shall carry out and complete the soil management plan activities specified below in Section 17 of this Agreement in accordance with the implementation schedule provided for in Section 17.2 hereof.

15. <u>Staging of Equipment and Materials</u>

15.1 Except as otherwise provided below in Sections 15.2 and 15.3 of this Agreement, the Con Edison Parties shall not: (i) stage any equipment or materials required for the performance of the Authorized Activities in any area of the Park other than in those specific locations ("Work Locations") within the OU1 Area in which the Con Edison Parties are performing the Authorized Activities; (ii) leave their equipment or materials unattended or unsecured in the OU1 Area while the Park is open for use by the public; (iii) leave any Work Locations unsupervised while Authorized Activities are being performed in them, or (iv) park any vehicles, other than those necessary for the performance of the Authorized Activities, in any area of the Park without prior notice and the express written approval of the Parks Department in the form of a Parks Department standard construction permit or otherwise.

15.2 During their performance of repair/replacement and development activities for any damaged or destroyed required groundwater monitoring wells in the OU1 Area, the Con Edison Parties are authorized to store within the Work Location(s) in which the groundwater monitoring well repair/replacement and development activities are being performed or within such other area(s) of the Park, as may be designated by the Parks Department in writing in the form of a Parks Department standard construction permit or otherwise: (i) the drill rig, other equipment, and materials required for the performance of groundwater monitoring well repair/replacement and development activities; (ii) sealed drums containing soil cuttings from the installation of the replacement groundwater monitoring well(s); and (iii) sealed drums containing purge water from the development of the repaired or replacement groundwater monitoring well(s). The Con Edison Parties shall provide adequate security for all such equipment, materials, and drums of waste soil cuttings and purge water. When the Con Edison Parties are not present within the Work Location(s) the security measures shall include either the posting of a watch man or the erection of a six-foot high temporary construction fence around the Work Location(s) in which such equipment and materials are stored during the time the groundwater monitoring well repair/replacement and development activities are performed. The Con Edison Parties shall promptly remove any such stored equipment, materials and drums of soil cuttings and purge water from the Work Location(s) when the repair/replacement and development activities for the required groundwater monitoring wells are completed.

15.3 For construction work or other activities that necessitate the excavation of soil beneath the Demarcation Warning Barrier, the City or the Parks Department, the City or the Parks Department contractor, or the Parks Department Permit Holder performing such work or activities (the individual or entity conducting such work or activities is hereinafter referred to as the "Disturbance Activity Entity") shall establish an appropriately-sized work area meeting the security requirements specified above in Section 15.2 of this Agreement around the location within the OU1 Area in which such work or activities will be performed. During the Con Edison Parties' implementation of the DEC-approved Soil Plan for any such work or activities, the Con Edison Parties are authorized to store within the Disturbance Activity Entity's work area: (i) the equipment (including earth moving equipment) and materials required for the implementation of the DEC-approved Soil Plan; (ii) the certified clean fill excavated from above the visible demarcation barrier of the Isolation Cap; and (iii) the soil excavated from beneath the Isolation Cap. The excavated certified clean fill will be stockpiled on tarps, plastic sheeting, or other suitable lay-down materials or stored within roll-off containers. The soil excavated from beneath the Demarcation Warning Barrier will be staged on tarps, plastic sheeting, or other suitable lay-down materials and transferred to and stored within roll-off containers covered with tarps, drums, and/or other suitable containers. The Con Edison Parties shall promptly remove from the work area(s) and the Park any stored equipment, materials, and certified clean fill that are not used for the restoration of the Isolation Cap and any excavated soil from beneath the Demarcation Warning Barrier that is not used to or that cannot be used to backfill the excavation below the level of the Demarcation Warning Barrier when the construction work or other activities necessitating the excavation have been completed. If the Parks Department's establishment of a work area as described in this Section 15.3 causes the Parks Department to incur expenses that it would not have otherwise incurred but for the need for the work to comply with the DEC-approved Soil Plan contained in the SMP, Con Edison shall reimburse the Parks Department for such costs as determined under and provided in Section 19.2 of this Agreement.

15.4 Notwithstanding the foregoing, any equipment or materials brought onto the OU1 Area and/or Park or stored within the OU1 Area or the Park by the Con Edison Parties shall be at their sole risk, and the City and the Parks Department shall under no circumstances have any liability for any loss of or damage to any such stored equipment, or materials or for any losses, injuries or damages arising out of the storage of any such equipment, materials, or soil cuttings, groundwater monitoring purge water, certified clean fill material from the Isolation Cap, or soil excavated from beneath the Demarcation Warning Barrier.

16. **OU1 Area Reconstruction**

16.1 The Parks Department agrees that it will: (i) provide Con Edison and the DEC with at least sixty (60) days prior written notice of the commencement of the planned activities to reconstruct the OU1 Area for use as a public park; and (ii) require the contractors conducting such activities to obtain from the supplier(s) of the top soil that that is placed over the Isolation Cap written certifications documenting that such top soil does not contain volatile organic compounds ("VOCs"), semi-volatile organic compounds ("SVOCs"), or metals in concentrations that exceed the VOC, SVOC, PCB, and metals concentration limits specified in the RAWP for the Clean Fill Cover of the Isolation Cap. Con Edison and/or its environmental consultant will observe the performance of the planned reconstruction activities for the following purposes:

(a) To ensure that the performance of the planned reconstruction activities does not impair the remedial measures that were completed for the OU1 Area pursuant to RAWP or damage or jeopardize the integrity of the Isolation Cap;

(b) To ensure that adequate safeguards are employed during the performance of the planned reconstruction activities to prevent the groundwater monitoring wells in the OU1 Area from being damaged or buried; and

(c) To ensure that the supplier(s) of the top soil that is placed over the Isolation Cap have provided the certifications required in this section and, in Con Edison's discretion, to collect samples of the such top soil for confirmatory VOC, SVOC, and metal analyses by DOH-accredited environmental testing laboratories.

