SITE MANAGEMENT PLAN

FORMER DOVER ELECTRONICS SITE
29 INDUSTRIAL PARK DRIVE
BROOME COUNTY
KIRKWOOD, NEW YORK

NYSDEC Site Number: 7-04-026

Prepared for:

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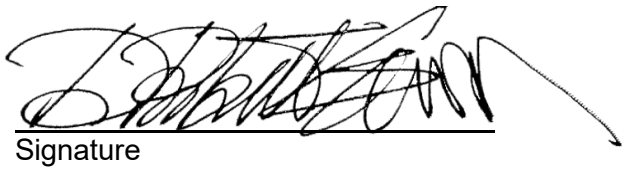
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Revisions to Final Approved Site Management Plan:

Revision No.	Date Submitted	Summary of Revision	NYSDEC Approval Date
0	09/19/2019	Draft SMP for NYSDEC review and approval	
1	12/02/2019	Responding to NYSDEC 10/29/19 Comments	
2	12/27/2019	Responding to NYSDEC 12/24/19 Comments	
3	07/17/2020	Responding to NYSDEC 7/15/20 Comments	

CERTIFICATION STATEMENT

I, D. Robert Gan, Ph.D., P.E. , certify that I am currently a NYS registered professional engineer and that this Site Management Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).



Signature

July 17, 2020
Date

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EXECUTIVE SUMMARY

This Site Management Plan (SMP) has been prepared for the former Dover Electronics site located at 29 Industrial Park Drive, Kirkwood, Broome County, New York (the Site). The SMP provides a summary of the controls implemented for the Site, as well as the inspections, monitoring, maintenance and reporting activities as follows:

Site Identification:	NYSDEC Site No. 7-04-026 Former Dover Electronics Site 29 Industrial Park Drive Block 1, Lot 8 Kirkwood, Broome County, New York 13903
Institutional Controls:	A Deed Restriction for the Site property has been recorded with Broome County in August 2005.
Engineering Controls:	1. Active Sub-slab Depressurization (ASD) System 2. Surface Cap System at Deed Notice Areas 3. In-Situ Chemical Oxidation (ISCO) Remediation Using Manual Injection Network
Inspections:	1. ASD System - Monthly 2. Surface Cap System – Monthly 3. ISCO Remediation - Monthly
Groundwater Monitoring:	Annual site-wide groundwater sampling at targeted monitoring wells.
Indoor Air Monitoring:	Annual indoor air sampling at on-site building
Maintenance:	1. ASD System – as needed basis 2. Surface Cap System – as needed 3. Monitoring and Injection wells - as needed 4. ISCO Solution Storage Tank – as needed
Reporting:	Annual Remedial Action Progress Report

Further descriptions of the above requirements are provided in detail in the sections of this SMP.

1.0 INTRODUCTION

1.1 General

This Site Management Plan (SMP) was prepared by Verina Engineering, P.C (VERINA) on behalf of Dover Corporation (Dover) for the former Dover Electronics Site at 29 Industrial Park Drive, Broome County, Kirkwood, New York (the Site). The SMP was prepared in accordance with the requirements of the NYSDEC's DER-10 "Technical Guidance for Site Investigation and Remediation", issued May 2010 and the guidelines provided by the NYSDEC. This SMP addresses the means for implementing the Institutional Controls (ICs) and Engineering Controls (ECs) that are required to manage remaining contamination at the site until the Deed Restriction is extinguished in accordance with ECL Article 71, Title 36. This plan has been approved by the NYSDEC, and compliance with this plan is required by the grantor of the Deed Restriction and the grantor's successors and assigns. This SMP may only be revised with the approval of the NYSDEC.

The Site is currently in the New York State (NYS) Inactive Hazardous Waste Disposal Site Remedial Program, Site No. 7-04-026, administered by New York State Department of Environmental Conservation (NYSDEC). Figure 1 is the site location map and Figure 2 shows the current site features.

On March 30, 2000, NYSDEC signed a Record of Decision (ROD) for the Site to address the volatile organic compounds (VOCs) in site soil and groundwater. Specifically, the March 2000 ROD selected: installation of a soil vapor extraction (SVE) system to treat inaccessible soils, excavation and off-site disposal of accessible soil, installation of a groundwater extraction and treatment system, property restrictions, and an evaluation of an in-situ groundwater treatment technology to shorten duration of the groundwater extraction and treatment. The Site was entered into an Order on Consent, Index No. B7-0515-97-05, with the NYSDEC on January 19, 2001 for remediation at the Site. It is important to note that: Failure to comply with this SMP is also a violation of Environmental Conservation Law, 6NYCRR Part 375, and thereby subject to applicable penalties.

On July 25, 2003, the Department approved a remedy modification under an Explanation of Significant Differences (ESD). The significant difference to the remedy approved at that time, compared to the remedy selected in the March 2000 ROD, was to install an active sub-slab depressurization system to address indoor air contamination in lieu of the SVE system to treat soil contamination, and to place a Deed Restriction on the property to address inaccessible soils. The change was in response to information from an SVE pilot test indicating lower than expected soil vapor permeability. As a result, soil vapor could not be effectively drawn out of the subsurface preventing the successful application of the SVE technology.

Prior to issuance of the ROD, two interim remedial measures (IRMs) were attempted to address contamination at the Site. In August 1994, recovery wells (RW-1 and RW-2) were installed near former tetrachloroethene (PCE) tanks as an interim groundwater extraction and the treatment system operated until 1996. Another recovery well (RW-3) was installed in 1997 and operated until December 1998. The groundwater remediation-by-extraction attempts were of limited success due to the tight nature of the glacial till, and the corresponding very low transmissivity across the Site, limiting groundwater recovery.

As a result, two field pilot tests were conducted as part of an alternative groundwater remediation field study. The field tests consisted of an enhanced bioremediation field study and an in-situ

chemical oxidation (ISCO) field pilot test. Enhancing biodegradation of PCE in the source area was found to have limited overall effectiveness, while ISCO was shown to be much more effective in remediating the constituents of concern (COCs) in groundwater. To further evaluate the ISCO in-situ alternative, three phases of ISCO field tests were conducted between 2005 and 2008 using sodium permanganate as a full-scale groundwater remedy. The results of the ISCO field tests indicated that the permanganate would be effective at reducing the concentration of COCs in groundwater. A full-scale ISCO groundwater remedy using sodium permanganate was initiated in November 2011 and is currently being implemented. NYSDEC issued a ROD Amendment, in addition to the previous ESD, on March 18, 2014.

In addition to the groundwater remediation efforts, an active sub-slab depressurization (ASD) system was installed and operated to mitigate the potential intrusion of vapors into the building from the remaining soil and groundwater contamination. A Deed Notice was filed with Broome County in August 2005 stating that there shall be no construction, use or occupancy property that results in the disturbance of the seven soil cover systems or which will result in human exposure to the contaminated soils.

All reports associated with the Site can be reviewed by contacting the NYSDEC or its successor agency managing environmental issues in the State of New York.

1.2 Revisions

Revisions to this SMP will be proposed in writing to the NYSDEC's Project Manager. Revisions will be necessary upon, but not limited to, the following occurring:

- A change in media monitoring requirements;
- Upgrades to or shut-down of the remedial systems; and
- Post-remedial removal of contaminated soils, or other significant change to the site conditions.

In accordance with the Deed Notice for the Site, the NYSDEC will provide a notice of any approved changes to the SMP and append these notices to the SMP that is retained in its files.

1.3 Notifications

Notifications will be submitted by the Responsible Party Dover Corporation or its representative to the NYSDEC in accordance with NYSDEC's DER–10 for the following reasons:

- 60-day advance notice of any proposed changes in site use that are required under the terms of the Order on Consent, 6NYCRR Part 375 and/or Environmental Conservation Law (ECL).
- 7-day advance notice of any field activity associated with the remedial program.
- 15-day advance notice of any proposed ground-intrusive activity.

- Notice within 48-hours of any damage or defect to the foundation, structures or EC that reduces or has the potential to reduce the effectiveness of an EC, and likewise, any action to be taken to mitigate the damage or defect.

- Verbal notice by noon of the following day of any emergency, such as a fire; flood; or earthquake that reduces or has the potential to reduce the effectiveness of ECs in place at the Site, with written confirmation within 7 days that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.

- Follow-up status reports on actions taken to respond to any emergency event requiring ongoing responsive action submitted to the NYSDEC within 45 days describing and documenting actions taken to restore the effectiveness of the ECs.

Any change in the ownership of the Site or the responsibility for implementing this SMP will include the following notifications:

- At least 60 days prior to the change, the NYSDEC will be notified in writing of the proposed change. This will include a certification that the prospective purchaser/Remedial Party has been provided with a copy of the Order on Consent, and all approved work plans and reports, including this SMP.