16.2 Con Edison will promptly report to the Parks Department and to the DEC any observed reconstruction activities that Con Edison believes may impair the remedial measures that were completed for the OU1 Area pursuant to the RAWP, damage or jeopardize the integrity of the Isolation Cap, or damage the groundwater monitoring wells in the OU1 Area. After receipt of such notice from Con Edison, the Parks Department shall promptly instruct the individuals or entities conducting the reconstruction activities to carry out the reconstruction activities: (i) in a manner that is designed to eliminate such adverse impacts and to prevent their re-occurrence; or (ii) if the DEC issues any directions or instructions with respect to performance of the reconstruction activities, in the manner specified by the DEC.

16.3 The Parks Department shall promptly provide Con Edison with a complete set of "as built" drawings (including finished elevation data) for the OU1 Area after the reconstruction activities have been completed. Con Edison shall promptly provide the Parks Department with a copy of the results of any laboratory analyses that the Con Edison Parties performed for any top soil that is placed over the Clean Fill Cover of the Isolation Cap, as part of the reconstruction activities for the OU1 Area.

17. **Implementation of the DEC-approved Soil Plan**

17.1 Except as otherwise provided below in Section 17.2 of this Agreement, the Parks Department shall notify Con Edison in writing as early as practicable of any construction work or other activities (regardless of whether the construction work or other activities will be performed by City personnel, Parks Department personnel, City or Parks Department contractors, or Permit Holders) that will disturb the Isolation Cap (such work and/or other activities are collectively referred to hereinafter as "Disturbance Activities") and shall notify the DEC in writing as early as practicable of any Disturbance Activities that entail or that are expected to entail the excavation of soil from beneath the Demarcation Warning Barrier. The Parks Department's notice to Con Edison (and to the DEC, if required) shall include the following information to the extent that such information is known at the time that the notice is given: (i) the nature of the Disturbance Activities; (ii) the specific section of the OU1 Area in which the Disturbance Activities will be performed; (iii) the depth and the approximate square footage of excavation required to support the Disturbance Activities; (iv) the proposed schedule for carrying out and completing the Disturbance Activities; (v) the names, addresses, and telephone numbers of the individuals or entities that will perform the Disturbance Activities; and (vi) the name, address and telephone number of the Parks Department's representative or project manager for the Disturbance Activities. Not later than ten (10) business days after its receipt of the Parks Department's notice, Con Edison shall contact the Park Department representative (and Permit Holder representative, if Disturbance Activities will be conducted by a Permit Holder) specified in the Parks Department's notice to discuss any additional information that Con Edison may require for the Disturbance Activities and to develop a mutual acceptable schedule for Con Edison's implementation of the DEC-approved Soil Plan, as provided below in Section 17.3 or Section 17.4 of this Agreement.

17.2 The Parks Department shall provide Con Edison with advance written notice that is reasonable under the circumstance for any unplanned Disturbance Activities that must be conducted on an expedited basis to abate an imminent risk of harm to public health, pubic safety or the environment or to prevent or minimize the impairment of any remedial measures that were completed for the OU1 Area pursuant to the RAWP and shall provide the DEC with such advance written notice as is reasonable under the circumstances for any such unplanned emergency Disturbance Activities that entail or are expected to entail the excavation of soil from beneath the Demarcation Warning Barrier. The Parks Department's written notice to Con Edison (and to the DEC, if required) shall explain the reasons why the Disturbance Activities must be performed without delay and shall include all of the information specified above in Section 17.1 of this Agreement. Con Edison shall contact the Park Department representative (and Permit Holder representative if the unplanned emergency Disturbance Activities will be conducted by a Permit Holder) specified in the Parks Department's notice, as expeditiously as is practicable under the circumstances, to discuss any additional information that Con Edison may require for the unplanned emergency Disturbance Activities and to develop a mutual acceptable schedule for the Con Edison's implementation of the DEC-approved Soil Plan, as provided below in Section 17.3 or Section 17.4 of this Agreement.

17.3 For Disturbance Activities that do not entail the excavation of soil from beneath the Demarcation Warning Barrier, Con Edison will implement the DEC-approved Soil Plan contained in the SMP by observing (or retaining a contractor to observe) the Disturbance Activity Entity's performance of the Disturbance Activity for the following purposes:

(a) To ensure that the Disturbance Activity Entity excavates any certified clean fill that must be removed from the Clean Fill Cover using methods that are designed to protect the Demarcation Warning Barrier of the Isolation Cap from being breached or damaged;

(b) To ensure that the certified clean fill removed from the Clean Fill Cover of the Isolation Cap is segregated from any other materials that may be excavated by the Disturbance Activity Entity and that the Disturbance Activity Entity properly stages and stores the excavated certified clean fill and adequately safeguards it from potential sources of contamination;

(c) To ensure that, after the Disturbance Activity Entity has completed its Disturbance Activity, the Disturbance Activity Entity back fills the excavation that was made in the Clean Fill Cover using the certified clean fill that was removed from the Clean Fill Cover (or soil from a certified clean source that meets the criteria specified in the DEC-approved Soil Plan contained in the SMP, if additional soil is required to restore the Clean Fill Cover), properly compacts the back filled certified clean fill, and restores the Clean Fill Cover of the Isolation Cap to the minimum depth specified in the RAWP and the SMP;

(d) To ensure that the Isolation Cap is not damaged by the Disturbance Activity Entity's repair and restoration of the work area in which its Disturbance Activity was performed, including the repair, replacement, or restoration of any vegetative cover or paving materials that were removed as part of the Disturbance Activities or that were impaired by the Disturbance Activity Entity's performance of the Disturbance Activity; and

(e) To create a written record of the performance of the Disturbance Activity, the proper implementation of the DEC-approved Soil Plan contained in the SMP for the Disturbance Activity, and the restoration of the portion of the Isolation Cap affected by the Disturbance Activity.

17.4 For Disturbance Activities that entail the excavation of soil from beneath the Demarcation Warning Barrier, Con Edison will implement the DEC-approved Soil Plan contained in the SMP as follows:

(a) Con Edison and/or its contractors will provide the Disturbance Activity Entity with information pertaining to the size and configuration of the secure work area that the Disturbance Activity Entity must establish and set up, as provided above in Section 15.3 of this Agreement, to support the implementation of the DEC-approved Soil Plan contained in the SMP for the Disturbance Activity;

(b) Before commencing the implementation of the DEC-approved Soil Plan, Con Edison will give the Parks Department the advance written notice provided for above in Section 14.3 of this Agreement and confirm that the Parks Department: (i) has given the DEC the advance written notice required by the DEC-approved Soil Plan and Section 17.1 or Section 17.2 of this Agreement; (ii) has obtained the DEC's written approval and consent for any Disturbance activities that constitute a change in the use of the OU1 Area, as provided for above in Section 13.3 of this Agreement;

(c) Con Edison and/or its contractors will inspect the secure work area that has been established and set up by the Disturbance Activity Entity to ensure that the work area is appropriately sized and configured to support the implementation of the DEC-approved Soil Plan contained in the SMP for the Disturbance Activity, and after the Disturbance Activity Entity has made any modifications to the secure work area that are necessary to accommodate the proper implementation of the DEC-approved Soil Plan for the Disturbance Activity, Con Edison and/or its contractors will mobilize and stage within the secure work area the equipment and materials needed for the implementation of the DEC-approved Soil Plan for the Disturbance Activity;

(d) Con Edison and/or its contractors will conduct the pre-excavation soil characterization sampling specified in the DEC-approved Soil Plan and will promptly provide a copy of the sample results to the Disturbance Activity Entity and to the Parks Department;

(e) The Disturbance Activity Entity will excavate or remove and either dispose of or store in an area of the Park specified by the Parks Department any top soil, grass, plants, paving materials, or structures situated on top of the section of the Isolation Cap in which the Disturbance Activities will be performed by the Disturbance Activity Entity;

(f) Con Edison and/or its contractors will excavate through and beneath the section of the Isolation Cap in which the Disturbance Activities will be performed and will advance the excavation to the depth specified by the Disturbance Activity Entity;

(g) Con Edison and/or its contractors will promptly notify the Disturbance Activity Entity when the excavation has been advanced to the depth specified by the Disturbance Activity Entity, and the Disturbance Activity Entity will then proceed with the performance of the Disturbance Activities and carry them out in compliance with all applicable federal, state, and local laws, rules, and regulations, including without limitation, the OSHA HAZWOPER Standard set out in 29 CFR Sections 1910.120 and 1926.65;

(h) After the Disturbance Activity Entity has completed the Disturbance Activities within the excavation, Con Edison and/or its contractor will back fill the excavation beneath the level of the Demarcation Warning Barrier in the manner specified in the SMP and the DEC-approved Soil Plan contained in the SMP, repair and patch the section of the Demarcation Warning Barrier that was breached, and back fill, compact and restore the Clean Fill Cover of the disturbed section of the Isolation Cap in the manner specified in the SMP and DEC-approved Soil Plan contained in the SMP;

(i) Con Edison and/or its contractors will arrange for the proper disposal of any soil that was excavated by them from beneath the Demarcation Warning Barrier and that is not used or that cannot be used as back fill under the DEC-approved Soil Plan contained in the SMP;

(j) The Disturbance Activity Entity shall be responsible for: (i) the disposal and/or other required disposition of any top soil, grass, plants, paving materials, or structures that were excavated or removed by Disturbance Activity Entity; and (ii) the restoration of the work area, including the repair, replacement, or restoration of the top soil, grass, plants, paving materials, and/or structures that were excavated or removed by the Disturbance Activity Entity.

(k) Con Edison and/or its contractors will create a written record written record of the performance of the Disturbance Activity, the proper implementation of the DEC-approved Soil Plan contained in the SMP for the Disturbance Activity, and the restoration of the portion of the Isolation Cap affected by the Disturbance Activity.

18. **Repair/Restoration**

18.1 Except as otherwise provided above in Sections 17.3 and 17.4 of this Agreement, upon the completion of any Authorized Activity performed by the Con Edison Parties pursuant to this Agreement, Con Edison shall at its cost and expense: (i) promptly restore to their pre-existing condition all portions of the OU1 Area (and/or the Park) that were disturbed or adversely affected by the Con Edison Parties' performance of the Authorized Activity; (ii) promptly remove from the OU1 Area and the Park all equipment, materials, refuse and wastes that were used or generated by the Con Edison Parties during their performance of the Authorized Activity; (iii) promptly repair all sidewalks, pavement, and improvements that were damaged or impaired by the Con Edison Parties' performance of the Authorized Activity; and (iv) leave the section of the OU1 Area in which the Con Edison Parties performed the Authorized Activity in a safe condition. All such required repair and restoration activities shall be done to the reasonable satisfaction of the Parks Department.

18.2 Not later than sixty (60) days after its receipt of written authorization from the DEC to do so, Con Edison will close and decommission in accordance with DEC guidance and any applicable New York City ordinances and regulations the groundwater monitoring wells that were installed within the OU1 Area by Con Edison and its contractors.

19. **Reimbursement of Certain Parks Department Costs**

19.1 Con Edison shall reimburse the Parks Department for all necessary and reasonable costs incurred by the Parks Department in procuring, installing and maintaining the warning signs specified in Section 4 of this Agreement and in complying with: (i) the requirements of any additional Applicable Institutional Controls that the DEC may impose for the OU1 Area after the effective date of this Agreement for reasons other than those specified in Sections 7.7 and 8(i)-(iii) of this Agreement; and (ii) the requirements of any revisions that DEC may direct Con Edison to make to the SMP after the effective date of this Agreement for reasons other than those specified in Section 9.2 of this Agreement. Con Edison shall reimburse the Parks Department for any such costs as provided below in Section 19.3 of this Agreement.