- Within 15 days after the transfer of all or part of the Site, the new owner's name, contact representative, and contact information will be confirmed in writing to the NYSDEC.

The contact information at NYSDEC for the above notification is summarized below. The contact information will be updated as necessary. A full listing of site-related contact information is provided in Appendix A, including a listing of responsibilities of the property owner(s) and responsible party.

Name	Contact Information
Jenelle Gaylord NYSDEC Project Manager	(518) 402-9791 Jenelle.gaylord@dec.ny.gov
Harry Warner NYSDEC Regional HW Engineer	(518) 426-7524 Harry.warner@dec.ny.gov
Kelly Lewandowski NYSDEC Site Control	(518) 402 -9553 Kelly.lewandowski@dec.ny.gov

2.0 SUMMARY OF PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIONS

2.1 Site Location and Description

The Site is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York and is identified as Section 162.01, Block 1, and Lot 8 on the Town of Kirkwood, Broome County, New York Assessor's Tax Map (see Figure 3).

The Site is an approximately 9.58 acres in size and is occupied by a one-story building along with associated asphalt parking areas and vegetated areas. The Site is bound to the northeast, southeast and southwest by Industrial Park Drive, and to the northwest by Colesville Road. The properties in the vicinity of the Site are primarily industrial and commercial properties and a major highway. The properties immediately south of the Site include truck stops and auto/truck services; immediately north of the Site a commercial property and a major highway; and, immediately to the east and to the west of the Site include industrial and commercial properties.

2.2 Physical Setting

2.2.1 Land Use

The Site consists of a one-story industrial building with associated parking, landscaping, and storage areas. The Site is zoned industrial and is currently utilized for manufacturing and office space uses. The Site is presently occupied by Modern Marketing Concepts, Inc (MMC) which handles outsourced service and product ordering for other companies.

2.2.2 Geology

The Site is immediately underlain by surficial soils that consist of various types of silty and gravelly loams that were reworked by cut and fill activities when the Site was developed. These surficial soils are derived from the underlying till deposits, a dense soil/sediment type of glacial depositional environment origin.

Below the surficial soils, weathered till is encountered. The weathered till consists of light brown to brown, poorly sorted silts and fine sands that contain varying, small amounts of clay and fine gravel. Cobbles are rarely present. The weathered till is dense and appears to be unstratified. The weathered till unit has a thickness that ranges from 10 to 25 feet. As with the surficial soils above, the weathered till appears to be restricted as a geologic unit to the area of the Universal Instruments property. The weathered till does not extend onto the former Pilot Truck Stop property (now, the Love's Truck Stop property), which occurs at an elevation lower than the Universal Instruments property.

The unweathered till is the next geologic unit encountered beneath the Site. The unweathered till consists primarily of brown to olive-gray, poorly sorted silts and fine sands. The unweathered till contains lenses of clay-rich sediment and sand and fine gravel rich lenses. The unweathered till is very dense and has less fracturing. Its thickness ranges from less than 20 feet at the southern part of the Site to greater than 80 feet at the northern part of the Site. The contact with the overlying weathered till appears to be a gradational boundary rather than a sharp one.
The deepest layer encountered is a well-sorted, medium to coarse-grained sand unit that contains some fine gravel that was found at a depth of 50 feet below ground surface (bgs) at the MW-34 location on the Love's Truck Stop property. This layer extended to the approximate termination of the boring at a depth of 56 feet.

Bedrock has not been encountered during previous drilling operations at the Site or at the Love's Truck Stop properties. Bedrock is believed to start at a depth around 115 feet bgs below the site building or approximately 80 feet bgs below the Love's Truck Stop.

2.2.3 Hydrogeology

Two distinct water-bearing zones exist with the first (uppermost) zone having shallow and intermediate parts and the lowermost deep zone constituting the second zone. Head differences within the first water-bearing zone vary, both spatially and temporally, with some well-pair locations having upward gradients and others downward gradients. There appears to be hydraulic communication between the two halves of the first water-bearing zone, but no hydraulic communication with the deeper water-bearing zone.

The groundwater within the upper shallow zone flows toward the southwest with a hydraulic gradient that ranges from 0.046 to 0.196 ft/ft. This gradient range is illustrative of the permeability change in the shallow zone as groundwater moves from the dense, silty and clayey till beneath the Site property into the more sandy area found beneath the Love's Travel Stop. Groundwater within the intermediate zone flows toward the southwest as well, with a hydraulic gradient ranging from 0.019 to 0.063 ft/ft. The direction of groundwater within the lowermost deep zone is unknown due to the lack of groundwater data from the deep zone.

The most recent groundwater contour maps for the uppermost zone's shallow and intermediate parts are shown on Figures 4 and 5, respectfully.

2.3 Investigation and Remedial History

The facility was first constructed in 1973, with subsequent additions built in 1978, 1982, and 1984. It has been historically occupied by Universal Instruments and Dover Electronics. In 1993, Dover Electronics was renamed Dovatron, Inc. (Dovatron). In 1995, Dovatron transferred its title to the facility to Universal Instruments. In 1996, Dovatron changed its name to the DII Group. Later, the DII Group sold to Flextronics International, Inc. and Universal Instruments became a wholly-owned subsidiary to the Dover Corporation. In 2007, Dover Technologies, Inc. (the parent company of Universal Instruments) sold the facility to MMC, who now occupies the property. Throughout the property transfers, Universal Instruments, a former subsidiary of Dover, retained responsibility from remediating the pre-existing environmental conditions.

Several remedial investigations (RIs) at the Site have been conducted since 1990s. The RIs indicated that soil, groundwater, surface (storm) water and indoor air have been impacted by volatile organic compounds (VOCs).

Historically, circuit board manufacturing processes used tetrachloroethene (PCE) as a cleaning solvent. Originally, the virgin PCE was stored in 55-gallon drums at an outside drum storage area (Figure 2). During the initial facility expansion, a ramp to the east-side overhead door served as the entry point for PCE drums. As production increased and the facility was again expanded, virgin PCE was stored in a 3,000-gallon aboveground storage tank that has since been removed. An aboveground 5,000-gallon waste PCE flux storage tank was also located on the Site (Figure 2). In March 1993, the aboveground PCE system was dismantled. Two 480-gallon PCE tanks were reportedly dismantled and removed from the building interior at that time.

After a former aboveground tank that contained PCE was dismantled, a groundwater extraction program was implemented as an Interim Remedial Measure (IRM). Recovery wells (RW-1 and

RW-2) were installed near the former PCE tanks located at the rear of the facility building and an interim groundwater treatment system became operational in August 1994. The system operated on a limited schedule and it was shut down and abandoned in 1996. This IRM removed an estimated 12,000 gallons of groundwater. Another recovery well, RW-3, was installed in 1997 adjacent to monitoring well MW-7A as part of a second IRM groundwater extraction and treatment using granulated activated carbon (GAC). This groundwater extraction and treatment system was in operation from April 1998 through December 1998 and was intended to help control the migration of the dissolved-phase PCE plume. During this time, approximately 41,000 gallons of water were extracted from well RW-3.

The groundwater remediation-by-extraction attempts were unsuccessful because of the tight nature of the subsurface glacial till and the corresponding very low transmissivity across the Site. For this reason two field pilot tests consisted of an enhanced bioremediation field study and an ISCO field pilot testing were conducted as part of an alternative groundwater remediation field study. Enhanced biodegradation of PCE in the source area was found to have limited overall effectiveness while ISCO found to be more effective in remediating the constituents of concern (COCs) in groundwater.

ISCO field testing using sodium permanganate was proposed in the September 2004 Groundwater Bioremediation Progress Report (GBRPR) by Blasland, Bouck and Lee, Inc. (BBL) for the remaining residual COCs within the central part of the groundwater plume. The field test objective was to reduce the PCE concentration within the area defined by the 1,000 micrograms per liter (µg/L) isoconcentration contour line as presented in the September 2004 report.

Three phases of ISCO field tests were conducted between 2005 and 2008 at the Site to evaluate the effectiveness of ISCO using sodium permanganate as a full-scale groundwater remedy. The results of ISCO field tests indicated that the permanganate is effective at reducing the concentration of COCs in groundwater. A full-scale ISCO groundwater remedy using sodium permanganate was implemented in November 2011 and is currently in use.