19.2 Con Edison shall reimburse the Parks Department for all necessary and reasonable additional costs that the Parks Department incurs in complying with the requirements imposed on the Parks Department by this Agreement; provided however, that the Parks Department shall not be entitled to the reimbursement of its administrative costs for reviewing and issuing to the Con Edison Parties construction permits for which application and/or other permit fees have been charged by the Parks Department and paid by the Con Edison Parties. In calculating the amount of any necessary and reasonable reimbursable additional costs, the Parks Department shall deduct from the expenses incurred by it in connection with Disturbance Activities conducted pursuant to Section 17.3 or Section 17.4 of this Agreement: (i) the costs and expenses that the Parks Department would have incurred establishing an adequate and safe work location meeting the requirements of all applicable federal, New York State, and New York City laws and regulations for its excavation activity in the absence of the requirements imposed on the Parks Department by this Agreement or by the SMP or Soil Plan contained in the SMP; (ii) the costs and expenses that the Parks Department would have incurred designing and implementing the required sheeting/shoring system for its excavation activity, digging the excavation, managing and stockpiling the clean fill materials removed from the excavation, back filling the excavation, and compacting the back filled clean fill materials had those activities not been performed by Con Edison, provided that in either (i) or (ii) as described above, the Parks Department would have performed any of those activities regardless of the requirements of this Agreement or the SMP or the DEC-approved Soil Plan contained in the SMP. The estimated costs and expenses that Parks Department would have incurred for the foregoing activities conducted by Con Edison shall be determined using applicable unit cost data for construction work at uncontaminated soil sites presented in the most recent version of the ***Means Building Construction Cost Data Book*** published by the R.S. Means Company or such other methods as may be mutually acceptable to the Parks Department and Con Edison.

19.3 Con Edison shall reimburse the Parks Department for the costs and expenses specified above in Sections 19.1 and 19.2 within 45 days after its receipt of the Parks Department's written demand for reimbursement of those costs and expenses. Demands for reimbursement of any such costs and expenses shall be accompanied by: (i) an explanation of the nature of the costs being demanded; (ii) detailed invoices and accountings for the costs and expenses for which reimbursement is demanded, including the Parks Department's calculation of the amount subject to reimbursement by Con Edison for any costs being sought pursuant to Section 19.2; and (iii) vouchers or other documentation evidencing that the costs and expenses for which reimbursement is demanded have been paid by the Parks Department. In the event that Con Edison disputes any such costs and expenses, Con Edison shall: (i) pay the undisputed portion of such costs and expenses within 45 days of receiving the Parks Department's demand; (ii) send written notice of the dispute to the Parks Department's First Deputy Commissioner, with a copy to the Parks Department's General Counsel, within thirty (30) days after receiving the Parks Department's City's demand and thereafter negotiate in good faith with the Parks Department's First Deputy Commissioner, or his/her designee, for the purposes of resolving the dispute; and (iii) pay the disputed portion of such costs and expenses in accordance with and to the extent required under the resolution reached with the Parks Department's First Deputy Commissioner, or his/her designee.

20. <u>Releases of Hazardous Substances/Petroleum and Isolation Cap Damage</u>

20.1 In the event that the Con Edison Parties damage the Isolation Cap or cause a release of any hazardous substance or petroleum within the OU1 Area or the Park while performing the Authorized Activities or any other activity conducted by Con Edison pursuant to this Agreement or the SMP or DEC-approved Soil Plan contained in the SMP , Con Edison shall: (i) promptly notify the Parks Department and DEC; and (ii) implement such remedial response measures as the DEC determines are necessary to protect human health and the environment from the damage to the Isolation Cap or the contamination caused by the release. Con Edison shall repair the Isolation Cap in the manner specified in the SMP and Soil Plan contained therein and shall carry out the required remedial response measures for the contamination caused to the Isolation Cap pursuant to a DEC-approved work plan and shall commence and complete the required remedial response measures in accordance with an implementation schedule that is mutually acceptable to the Parties and to the DEC. Con Edison shall be also responsible for any other monetary costs, fines, damages, penalties or the like, which are imposed by DEC or any other governmental agency due to damage to the Isolation Cap or release of any hazardous substance or petroleum, which is caused by Con Edison.

20.2 Nothing in this Agreement is intended to impose any obligation whatsoever upon Con Edison to implement or to pay for the implementation of any remedial response measures that may be required by the DEC or any other governmental agency for any release of any hazardous substance or petroleum that is not caused by Con Edison's implementation of the remedial measures specified in the RAWP, the SMP, the DEC-approved Soil Plan contained in the SMP, or any other activity conducted by Con Edison pursuant to this Agreement within the OU1 Area or the Park, but that is instead caused by: (i) the City; (ii) the Parks Department; (iii) City or Parks Department personnel or contractors; (iv) any department or administrative agency of the City or any such department's or agency's personnel or contractors; (v) Parks Department Permit Holders or their personnel or contractors; or (vi) an individual or entity not a party to this Agreement, regardless of whether any such individual or entity was acting with authorization from the City or the Parks Department when the individual or entity caused the release. In the event that Con Edison discovers contamination from such a release, Con Edison will promptly notify the Parks Department and DEC. The City and/or the Parks Department shall ensure that the required remedial response measures for the contamination caused by the release (including any such measures required for any affected section of the Isolation Cap within the OU1 Area) are performed in accordance with a DEC-approved work plan by the individual or entity responsible for causing the release or the individual or entity deemed responsible under the New York Navigation Law and/or New York Environmental Conservation Law for performing the required remedial response measures for the contamination caused by the release. The Parties do not intend the provisions of this Section 20.2 to apply to (and under no circumstances are they to be construed as applying to) any past release(s) of hazardous substances or petroleum that were present in the OU1 Area on or before the effective date of this Agreement.

20.3 Nothing in this Agreement is intended to impose any obligation whatsoever upon Con Edison to implement or to pay for the implementation of any remedial response measures that may be required by the DEC or any other governmental agency to repair any damage to the Isolation Cap that is not caused by Con Edison or the Con Edison Parties or for any other monetary costs, fines, damages, penalties or the like, which are imposed by DEC or any other governmental agency due to damage to the Isolation Cap as provided above in Section 20.1 of this Agreement, but is instead caused by: (i) the City; (ii) the Parks Department; (iii) City or Parks Department personnel or contractors; (iv) any department or administrative agency of the City or any such department's or agency's personnel or contractors; (v) Parks Department Permit Holders or their personnel or contractors; or (vi) an individual or entity not a party to this Agreement, regardless of whether any such individual or entity was acting with authorization from the City or the Parks Department when the individual or entity damaged the Isolation Cap. In the event that Con Edison discovers any such damage to the Isolation Cap, Con Edison will promptly notify the Parks Department and DEC. The City and/or the Parks Department shall ensure that the required remedial response measures for the repair and restoration of the damaged section of the Isolation Cap are performed in accordance with a DEC-approved work plan by the individual or entity responsible for causing the damage. In the event that the damage is caused by an unknown individuals or entities not acting with authorization from the City or the Parks Department, the required remedial response measures for the repair and restoration of the Isolation Cap shall be performed by the City and/or the Parks Department, at its or their expense, unless the damage: (1) was caused during the period that Con Edison and its contractors occupied the OU1 Area pursuant to the Access Agreement annexed hereto as Exhibit "C"; or (2) the damage was caused within a Work Location during such time that the Con Edison Parties were responsible for the security of the Work Location under Section 13.4 of this Agreement and/or pursuant to a permit issued in accordance with this Agreement, in which cases Con Edison shall be responsible for performing such required remedial response measures for the repair and restoration of the Isolation Cap.

21. Indemnification

Con Edison agrees to and shall indemnify, to the fullest extent permitted by law, defend, and hold harmless the City, the Parks Department, and their respective officials, employees, agents, and representatives (collectively the "Indemnitees") from and against any and all causes of action, damages, claims, demands, judgments, liens, litigation, liability, penalties, orders, loss, cost, or expense which may at any time be asserted against or incurred by the Indemnitees or any one or more of them, due to (i) any acts or omissions of any Con Edison Parties in the performance of the Authorized Activities; (ii) any unauthorized interference by the Con Edison Parties with the use of the OU1 Area during the performance of the Authorized Activities; (iii) Con Edison's breach of any of its obligations under this Agreement; (iv) any damage to persons or property arising from acts or omissions of the Con Edison Parties in their performance of the Authorized Activities or in connection with the access granted to Con Edison under the License, including, but not limited to, the Con Edison Parties' storage of any equipment, materials, vehicles, or waste materials in the OU1 Area or the Park during their performance of the Authorized Activities; and (v) any liability, losses or damages that any Indemnitee directly or indirectly suffers, sustains or is subjected to on account of or arising out of the Con Edison Parties' offsite transportation and/or disposal of any soil, wastes, or materials generated by the Con Edison Parties' performance of the Authorized Activities. The Indemnitees agree to cooperate with Con Edison in connection with Con Edison's defense or settlement of any claim or litigation that is asserted against the Indemnitees (or any of one or more of them). Such cooperation includes, but is not limited to, making employees of the City or Parks Department available for interviews by the counsel retained by Con Edison to defend the Indemnitees and assisting such counsel in responding to discovery requests by producing relevant documents, providing information, and making employees of the City and/or Parks Department available for depositions. The Indemnitees agree to notify Con Edison promptly, in writing, of all claims and litigation asserted against them (or any one or more them) for which Con Edison is required to indemnify, defend, and hold harmless the Indemnitees under this Section 21 after the receipt of any such claim or the summons and complaint in any such litigation by any one or more of the Indemnitees. However, in the event that the Indemnitees fail to provide prompt notice to Con Edison, Con Edison shall not refuse to indemnify the Indemnitees unless it has been prejudiced by such failure to provide prompt notice. The Indemnitees shall not knowingly allow a default judgment to be taken or entered against any one or more of them prior their notification of Con Edison of the claim or litigation.

22. Insurance

22.1 Con Edison's self insured retentions shall cover all claims that arise from its operations under this Agreement as well as any litigation, claims, demands, damages, liability, losses, costs and expenses arising out of or from the Con Edison Parties' performance of the Authorized Activities up to $5 million. Treating Con Edison's self-insured retentions as if it were a policy of commercial liability insurance, the City and its officials and employees and the Parks Department shall be deemed to be an "Additional Insured" with coverage at least as broad as Insurance Services Office ("ISO") Form CG 20 10 11 85 with respect to claims that arise from Con Edison's operations under this Agreement as well as any litigation, claims, demands, damages, liability, losses, costs and expenses arising out of or from the Con Edison Parties' performance of the Authorized Activities.

22.2 During the term of this Agreement, Con Edison shall, at its expense, maintain an excess liability insurance policy(ies) (the "**Insurance Policy**") in excess of Con Edison's self insured retentions, in the amount specified in Section 22.3 below, covering Con Edison as the named insured and the City and the Parks Department as an Additional Insured, as specified below in section 22.3, with respect to Con Edison's operations under this Agreement as well as any litigation, claims, demands, damages, liability, losses, costs and expenses arising out of or from the performance of the Authorized Activities by the Con Edison Parties. Coverage for the City and the Parks Department as an Additional Insured for such operations, litigation, claims, demands, damages, liability, losses, costs, and expenses shall specifically include the City's officials and employees and shall be as broad as ISO Form CG 20 10 11 85.

22.3 Before commencing any Authorized Activities within the OU1 Area pursuant to this Agreement and the License granted hereunder, Con Edison shall provide the Parks Department with a copy of that portion of the Insurance Policy containing the definitions and conditions of excess liability coverage afforded under the Insurance Policy, and shall provide the Parks Department with a Certificate of Insurance evidencing that:

(a) Con Edison has secured the required Insurance Policy which provides excess liability insurance coverage with the following limits above Con Edison's self-insured retentions: (i) $10 million per occurrence and annual aggregate for commercial general liability, including sudden and accidental pollution liability; (ii) $10 million per accident for auto liability; (iii) $10 million per occurrence and annual aggregate for employer's liability coverage; and (iv) $10 million per occurrence and annual aggregate for excess workers' compensation; and

(b) The Insurance Policy includes the City of New York and its officials and employees and the Parks Department as an Additional Insured with respect to Con Edison's operations under this Agreement as well as any litigation, claims, demands, damages, liability, losses, costs and expenses arising out of or from the Con Edison Parties' performance of the Authorized Activities in each excess liability coverage specified above, except excess workers compensation coverage.