In June and July 2003, remedial action was performed at the Site towards the removal of accessible PCE affected soils. A total of 7 areas of the facility were excavated and backfilled after post excavation sampling. Post-excavation samples were collected using the frequency and location guidance found in the NYSDEC's *Draft DER-10, Technical Guidance for Site Investigation and Remediation* (Section 5.4 Remedial Action Performance Compliance, (a)2, dated December 2002). Because some of the analytical results from the first set of post-excavation samples exceeded the NYSDEC criterion for PCE, additional excavation work was performed and a second round of samples were collected. To address the remaining PCE soil exceedances, clean soil, concrete slab or asphalt cap areas overlying the contaminated soil were added to the deed notice, which was recorded with Broome County in 2005.

In June 2003, a field test was conducted in the presence of NYSDEC representatives to see if it could be helpful in reducing indoor air concentrations of PCE within the building. Based on test results, an ASD system was installed in the MMC building in June 2003 to mitigate the adverse effects on indoor air quality caused by vapor intrusion. The relocation of two sub-slab depressurization points (ASD-2 and ASD-3) occurred in December 2014 due to building renovations. Additionally, during the ASD inspection of May 2015, it was discovered that three depressurization points, ASD-3 through 5, had no observed vacuum and that the fan which was connected to these points was not operating. In response, VERINA replaced the ASD fan and the ASD system was restarted on June 9, 2015. The ASD system is checked once per month to verify that the system is running properly.

2.4 Remedial Action Objectives

The Remedial Action Objectives (RAOs) for the Site as listed in the March 2000 ROD and March 2014 ROD Amendment include:

Groundwater:

RAOs for Public Health Protection:

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles from contaminated groundwater.

RAOs for Environmental Protection:

- Restore groundwater aquifer to pre-disposal/pre-release conditions, to the extent practicable.
- Prevent the discharge of contaminants to surface water.
- Remove the source of groundwater or surface water contamination.

Soil:

RAOs for Public Health Protection:

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatizing from contaminants in soil.

RAOs for Environmental Protection:

- Prevent migration of contaminants that would result in groundwater or surface water contamination.
- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.

Soil Vapor:

RAOs for Public Health Protection:

- Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at a site.

2.5 Remaining Contamination

2.5.1 Soil

The Site soil was remediated in accordance with the NYSDEC-approved Remedial Design (RD) Package prepared by BBL in June 2003. Based on data from a soil remedial action report

prepared by BBL (Remedial Action Report, July 2004), the constituents of concern in soil at the Site are the volatile organic compounds PCE and its breakdown products – cis-1,2-dichloroethene and vinyl chloride. Several remedial actions have been performed at the Site to address the impacted soil. During June and July 2003, contaminated soil was excavated and removed from the Site. Post excavation sampling showed that some PCE- affected soils remained above standards, including the compounds PCE (maximum concentration of 120 mg/kg) and 1,1-dichloroethene (maximum concentration of 1.4 mg/kg). Table 1 provides the results of all post excavation soil samples collected that exceed the Unrestricted Use SCOs and the Industrial Use SCOs at the Site after completion of the soil remedial action, and Figure 6 shows the locations of these soil samples.

A deed notice with environmental restrictions was filed to provide an institutional control (IC) for contaminated inaccessible soils that remain below facility floor slabs, and for the areas where complete removal of soil to below the NYSDEC criterion for PCE was not achieved, soil cap areas were established to prevent contact with the underlying contaminated soils. Inspections of the building slab and soil cap areas are conducted on a monthly basis.

2.5.2 Groundwater

Groundwater contamination has been identified within the shallow perched groundwater unit and consists of chlorinated VOCs. Compounds which have historically been shown to exceed the NYSDEC's Groundwater Quality Standards (GWQS) include: PCE, trichloroethene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), cis-1,2-Dichloroethene (c-1,2-DCE); trans-1,2-Dichloroethene (trans-1,2-DCE), 1,1-Dichloroethane (1,1-DCE) and Vinyl Chloride (VC).

As of September 2019, the extent of the groundwater impact is presented on Figure 7. Those compounds which still exceed the NYSDEC's GWQS include:

Compound	GWQS	Well ID and Concentration (µg/L)
PCE	5	MP-4 (2400), MP-6S (430), MP-8S (24), MP-14 (9.0), MW-3 (38), MW-5(44), MW-13(6.3), MW-16 (80), MW-19 (11), MW-25R (150), MW-26 (15), MW-28 (9.7) MW-38 (65)
TCE	5	MP-8S (30), MW-28 (7.0)
c-1,2-DCE	5	MP-8S (74), MW-19 (6.0), MW-27 (20)

2.5.3 Soil Vapor

Pilot studies have shown that a soil vapor extraction system will not be effective when removing VOC contamination from very tight soils beneath a building. As a result, an ASD system was installed at the Site building in 1978 to mitigate indoor air concentrations of PCE, and additions to the system were installed in 1984. After conducting a field test to assess the materials underneath the flow slab and assess the potential for vacuum propagation and airflow beneath the slab, NYSDEC agreed to modifications to the system. Construction to the ASD system was performed in June 2003. Since installation and start-up, the ASD system has been operated continuously, and again expanded in December 2006. As part of the remedial action, operation of the ASD system will continue along with periodic indoor air sampling events. Indoor air quality samples have been collected in the building since November 1998. No site specific COC concentrations in the indoor air samples have exceeded the NYSDOH's Indoor Air Guidance Values since 2003.

Additionally, no modifications have been or will be done to the ASD system without the approval of NYSDEC.

3.0 INSTITUTIONAL AND ENGINEERING CONTROL PLAN

3.1 General

Since remaining contamination exists at the Site, ICs and ECs are required to protect human health and the environment. This IC/EC Plan describes the procedures for the implementation and management of all IC/ECs at the Site. The IC/EC Plan is one component of the SMP and is subject to revision by the NYSDEC.

This plan provides:

- A description of all IC/ECs on the Site;
- The basic implementation and intended role of each IC/EC;
- A description of the key components of the ICs set forth in the Deed restriction;
- A description of the controls to be evaluated during each required inspection and periodic review;
- A description of plans and procedures to be followed for implementation of IC/ECs, such as the implementation of the Excavation Work Plan (EWP) (as provided in Appendix B) for the proper handling of remaining contamination that may be disturbed during maintenance or redevelopment work on the Site; and,
- Any other provisions necessary to identify or establish methods for implementing the IC/ECs required by the site remedy, as determined by the NYSDEC.

3.2 Institutional Controls

The ICs required by the ROD and its amendments include:

- To implement, maintain and monitor IC system;
- To prevent future exposure of remaining contamination; and
- To limit the use and development of the Site to industrial uses only.
- The property may be used for industrial use;
- All ECs must be operated and maintained as specified in this SMP;
- All ECs must be inspected at a frequency and in a manner defined in the SMP;
- The use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the NYSDOH or the Broome County Department of Health to render it safe for use as drinking water or for industrial purposes, and the user must first notify and obtain written approval to do so from the Department. Groundwater and other environmental or public health monitoring must be performed as defined in this SMP;

- Data and information pertinent to site management must be reported at the frequency and in a manner as defined in this SMP; All future activities that will disturb remaining contaminated material must be conducted in accordance with this SMP;

- Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in this SMP;

- Operation, maintenance, monitoring, inspection, and reporting of any mechanical or physical component of the remedy shall be performed as defined in this SMP;

- Access to the Site must be provided to agents, employees, or other representatives of the State of New York with reasonable prior notice to the property owner to assure compliance with the restrictions identified by the Deed Restriction;

- The potential for vapor intrusion must be evaluated for any buildings developed in the area within the IC boundaries noted on Figure 8, and any potential impacts that are identified must be monitored or mitigated and

- Vegetable gardens and farming on site are prohibited.

NYSDEC approved the Deed Notice and the Deed Notice was recorded with Broome County, State of New York in October 2005.

Adherence to these ICs on the Site is required by the Deed Restriction and will be implemented under this SMP. ICs identified in the Deed Restriction may not be discontinued without an amendment to or extinguishment of the Deed Restriction. The IC boundaries are shown on Figure 8.

Additionally, if the on-site building undergoes renovations or demolishment, for either a portion of or the entirety of the building, where the soils underlying the building become accessible, those soils underneath the building shall be investigated and, if necessary, remediated, in accordance with NYSDEC regulations and this SMP.

3.2 Engineering Controls

3.2.1 ASD System

An ASD system was installed in the MMC building in July 2003. In December 2014, MMC initiated building renovations which required the relocation of two sub-slab depressurization points (ASD-2 and ASD-3). The ASD modification work was summarized in VERINA's 2014 Annual Remedial Action Progress Report, submitted to the NYSDEC in January 2015. Additionally, during the ASD inspection of May 2015, it was discovered that three depressurization points, ASD-3 through 5, had no observed vacuum and that the fan which was connected to these points was not operating. In response, VERINA replaced the ASD fan and the ASD system was restarted on June 9, 2015. The location and layout of the ASD system is presented on Figure 9.