A copy of that portion of the Insurance Policy containing the definitions and conditions of excess liability coverage afforded under the Insurance Policy and the Certificate of Insurance shall be sent to the Parks Department and the Certificate of Insurance shall include the Parks Department as a Certificate Holder using the following address:

Adrian Benepe, Commissioner
The City of New York Department of Parks & Recreation
Attention: Rex Diamond, Director of Permits
Olmstead Center
Flushing Meadows-Corona Park
Flushing, NY 11368

22.4 Con Edison shall promptly notify the City and the Parks Department in the event that the Insurance Policy lapses or is terminated during the term of this Agreement. Before commencing any Authorized Activities within the OU1 Area after any such lapse or termination of the Insurance Policy, Con Edison shall provide the Parks Department with: (i) a Certificate of Insurance evidencing that Con Edison procured and has in effect an insurance policy or policies to replace the lapsed or terminated Insurance Policy, that the replacement insurance policy or policies provide coverage in the amounts specified above in Section 22.3 of this Agreement, and that the City and the Parks Department have been included as Additional Insureds in the replacement policy or policies as required under Section 22.2 of this Agreement; and (ii) a copy of that portion of the replacement insurance policy or polices containing the definitions and conditions of excess liability coverage afforded under the replacement insurance policy or policies.

23. Data Sharing/Split Samples

23.1 Con Edison shall promptly provide the Parks Department with a copy of all: (i) validated environmental sample data; (ii) final laboratory reports; and (iii) boring logs for the Authorized Activities conducted by the Con Edison Parties within the OU1 Area. Upon reasonable advance request, Con Edison shall promptly provide the Parks Department or its consultants with split samples of any soil and/or groundwater samples that are collected by the Con Edison Parties within the OU1 Area as part of the Authorized Activities.

23.2 The City and/or the Parks Department shall promptly provide Con Edison with a copy of all (i) validated environmental sample data; (ii) final laboratory reports; and (iii) boring logs for any environmental sampling work or geotechnical investigations that may be conducted within the OU1 Area by or for the City, the Parks Department, any agency or department of the City, or any Permit Holder. The City and/or the Parks Department shall provide Con Edison with reasonable advance notice of any and all such environmental sampling work and/or geotechnical investigations. Upon reasonable advance request, the City and/or the Parks Department shall: (i) provide Con Edison with split samples of any soil and/or groundwater samples that are collected as part of any such environmental sampling work or geotechnical investigations; or (ii) arrange to have the individuals or entities conducting the environmental sampling work and/or geotechnical investigations to provide Con Edison with split samples of the soil and/or groundwater samples collected as part of such work or investigations.

24. New York State and City Audits/Investigations

24.1. The Parties to this Agreement agree to cooperate fully and faithfully with any investigation, audit or inquiry conducted by a State of New York ("**State**") or New York City ("**City**") governmental agency or authority that is empowered directly or by designation to compel the attendance of witnesses and to examine witnesses under oath, or conducted by the Inspector General of a governmental agency that is a party in interest to the transaction, submitted bid, submitted proposal, contract, lease, or license that is the subject of the investigation, audit or inquiry.

24.2. (a) If any person who has been advised that his or her statement, and any information from such statement, will not be used against him or her in any subsequent criminal proceeding refuses to testify before a grand jury or other governmental agency or authority empowered directly or by designation to compel the attendance of witnesses and to examine witnesses under oath concerning the award of or performance under any transaction, agreement, lease, contract, or license entered into with the City, the State, or any political subdivision or public authority thereof, or the Port Authority of New York or New Jersey, or any local development corporation within the City, or any public benefit corporation organized under the laws of the State of New York; or

(b) If any person refuses to testify for a reason other than the assertion of his or her privilege against self-incrimination in an investigation, audit or inquiry conducted by a City or State governmental agency or authority empowered directly or by designation to compel the attendance of witnesses and to take testimony under oath, or by the Inspector General of the governmental agency that is a party in interest in, and is seeking testimony concerning the award of, or performance under, any transaction, agreement, lease, permit, contract, or license entered into with the City, the State, or any political subdivision thereof or any local development corporation within the City; then the Commissioner or agency head whose agency is a party in interest to the transaction, submitted bid, submitted proposal, contract, lease, permit, or license shall convene a hearing, upon not less than five days written notice to the parties involved to determine if any penalties should attach for the failure of a person to testify. If any non-governmental party to the hearing requests an adjournment, the Commissioner or agency head who convened the hearing may, upon granting the adjournment, suspend any contract, lease, permit, or license pending the final determination pursuant to Subsection 24.4 without the City incurring any penalty or damages for delay or otherwise.

24.3. The penalties which may attach after a final determination by the Commissioner or agency head pursuant to Section 24.4 below may include but shall not exceed:

(a) The disqualification for a period not to exceed five years from the date of an adverse determination for any person, or any entity of which such person was a member at the time the testimony was sought, from submitting bids for, or transacting business with, or entering into or obtaining any contract, lease, permit or license with or from the City; and/or

(b) The cancellation or termination of all such existing City contracts, leases, permits or licenses that the refusal to testify concerns and that have not been assigned as permitted under this Agreement, nor the proceeds of which pledged, to an unaffiliated and unrelated institutional lender for fair value prior to the issuance of the notice scheduling the hearing, with the City incurring any penalty or damages on account of such cancellation or termination; monies lawfully due for goods delivered, work done, rentals, or fees accrued prior to the cancellation or termination shall be paid by the City.

24.4. The Commissioner or agency head shall consider and address in reaching his or her determination and in assessing an appropriate penalty the factors in Paragraphs (a) and (b) below. He or she may also consider, if relevant and appropriate, the criteria established in

Paragraphs (c) and (d) below in addition to any other information, which may be relevant and appropriate:

(a) The party's good faith endeavors or lack thereof to cooperate fully and faithfully with any governmental investigation or audit, including but not limited to the discipline, discharge, or disassociation of any person failing to testify, the production of accurate and complete books and records, and the forthcoming testimony of all other members, agents, assignees or fiduciaries whose testimony is sought.

(b) The relationship of the person who refused to testify to any entity that is a party to the hearing, including, but not limited to, whether the person whose testimony is sought has an ownership interest in the entity and/or the degree of authority and responsibility the person has within the entity.

(c) The nexus of the testimony sought to the subject entity and its contracts, leases, permits, or licenses with the City.

(d) The effect a penalty may have on an unaffiliated and unrelated party or entity that has a significant interest in an entity subject to penalties under Subsection 24.3 above, provided that the party or entity has given actual notice to the Commissioner or agency head upon the acquisition of the interest, or at the hearing called for in Subsection 24.2 above gives notice and proves that such interest previously was acquired. Under either circumstance, the party or entity must present evidence at the hearing demonstrating the potential adverse impact a penalty will have on such person or entity.

24.5. Definition of Terms

(a) The term "license" or "permit" as used herein shall be defined as a license, permit, franchise or concession not granted as a matter of right.

(b) The term "person" as used herein shall be defined as any natural person doing business alone or associated with another person or entity as a partner, director, officer, principal or employee.

(c) The term "entity" as used herein shall be defined as any firm, partnership, corporation, association, or person that receives monies, benefits, licenses, leases, or permits from or through the City or otherwise transacts business with the City.

(d) The term "member" as used herein shall be defined as any person associated with another person or entity as a partner, director, officer, principal or employee.

24.6. In addition to and notwithstanding any other provisions of this Agreement, the Commissioner or agency head may in his or her sole discretion terminate this Agreement upon not less than three days written notice in the event Con Edison fails promptly to report in writing to the Commissioner of Investigation of the City of New York any solicitation of money, goods, requests for future employment or other benefit or thing of value, by or on behalf of any employee of the City or other person, firm, corporation or entity for any purpose which may be related to the procurement or obtaining of this Agreement by Con Edison, or affecting the performance of this Agreement.

25. **DEC Correspondence**

25.1 Con Edison shall promptly provide the City and the Parks Department with a copy of the following correspondence between Con Edison and the DEC: (i) annual certifications required under the SMP for the OU1 Area; (ii) requests by Con Edison for DEC approval of revisions to the SMP and the DEC's response to such requests; (iii) requests by Con Edison to the DEC for approval of revisions to the Applicable Institutional Controls and the DEC's response to such requests; (iv) communications between Con Edison and the DEC relating to any revisions that DEC requires Con Edison to make to the SMP; (v) communications by the DEC relating to any revisions that the DEC makes to the Applicable Institutional Controls; (vi) communications between Con Edison and the DEC relating to any soil and/or groundwater sampling that Con Edison conducts within the OU1 Area as part of the Authorized Activities; (vii) correspondence by DEC relating to any additional remedial measures that the DEC determines is required for the soil and groundwater within the OU1 Area; and (vii) all written records of the performance of Disturbance Activities that Con Edison completes pursuant to Sections 17.3 and 17.4 of this Agreement.

25.2 The City and the Parks Department shall promptly provide Con Edison with a copy of the following correspondence between the City and/or the Parks Department and the DEC:(i) requests by the City and/or the Parks Department for DEC approval of any revisions to the Applicable Institutional Controls; (ii) requests by the City and/or the Parks Department for approval of any revisions to the SMP; (iii) requests by the City and/or the Parks Department for DEC approval of any proposed change in use of the OU1 Area; (iv) requests by the City and/or the Parks Department for DEC approval of any additional remedial measures for the soils and/or groundwater within the OU1 Area; and (v) notifications given to the DEC by the City and/or Parks Department for any Disturbance Activities that require the excavation of soil from beneath the Isolation Cap.

26. **Operation of Vehicles**

26.1 All vehicles (including drills rigs and earth moving equipment) brought into the Park or OU1 Area by the Con Edison Parties in connection with their performance of Authorized Activities are required to comply with the Park Department's rules and regulations pertaining to the operation of motor vehicles within parklands, park paths, and park roads subject to the Parks Department's jurisdiction. No such vehicles may be brought into the Park or operated in the Park or OU1 Area without specific authorization from the Parks Department in the form of a permit issued by the Parks Department pursuant to Section 26.2 of this Agreement. Any such vehicles authorized by the Parks Department to operate in the Park and/or OU1 Area must be operated by the Con Edison Parties to ensure the safety of all park patrons and with the highest level of caution.

26.2 All vehicles that the Parks Department authorizes the Con Edison Parties to bring into the Park and operate in the OU1 Area must display an official Parks Department Permit noting the purpose, date(s), and time of authorized use. The Parks Department agrees that it will promptly issue such permits and that it will not include in them requirements inconsistent with the terms and conditions of this Agreement. To expedite the Parks Department's processing of requests for such permits, Con Edison shall provide the Parks Department with a list of the numbers, types, and owners of the vehicles that Con Edison expects will be involved in the performance of an Authorized Activity. Con Edison shall provide the Parks Department with such information as follows: (i) for Authorized Activities for which the Parks Department requires a Parks Department construction permit, Con Edison shall provide the information when it files its construction permit application or as soon thereafter as possible; (ii) for Authorized Activities involving the implementation of the DEC-approved Soil Plan pursuant to Sections 17.3 or 17.4 of this Agreement, Con Edison shall provide the information when it submits its proposed implementation schedule to the Parks Department or as soon thereafter as possible; and (iii) for all other Authorized Activities, Con Edison shall provide the information when it submits the advance written notice required under Section 14 of this Agreement to Parks Department or as soon thereafter as possible.

26.3 Unless essential to the performance of the Authorized Activities and approved by the Parks Department (which approval shall not be unreasonably withheld or delayed), the Con Edison Parties shall operate vehicles only on designated drives or roads within the OU1 Area after the OU1Area has been reconstructed and returned to use for public park purposes. The Con Edison Parties shall not operate vehicles on in park use areas, such as lawns or playgrounds, solely for convenience. When authorized by the Park Department to operate vehicles in park areas, the Con Edison Parties shall use a person outside the vehicle to guide the vehicle unless the Park is closed. The persons used as guiders must be dedicated and focused to that task when acting as guiders for vehicles. Guiders shall also be used whenever a vehicle is operating in a crowded or tight space within a park area.

26.4 The Con Edison Parties shall also comply with the following rules and regulations when operating vehicles within the Park and OU1 Area:

(a) Traffic lights and signs must be obeyed at all times, including on closed park roads.

(b) Vehicle flashers and hazard safety lights must be used whenever a vehicle is on a parks path or in a park area. When appropriate, horns may also be used to alert pedestrians.

(c) The Con Edison Parties must always yield to pedestrians, skaters, bikers, joggers, and park users within the Park. They always have the right of way. The Con Edison Parties must also always obey a 5 mph speed limit on pedestrian paths and a 15 mph speed limit on park drives.

(d) The Con Edison Parties must use caution and be aware of the height, width and line of sight of the vehicles that they operate within the Park and OU1 Area. Vehicles such as dump trucks may have high lines of sight that can impede the view of ground objects.