The ASD system is comprised of eight (8) PVC extraction points equipped with U-tube vacuum gauges connected to a blower along the exterior portion of the building along with a power switch. ASD Construction details can be found within the Remedial Action Report prepared and submitted to the NYSDEC by BBL in March 2004.

3.2.2 Soil Cap System

The purpose of the soil cap system is to eliminate the potential for human contact with the remaining contaminated soil, and eliminate the potential for soil erosion and contaminated soil and storm water runoff from the Site property. The building slab acts as a soil cap system for those inaccessible areas of remaining soil contamination. There are also seven exterior soil cap system areas, which consists of two types of covers, depending upon location of the area of concern:

1. Soil and vegetated cover – clean native and/or imported fill stabilized by grass or landscaping (tan bark/peat moss and shrubbery)
2. Soil and asphalt cover – clean native and/or imported fill covered by 4 to 6 inches of asphalt base and a 2-inch thick layer of asphalt

There are eight areas of the Site where PCE-affected soils are capped by a cover system. The PCE-affected soils are capped by asphalt, concrete, and/or a minimum of 3 feet of clean soil. Exterior soil cap system cover type #1 is found at deed notice areas 1, 3, 4, 5, and 6. Cover system type #2 is found at deed notice areas 2 and 7. The locations of the deed notice and soil cap areas are presented on Figure 8.

Inspection of these areas occurs once a month to verify that the soil and asphalt caps are in place and in good condition

Procedures for inspecting, operating and maintaining the ASD system and Soil Cap areas are documented in Sections 4.0 and 5.0 of this SMP.

The EWP provided in Appendix B outlines the procedures required to be implemented in the event the cover system is breached, penetrated or temporarily removed, and any underlying remaining contamination is disturbed. Any work conducted pursuant to the EWP must also be conducted in accordance with the procedures defined in the Health and Safety Plan (HASP) (Appendix C) and associated Community Air Monitoring Plan (CAMP) (Appendix B).

3.2.3 ISCO Remediation System

In 2004 an ISCO field testing using sodium permanganate was proposed for the remaining residual chlorinated ethenes within the central part of the groundwater plume. Sodium permanganate is a proven oxidizer of chlorinated ethenes and has very high water solubility allowing high dissolved concentrations of the oxidant to be introduced into the aquifer. Three phases of ISCO field tests were conducted between 2005 and 2008 at the Site to evaluate the effectiveness of ISCO using sodium permanganate. The results of the ISCO field tests indicated the reduction of PCE concentration within the area; thus ensuring that permanganate is effective in reducing chlorinated ethenes concentrations.

In 2007, ISCO was proposed as a full-scale remedy to remediate the remaining central part of the groundwater plume. The full scale ISCO consisted of the injection of a diluted solution of sodium permanganate to be delivered by an automatic gravity-feed system in the source area and manual injection downgradient of the source area. This remediation effort was approved by NYSDEC in an e-mail dated March 25, 2009 and implementation began in June 2011.

The ISCO injection system included a mixing tank, distribution box and associated pipes and fittings installed at the Site. A 6,500-gallon heavy-duty polyethylene (HDPE) double wall vertical above-ground storage tank (AST) was installed to allow for mixing and to store the oxidant solution

for injection. The double wall mixing tank was equipped with the following: 1) leak detection sensor; 2) heat tracing elements and insulation; 3) level switches; and 4) required piping and appurtenances. Each injection well was connected to the distribution box by a 1-inch diameter HDPE pipe.

Due to a failure of the AST system's piping in December 2013, VERINA no longer uses the automatic system's distribution box and all ISCO injections are conducted manually on a monthly basis utilizing a 10% sodium permanganate solution. Additionally, the ISCO AST is inspected during monthly site visits to ensure satisfactory condition of the tank.

3.3 Criteria for Completion of Remediation

3.3.1 Active Sub-Slab Depressurization (ASD) System

The ASD system will not be discontinued unless prior written approval is granted by the NYSDEC and the NYSDOH. In the event that groundwater monitoring data indicates that the ASD system may no longer be required, a proposal to discontinue the ASD system will be submitted to the NYSDEC and NYSDOH.

3.3.2 Monitoring Wells Associated with Monitored Natural Attenuation

Groundwater monitoring activities will continue, as determined by the NYSDEC with consultation with NYSDOH, until residual groundwater concentrations are found to be consistently below ambient water quality standards, the Site GWQS, or have become asymptotic at an acceptable level over an extended period. In the event that monitoring data indicates that monitoring of groundwater may no longer be required, a proposal to discontinue the system will be submitted to NYSDEC. Monitoring will continue until permission to discontinue is approved by the NYSDEC. If groundwater contaminant levels become asymptotic at a level that is not acceptable to the NYSDEC, additional source removal, treatment and/or control measures will be evaluated.

3.3.3 Soil Cap System

The soil cap system will continue to be inspected on a monthly basis and maintained as needed to ensure the integrity of the system. The composite cover system is a permanent control and the quality and integrity of this system will be inspected at defined, regular intervals in accordance with this SMP in perpetuity.

4.0 MONITORING AND SAMPLING PLAN

4.1 General

This Monitoring and Sampling Plan describes the measures for evaluating the overall performance and effectiveness of the remedy. Details regarding the sampling procedures, data quality usability objectives, analytical methods, etc. for all samples collected as part of Site management for the Site are included in the Quality Assurance Project Plan (QAPP) (Appendix D). This Monitoring and Sampling Plan may only be revised with the approval of the NYSDEC.

4.2 Site-Wide Inspection

Site-wide inspections are performed semi-annually. Site-wide inspections will also be performed after all severe weather conditions that may affect ECs or the monitoring network. Modification to the frequency or duration of the inspections will require approval from the NYSDEC.

Inspections of all remedial components installed at the Site will be conducted. A comprehensive site-wide inspection will be conducted and documented according to the SMP schedule, regardless of the frequency of the Periodic Review Report. Reporting requirements are outlined in Section 6.0 of this plan. The inspections will determine and document the following:

- Whether ECs continue to perform as designed;
- If these controls continue to be protective of human health and the environment;
- Compliance with requirements of this SMP and the Deed Restriction;
- Achievement of remedial performance criteria; and
- If site records are complete and up to date.

Inspections will also be performed in the event of an emergency. If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs that reduces or has the potential to reduce the effectiveness of ECs in place at the Site, verbal notice to the NYSDEC must be given by noon of the following day. In addition, an inspection of the Site will be conducted within 5 days of the event to verify the effectiveness of the IC/ECs implemented at the Site by a qualified environmental professional, as determined by the NYSDEC. Written confirmation must be provided to the NYSDEC within seven (7) days of the event that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.

4.3 ISCO System Monitoring and Sampling

Monitoring of the ISCO system will be performed on a monthly basis and will include an inspection of the AST and its related components. An ISCO system inspection form is provided in Appendix E. Sampling of the ISCO system itself will not be conducted; however, groundwater will be sampled on an annual basis to ensure the ISCO remedy is continuing to effectively decrease dissolved-phase COCs at the Site as described below.

4.3.1 Groundwater Monitoring

Groundwater monitoring will be performed on an annual basis in September of each year. Wells to be sampled include those located at both the Site source area and the Pilot Truck Stop area. Modification to the frequency or sampling requirements will require approval from the NYSDEC. The groundwater samples will be collected and analyzed for site-specific VOCs, including:

- 1,1-Dichloroethane
- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Tetrachloroethene
- 1,1,1-Trichloroethane
- Trichloroethene
- Vinyl Chloride

Wells to be sampled for these site specific VOCs include: MW-2, MW-3, MW-7A, MW-13, MW-14, MW-16, MW-17, MW-19, MW-22, MW-24, MW-25R, MW-26, MW-27, MW-28, MW-31, MW-32, MW-35, MW-38, MW-39, MP-3D, MP-4, MP-5, MP-6D, MP-6S, MP-8D, MP-8S, MP-11, MP-12, MP-13, MP-14. Table 2 summarizes the wells' identification numbers, as well as the purpose, location, depths, diameter and screened intervals of the wells. As part of the groundwater monitoring, 2 upgradient wells, 20 on site wells and 8 downgradient wells are sampled to evaluate the effectiveness of the remedial system.

If biofouling or silt accumulation occurs in the on-site and/or off-site monitoring wells, the wells will be physically agitated/surged and redeveloped. Additionally, monitoring wells will be properly decommissioned and replaced, if an event renders the wells unusable. Monitoring wells that are decommissioned because they have been rendered unusable will be replaced in kind in the nearest available location, unless otherwise approved by the NYSDEC. Repairs and/or replacement of wells in the monitoring well network will be performed based on assessments of structural integrity and overall performance.