(e) The Con Edison Parties must plan the safest route possible through the Park to work locations within the OU1 Area. They shall use the park entrances closest to the work locations and always follow the safety plan for the implementation of the Authorized Activity be performed.

(f) Except as otherwise provided in Section 15 of this Agreement, the Con Edison Parties may store vehicles in the Park or the OU1 Area only with the Parks Department's approval (which approval will not be unreasonably withheld or delayed).

27. Communications

27.1 Except as provided below in Section 27.2 of this Agreement, all notices and correspondence required or contemplated under this Agreement shall be delivered by United States Postal Service, by Airborne Express or other private courier service, or hand delivered to the Parties as follows:

If to the Parks Department:

Hector Aponte
Bronx Borough Commissioner
New York City Department of Parks and Recreation
Ranaqua, Bronx Park
Bronx, NY 10462

If to Con Edison:

Randolph S. Price
Vice President, Environment, Health & Safety
Con Edison
4 Irving Place
New York, NY 10003

24.2 Any notices required under Section 14.1, Section 14.2, Section 14.3, Section 17.1, or Section 17.2 of this Agreement shall be delivered either by facsimile or by United States Postal Service, by Airborne Express or other private courier service, or hand delivered to the Parties as follows:

If to the Parks Department:

John Bachman, Chief of Bronx Operations
New York City Department of Parks and Recreation
Ranaqua, Bronx Park
Bronx, NY 10462
Fax # (718) 430-1818

If to Con Edison:

Eddy Louie
Section Manger, MGP Remediation
Con Edison
31-01 20th Avenue, Bldg. 136
Astoria, NY 11101
Fax # (718) 932-2687

27.3 The Parties reserve the right to designate addition or different addressees for the receipt of notices or correspondence required or contemplated under this Agreement. If any party hereto elects to change its designated addressees for the receipt of such notices or correspondence, that party shall notify the other party hereto in writing not less than five (5) business days before changing its designated addressees.

28. Termination of VCA

Con Edison acknowledges and agrees that its obligations under this Agreement are separate and distinct from its obligations under the VCA. If the VCA is terminated by Con Edison or the DEC, Con Edison shall promptly notify the City and the Parks Department and, unless otherwise provided herein, Con Edison's obligations under this Agreement shall not be excused, impaired or diminished.

29. Survival of Obligations

Con Edison agrees and acknowledges that its obligations under Section 21 of this Agreement survive the termination of this Agreement with respect to claims, causes of action, damages, liability, losses, and judgments arising out of: (i) any acts or omissions of Con Edison Parties in connection with any and all Authorized Activities that were performed by them prior to the termination of this Agreement; (ii) the Con Edison Parties unauthorized interference with the use of the OU1 Area and/or the Park during the Con Edison Parties' performance of any and all such Authorized Activities; (iii) any breach by Con Edison of its obligations under this Agreement prior to the termination of this Agreement; (iv) any damage to persons or property arising from acts or omissions of the Con Edison Parties in their performance of the Authorized Activities or in connection with the access granted to Con Edison under this Agreement, including, but not limited to, the Con Edison Parties' storage of any equipment, materials, vehicles, or waste materials in the OU1 Area or the Park during their performance of the Authorized Activities; and (v) the Con Edison Parties' off-site transportation and/or disposal of the waste materials generated by their performance of any and all such Authorized Activities.

30. Exhibits

The exhibits to this Agreement are incorporated by reference and made a part hereof.

31. Merger, Integration and Modification

This is an integrated Agreement that reflects the Parties' full and final understanding of their respective obligations, rights, and duties with respect to each matter addressed herein. Any and all prior agreements and understandings, written or oral, formal or informal, relating to such matters are void and ineffective. No changes, waivers, modifications, or amendments to or of this Agreement, of any kind whatsoever, shall have any force or effect unless the same is contained in a writing and is fully executed all Parties hereto.

32. Venue and Choice of Law

This Agreement shall be governed and interpreted in accordance with the laws of the State of New York, and all actions for its enforcement or interpretation shall be brought in a court of competent jurisdiction in the City and State of New York.

33. Severability

Notwithstanding anything to the contrary in this Agreement, if any provision of this Agreement or the application thereof to any person or circumstances is invalid or unenforceable to any extent, such provision shall be deemed modified so that intent thereof shall be effected to the greatest extent permitted by law and the remainder of this Agreement and the application of such provisions to other persons or circumstances shall not be affected thereby and shall be enforced to the greatest extent permitted by law.

34. Termination

Notwithstanding anything to the contrary in this Agreement, any party hereto may terminate this Agreement upon written notice to the other parties in the event that: (i) the DEC determines that compliance with the Applicable Institutional Controls and the SMP (including the DEC-approved Soil Plan) is no longer necessary to protect human health or the environment; or (ii) the DEC approves and consents to the use of the OU1 Area for purposes other than as a public park.

35. Successors and Assigns

This Agreement is binding upon and shall inure to the benefit of the Parties and their respective heirs, successors, legal representatives and assigns.

36. Authority

Each party hereto warrants and represents that it has full power and authority to enter into this Agreement and to perform its obligations under this Agreement, and that the person executing this Agreement on its behalf has been duly authorized and is empowered to bind it to this Agreement.

37. Counterparts

For the convenience of the Parties, this Agreement may be executed individually or in combination in one or more counterparts, each of which shall be deemed to have the status of an executed original and all of which shall together constitute one and the same instrument.

38. **Effective Date**

The effective date of this Agreement shall be the date on which it has been duly executed by all Parties hereto.

IN WITNESS WHEREOF, the Parties hereto, intending to be legally bound hereby, execute this Agreement by their duly authorized representatives.

THE CITY OF NEW YORK ACTING BY AND THROUGH THE NEW YORK CITY DEPARTMENT OF PARKS AND RECREATION

Dated: 11/9, 2006 By: ______________________

First Deputy Commissioner
[Title]

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

Dated: 10-27, 2006 By: Randolph Price

VP- EH&S
[Title]

APPROVED AS TO FORM

Steve Stein Cashin CS
ACTING CORPORATION COUNSEL

OCT 24 2006