The NYSDEC will be notified prior to any repair or decommissioning of any monitoring well for the purpose of replacement, and the repair or decommissioning and replacement process will be documented in the subsequent Periodic Review Report. Well decommissioning without replacement will be done only with the prior approval of the NYSDEC. Well abandonment will be performed in accordance with NYSDEC's guidance entitled "CP-43: Groundwater Monitoring Well Decommissioning Procedures."

All sampling activities will be recorded in a field book and associated sampling log as provided in Appendix E. Other observations (e.g., groundwater monitoring well integrity, etc.) will be noted on the sampling log. The sampling log will serve as the inspection form for the monitoring network. Additional detail regarding monitoring and sampling protocols are provided in the site-specific Field Activities Plan in Appendix F. The sampling frequency may only be modified with the approval of the NYSDEC. This SMP will be modified to reflect changes in sampling plans approved by the NYSDEC. Deliverables for the groundwater monitoring program are specified in Section 6.0 –Reporting Requirements.

4.4 Soil Cap System Monitoring and Sampling

Soil cap system monitoring will be performed on a monthly basis and will include a visual inspection to verify that the interior and exterior soil caps are in place and in good condition. With respect to asphalt and concrete caps, the area surface will be visually checked for subsidence/settlement, excessive wear and/or cracking, and for breaches (such as pot holes). Areas with soil cover are checked for subsidence/settlement, missing vegetative cover and/or excessive erosion. Construction activities (authorized or unauthorized) that have or may interfere with cap integrity will be noted and repaired and/or replaced in accordance to Soils Management

Plan, which is included in Appendix G. A complete list of components to be inspected is provided in the soil cap area inspection log provided in Appendix E.

4.4.1 Monitoring and Sampling Protocol

All monitoring and sampling activities will be recorded in a field book and associated monitoring and sampling logs as provided in Appendix E – Site Management Forms. Other observations (e.g., groundwater monitoring well integrity, etc.) will be noted on the monitoring and sampling logs, which will serve as the inspection forms for the monitoring network. Additional detail regarding monitoring and sampling protocols are provided in the site specific Field Activities Plan provided as Appendix F of this document.

4.5 ASD Monitoring and Sampling

Monitoring of the ASD system will be performed on a monthly basis, including

- Extraction Point Vacuum Gauges - Measurement of vacuum readings.
- Electronic Panel - Functionality of electronic system and controls
- ASD Fan - Functionality and operation of the vacuum fan.

A visual inspection of the complete system will be conducted during each monitoring event. Unscheduled inspections and/or sampling may take place when a suspected failure of the ASD system has been reported or an emergency occurs that is deemed likely to affect the operation of the system.

A complete list of components to be inspected is provided in the ASD inspection log provided in Appendix E. If any equipment readings are not within their specified operation range, any equipment is observed to be malfunctioning or the system is not performing within specifications, maintenance and repair will be implemented immediately. To monitor the effectiveness of the ASD system, indoor air sampling will be conducted annually in March of each year at the sampling locations depicted on Figure 9.

5.0 OPERATION AND MAINTENANCE PLAN

This operation and Maintenance Plan provides a brief description of the measures necessary to operate, monitor and maintain the mechanical components of the remedy selected for the Site. This Operation and Maintenance Plan:

- Includes the procedures necessary to allow individuals unfamiliar with the Site to operate and maintain the ISCO, ASD, and Soil Cap systems.

- Will be updated periodically to reflect changes in the site conditions or the manner in which the ISCO, ASD, and Soil Cap systems are operated and maintained.

Further detail regarding the Operation and Maintenance of the ISCO, ASD and Soil Cap systems is provided in Appendix G – Operations, Maintenance and Monitoring Plan (OM&M Plan). A copy of this OM&M Plan, along with the complete SMP, is to be maintained at the Site. This OM&M Plan is not to be used as a stand-alone document, but as a component document of this SMP.

5.1 ISCO System Operation and Maintenance

As stated previously in Section 3.2.3, the ISCO system operation will be conducted as a manual injection activity. On a monthly basis, approximately 1,000 gallons of 10% sodium permanganate solution is transferred from the 6,500 gallon HDPE AST located on the west side of the building into the mobile "turtle tank" using a sump pump. The solution is then manually injected using gravity feed into the following wells at the Site: MW-7A, MW-16, MW-24, MW-25R, MW-28, MP-4, MP-5, MP-8S, MP-11, MP-12, IJ-1, IJ-2, IJ-5, IJ-6, IJ-7 and IJ-8. During the monthly injection events, the ISCO AST and its related components will also be inspected as shown on the inspection form provided in Appendix E. The AST and its related components as well as the smaller, mobile "turtle tank" and 5-gallon pails with spigots used to complete the manual injections will be maintained, repaired or replaced as needed.

5.2 ASD System Operation and Maintenance

5.2.1 System Start-Up and Testing

The ASD system is essentially self-operating and does not require adjustments. The ASD system operates as either on or off. The ASD system is a basic design based on radon mitigation type technology as approved by the NYSDEC. The ASD system includes mechanisms to monitor system performance and warn of system failure (shut off). The electrical monitor is installed on non-switched circuits and is designed to reset automatically after a power supply interruption.

To monitor the effectiveness of the ASD system, indoor air quality testing will be done annually. Samples shall be collected within the facility building at the sampling locations shown in Figure 9.

5.2.2 Routine System Operation and Maintenance

The ASD system includes eight suction fans/blowers. The fans do not require maintenance and have an expected operational life of 7 to 8 years. Other systems components, such as piping, gauges, and wiring could be inadvertently damaged or broken by other site activities. Monthly monitoring ASD system inspection events include collecting vacuum readings from extraction point vacuum gauges, inspect the electronic panel for functionality of electronic system and

controls, and verify the functionality and operation of the vacuum ASD fan. All these features and system components will be checked for damage. Broken or damaged parts of the system will be repaired or replaced.

This system can be easily modified should future conditions warrant such changes. Additional extraction points can be added and plumbed to the existing system with the addition of a new fan. Additionally, the present system is flexible as it can be operated in different configurations in that all extraction points can be open or closed in any combination allowing for focused ASD if future testing indicates a specific area of greater concern for beneath the floor slab.

A copy of the Operations and Maintenance Manual specific to the ASD system is provided in Appendix G, which will provide further detail on the above.

5.2.3 Non-Routine Operation and Maintenance

Unscheduled inspections and/or sampling may take place when a suspected failure of the ASD system has been reported or an emergency occurs that is deemed likely to affect the operation of the system. If any equipment readings are not within their specified operation range, any equipment is observed to be malfunctioning or the system is not performing within specifications, maintenance and repair will be implemented immediately.

5.3 Soil Cap System

Environmental guidelines for the management of subsurface soils and the long-term maintenance of the cover system are as follows:

- Any breach of the cover system, including for the purposes of construction or utility work, must be replaced or repaired using materials such as clean soil, as defined by 6 NYSCRR Part 375, with grass seed or sod or impervious asphaltic or cementitious concrete to prevent future possible erosion.

- Control of surface erosion and storm water runoff from the deed notice areas at all times, including during construction activities in these areas.

- Site soil that is excavated from a deed notice area and is intended for removal from the property must be managed, characterized, and properly disposed of in accordance with NYSDEC regulations and directives.

- Prior to any construction activities within the deed notice areas, workers are to be notified of the site conditions with clear instructions regarding how the work is to proceed safely. Invasive/intrusive work performed in the deed notice areas will be conducted in accordance with applicable local, state, and federal regulations to protect worker health and safety. NYSDEC will be notified 15 days before any construction activities.

- The controlling entity on the Site (owner and/or tenant) shall complete and submit to NYSDEC an annual report by January 30th of each year. The annual report shall contain a certification that the institutional controls put in place (Deed Notice with Environmental Restrictions) are still in place; have not been altered and are still effective, that the

remedy and protective cover have been maintained; and that the conditions at the Site are fully protective of public health and the environment.

As stated previously, the soil cap systems will be inspected on a monthly basis. If any (or all) of the cover systems is found to be breached or in poor condition, maintenance of the cap system(s) will be conducted on an as needed basis. Additionally, if any soil cap area maintenance is conducted during the year covered by the annual Periodic Review Report, the responsible party shall include a certification that all work, including repair/replacement, was performed in conformance with this SMP.

6.0 REPORTING REQUIREMENTS

6.1 Site Management Reports

All site management inspection, maintenance and monitoring events will be recorded on the appropriate site management forms provided in Appendix E. These forms are subject to NYSDEC revision.

All applicable inspection forms and other records, including media sampling data and system maintenance reports, generated for the Site during the reporting period will be provided in electronic format to the NYSDEC as part of the Periodic Review Report (see Section 6.2) to NYSDEC.

6.2 Periodic Review Report

Periodic Review Reports (PRRs) have been submitted to the NYSDEC since 2004. Currently the PRR is submitted to the NYSDEC on an annual basis. The PRR is prepared in accordance with NYSDEC's DER-10 and submitted within 30 days of the end of each certification period. Media sampling results are incorporated into the Periodic Review Report. In the event that the Site is subdivided into separate parcels with different ownership, a single Periodic Review Report will be prepared that addresses the locations shown in Figure 8.

The PRR includes:

- Identification, assessment and certification of all ECs/ICs for the Site;
- Results of the site inspections and correct measures, if applicable;
- All applicable site management forms and other records during the reporting period in the NYSDEC- approved electronic format;
- A summary of any discharge monitoring data and/or information generated during the report period, with comments and conclusions.
- Data summary tables and figures for the constituents of concern by impacted media at the Site which include a listing of all compounds analyzed, along with applicable standards, with all exceedances highlighted. These will include a presentation of past data as part of an evaluation of contaminant concentration trends.
- Results of all analyses, copies of all laboratory data sheets, and the required laboratory data deliverables for all samples collected during the reporting period will be submitted in digital format as determined by the NYSDEC. Currently, data is supplied electronically and submitted to the NYSDEC EQuIS database in accordance with the requirements found at this link: http:/www.dec.ny.gov/chemical/62440.html.
- A site evaluation, which includes the following:
    - The compliance of the remedy with the requirements of the site-specific RAWP, ROD, or Decision Document;

- The operation and the effectiveness of all treatment units, etc., including identification of any needed repairs or modifications;
- Any new conclusions or observations regarding site contamination based on inspections or data generated by the Monitoring and Sampling Plan for the media being monitored;
- Recommendations regarding any necessary changes to the remedy and/or Monitoring and Sampling Plan;
- Trends in contaminant levels in the affected media will be evaluated to determine if the remedy continues to be effective in achieving remedial goals as specified by the Decision Document; and
- The overall performance and effectiveness of the remedy.

Following the last inspection of the reporting period, a Certification of Institution and Engineering Controls will be signed by a Professional Engineer licensed to practice in State of New York as per the requirements of NYSDEC DER-10. The Certification will include the following:

"*For each institutional or engineering control identified for the site, I certify that all of the following statements are true:*

- *The inspection of the site to confirm the effectiveness of the institutional and engineering controls required by the remedial program was performed under my direction;*
- *The institutional control and/or engineering control employed at this site is unchanged from the date the control was put in place, or last approved by the Department;*
- *Nothing has occurred that would impair the ability of the control to protect the public health and environment;*
- *Nothing has occurred that would constitute a violation or failure to comply with any site management plan for this control;*
- *Access to the site will continue to be provided to the Department to evaluate the remedy, including access to evaluate the continued maintenance of this control;*
- *If a financial assurance mechanism is required under the oversight document for the site, the mechanism remains valid and sufficient for the intended purpose under the document;*
- *Use of the site is compliant with the environmental easement;*
- *The engineering control systems are performing as designed and are effective;*
- *To the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program and generally accepted engineering practices; and,*

- *The information presented in this report is accurate and complete.*

I certify that all information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law. I, [name], of [business address], am certifying as [Owner/Remedial Party or Owner's/Remedial Party's Designated Site Representative]."

6.3 Corrective Measures Work Plan

If any component of the remedy is found to have failed, or if the periodic certification cannot be provided due to the failure of an institutional or engineering control, a Corrective Measures Work Plan will be submitted to the NYSDEC for approval. This plan will explain the failure and provide the details and schedule for performing work necessary to correct the failure. Unless an emergency condition exists, no work will be performed pursuant to the Corrective Measures Work Plan until it has been approved by the NYSDEC.

6.4 Remedial Site Optimization Report

A Remedial Site Optimization (RSO) study will be conducted any time that the NYSDEC requests in writing that an in-depth evaluation of the remedy is needed. An RSO will provide a critique of the Site's conceptual model, give a summary of past performance, document current clean up practices, summarize progress made towards the Site's clean up goals, gather additional performance or media specific data and information and provide recommendations for improvements to enhance the ability of the present system to reach RAOs or to provide a basis for changing the remedial strategy.

In the event that an RSO is to be performed, an RSO report will be submitted to the NYSDEC for approval. The RSO report will include the following:

- The research/investigation and data gathering conducted
- Evaluation of results and facts obtained
- Revised conceptual site model
- Future recommendations
    - RSO recommendations will be implemented upon approval from NYSDEC.

7.0 PERIODIC ASSESSMENTS/EVALUATIONS

7.1 Climate Change Vulnerability Assessment

Increases in both the severity and frequency of storms/weather events, an increase in sea level elevations along with accompanying flooding impacts, shifting precipitation patterns and wide temperature fluctuation, resulting from global climactic change and instability, have the potential to significantly impact the performance, effectiveness and protectiveness of a given site and associated remedial systems. Vulnerability assessments provide information so that the site and associated remedial systems are prepared for the impacts of the increasing frequency and intensity of severe storms/weather events and associated flooding.

As the Site is located on a topographical high point, is not located in a floodplain, coastal or tidal area, is equipped with suitable stormwater drainage features, and the site remedial system is not influenced by potential power outages, a climate change vulnerability assessment has not been performed at this time as climate change is expected to have very little to no impact on the Site conditions.

7.2 Green Remediation Evaluation

NYSDEC's DER-31 Green Remediation requires that green remediation concepts and techniques be considered during all stages of the remedial program including site management, with the goal of improving the sustainability of the cleanup and summarizing the net environmental benefit of any implemented green technology. This section of the SMP provides a summary of any green remediation evaluations to be completed for the site during site management, and as reported in the Periodic Review Report (PRR).

- Waste Generation – wastes which will be generated from Site activities include disposable sampling supplies (gloves, tubing, etc.) as well as purged groundwater. The disposable supplies will be disposable of as ordinary municipal wastes, while the purged groundwater will be drummed and properly disposed of off-site. No waste reduction projects are proposed at this time.

- Energy usage – energy usage at the Site consist of the energy to run the ASD system as well as the heating element for the ISCO AST.

- Emissions – the only emissions generated from this Site include the extracted soil vapor from the ASD system. Additionally, during sampling and inspections events, the only additional emissions generated are from the vehicles used to mobilize to/from/around the Site as well as a gas powered generators used to fill the "turtle tank" for manual ISCO injections.

- Water usage – water will be needed for decontamination purposes during the annual Site groundwater sampling and monthly ISCO injection events. Water will be obtained from the Site building and less than 50 gallons of water will be needed during these events. Additionally, during refilling of the ISCO AST, which occurs about every 6 months, approximately 4,500 gallons will be supplied by a water delivery company to dilute the delivered 40% sodium permanganate solution to the desired 10% concentration of the final injection solution.

7.2.1 Timing of Green Remediation Evaluation

For major remedial system components, green remediation evaluations and corresponding modifications will be undertaken as part of a formal Remedial System Optimization (RSO), or at any time that the Project Manager feels appropriate, e.g. during significant maintenance events or in conjunction with storm recovery activities.

Modifications resulting from green remediation evaluations will be routinely implemented and scheduled to occur during planned/routine operation and maintenance activities. Reporting of these modifications will be presented in the PRR.

7.2.2 Remedial Systems

Remedial systems will be operated properly considering the current site conditions to conserve materials and resources to the greatest extent possible. Consideration will be given to operating rates and use of reagents and consumables. Spent materials will be sent for recycling, as appropriate.

Remedial system types and associated parameters to be evaluated include:

- ISCO System
- Soil Cap System
- ASD System

7.2.3 Building Operations

Structures including buildings and sheds will be operated and maintained to provide for the most efficient operation of the remedy, while minimizing energy, waste generation and water consumption.

7.2.4 Frequency of System Checks, Sampling and other Periodic Activities

Transportation to and from the Site and use of consumables in relation to visiting the Site in order to conduct system checks and or collect samples and shipping samples to a laboratory for analyses have direct and/or inherent energy costs. The schedule and/or means of these periodic activities have been prepared so that these tasks can be accomplished in a manner that does not impact remedy protectiveness but reduces expenditure of energy or resources.

Consideration shall be given to:

- Reduced sampling frequencies;
- Reduced site visits and system checks;
- Installation of remote sensing/operations and telemetry;
- Coordination/consolidation of activities to maximize foreman/labor time; and
- Use of mass transit for site visits, where available.

8.0 REFERENCES

6NYCRR Part 375, Environmental Remediation Programs. December 14, 2006.

Arcadis U.S., Inc. 2010. *Full Scale In-Situ Chemical Oxidation Design Report. Former Dover Electronics Site, Kirkwood, Broom County, New York.* March 2010.

Blasland, Bouck, & Lee, Inc. (BBL). 2004. *Remedial Action Report. Universal Instruments, Kirkwood, Broome County, New York.* March 2004.

BBL. 2004. *Groundwater Bioremediation Progress Report. Universal Instruments Corporation, Kirkwood, Broome County, New York.* September 2004.

BBL. 2005 *In Situ Chemical Oxidation Field Test Results Report. Universal Instruments Corporation, Kirkwood, Broome County, New York.* October 2005.

New York State Department of Environmental Conservation (NYSDEC). 1998. Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1. June 1998 (April 2000 addendum).

NYSDEC. 2000. *Record of Decision: Former Dover Electronics Site, Kirkwood (T), Broome County, Site Number 7-04-026.* March 2000.

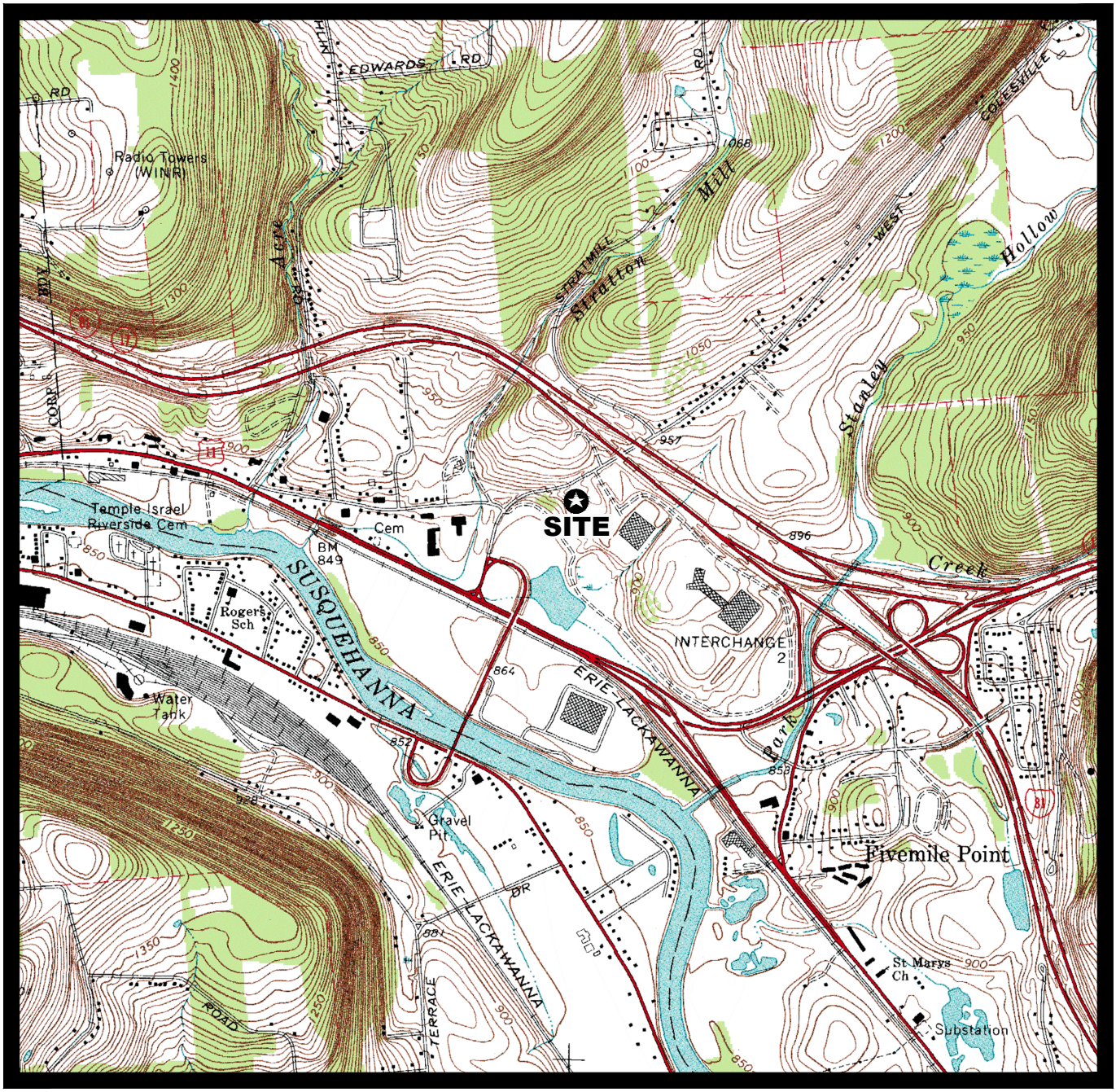
NYSDEC. 2001. *Order on Consent: Index #B7-0515-97-05,* January 19, 2001.

NYSDEC. 2010. DER-10 – "*Technical Guidance for Site Investigation and Remediation*", May 2010.

NYSDEC. 2014. *Declaration Statement – Record of Decision Amendment. Universal Instruments/Dover Electronics Site. Kirkwood (T), Broome County, New York, Site No. 7-04-026.* March 2014.

VERINA. January 2018. *2018 Remedial Action Progress Report. Former Dover Electronics Site, Kirkwood, New York.*

Figures



BINGHAMTON EAST QUADRANGLE
7.5–MINUTE SERIES

N

0 2000
APPROXIMATE SCALE

FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK

REGIONAL LOCATION MAP

VERINA Engineering, P.C.

1

N

MW-15
MW-21
MW-5
MW-16
MW-24
MW-29
MW-9
MW-14
MW-1
MW-23
MW-4
FORMER ABOVEGROUND STORAGE TANK
MW-10
MW-13
MW-12
BUILDING
MW-11
FORMER DRUM STORAGE SHED
MW-2
MW-38
MW-17
MW-7A
MW-7
MW-8
MW-3
MW-22
MW-18
MW-26
MW-19
MW-27
MW-20
MW-6
MW-30
MW-37
MW-25R
MW-28
MW-25
MW-34
MW-31
MW-33
MW-39
MW-35
MW-32
MW-36

MP-2 (to approx. 45ft)
MP-1 (to approx. 45ft)
MP-3D (to approx. 75ft)
MP-11
MP-4
MP-12
MP-5
MP-13
MP-14
MP-6S
MP-6D (to approx. 55ft)
MP-7
MP-9
MP-8S
MP-10D (to approx. 55ft)
MP-10S
MP-8D (to approx. 55ft)

IJ-7
IJ-2
IJ-8
IJ-3
IJ-9
IJ-4
IJ-10
IJ-1
IJ-5
IJ-6

GRAVEL ROAD
PAVED SHOULDER
CABLE GUIDE RAIL

EXPLANATION

- **MW-2** — DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW MONITORING WELL
- **MW-6** — DESIGNATION AND APPROXIMATE LOCATION OF INTERMEDIATE MONITORING WELL
- **MW-34** — DESIGNATION AND APPROXIMATE LOCATION OF DEEP MONITORING WELL
- **MW-1** — DESIGNATION AND APPROXIMATE LOCATION OF ABANDONED MONITORING WELL
- **MP-1** — DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW MONITORING POINT
- **MP-10S** — DESIGNATION AND APPROXIMATE LOCATION OF ABANDONED MONITORING POINT
- **MP-6D** — DESIGNATION AND APPROXIMATE LOCATION OF INTERMEDIATE MONITORING POINT
- **IJ-1** — DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW INJECTION WELL
- **IJ-6** — DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW–INTERMEDIATE INJECTION WELL

SOURCE:
SITE MAP AND FEATURES OBTAINED FROM *BOUNDARY AND TOPOGRAPHIC SURVEY UNIVERSAL INSTRUMENTS CORPORATION 29 INDUSTRIAL PARK DRIVE TOWN OF KIRKWOOD BROOME COUNTY NEW YORK STATE* PREPARED BY HAWK ENGINEERING OF BINGHAMTON, NEW YORK
OCTOBER 7, 1996
MONITORING WELLS OBTAINED FROM HULBERT ENGINEERING AND LAND SURVEYING, DPC, AUGUST 28, 2015 AND UPDATED ON MARCH 28, 2018 AND SEPTEMBER 30, 2019

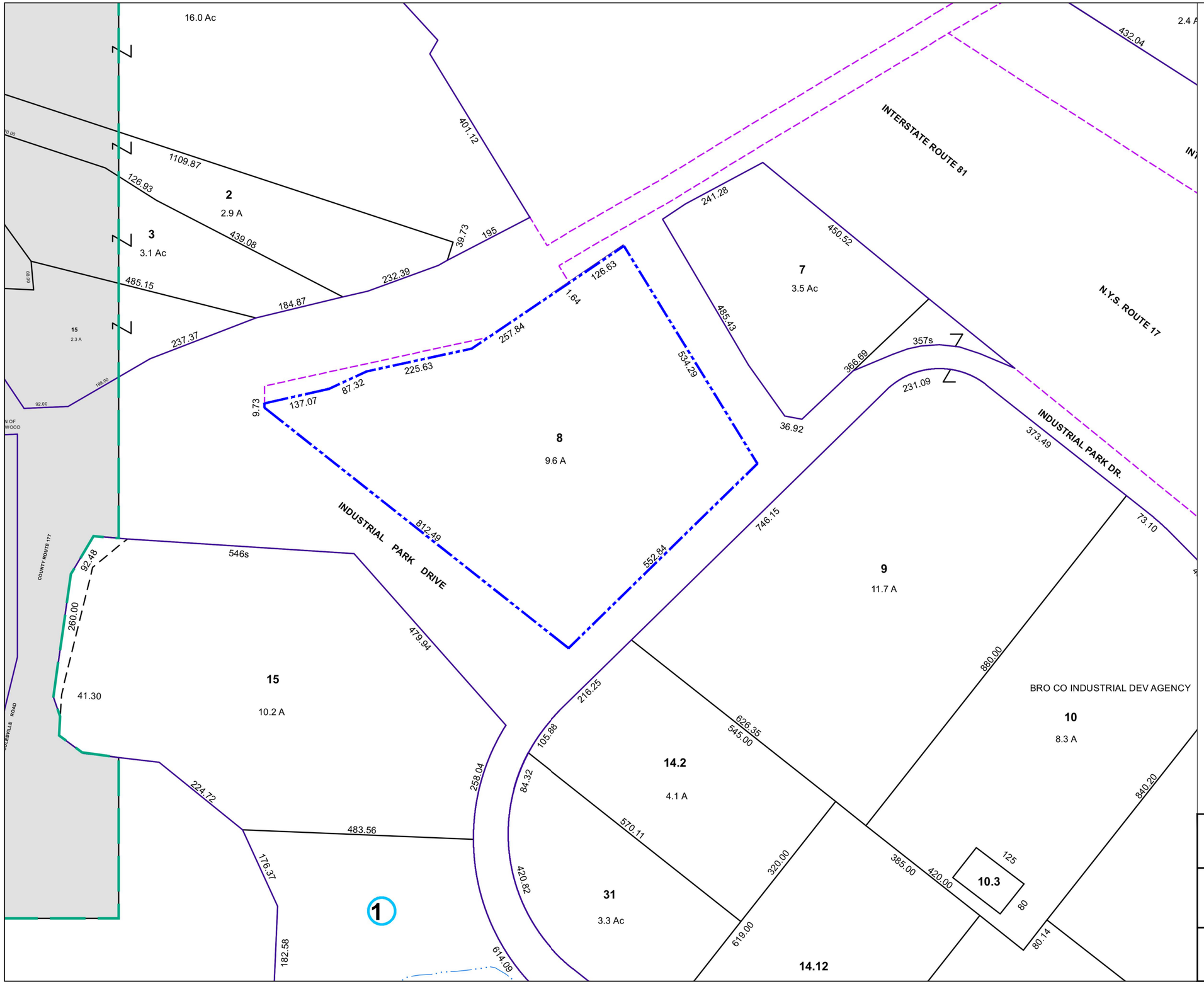
0 110 FT.
APPROXIMATE SCALE

FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK

SITE MAP WITH MONITORING WELL LOCATIONS

VERINA Engineering, P.C.

2



EXPLANATION

SITE PROPERTY BOUNDARY
(SECTION 162.01, BLOCK 1, LOT 8 OBTAINED FROM *ASSESSOR'S TAX MAP, SECTION 162.01 TOWN OF KIRKWOOD, BROOME COUNTY, NEW YORK*)

SOURCE:
TAX MAP OBTAINED FROM
ASSESSOR'S TAX MAP, SECTION 162.01
TOWN OF KIRKWOOD, BROOME COUNTY, NEW YORK
PREPARED BY BROOME COUNTY GIS ON
MARCH 11, 2019

0 200 FT.
APPROXIMATE SCALE

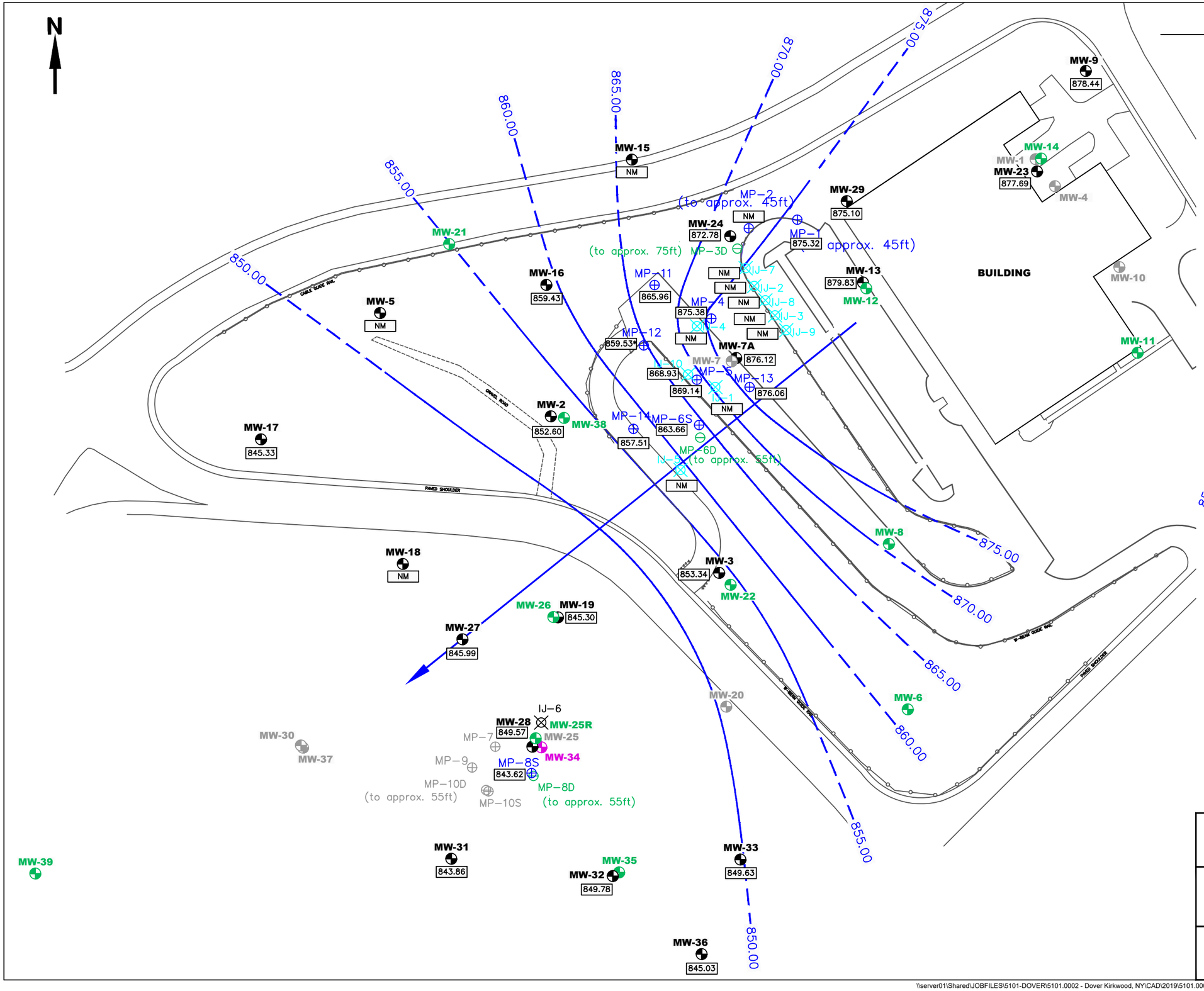
FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK

SITE TAX MAP
SECTION 162.01, BLOCK 1, LOT 8

VERINA Engineering, P.C.

3

\\server01\Shared\JOBFILES\5101-DOVER\5101.0002 - Dover Kirkwood, NY\CAD\2019\5101.0002-Figure-003-TAX-00.dwg LAYOUT: TAX SAVED: 12/26/2019 8:18 AM BY: CLAUDIO STABILE



EXPLANATION

- MW-2 — DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW MONITORING WELL
- MW-1 — DESIGNATION AND APPROXIMATE LOCATION OF ABANDONED MONITORING WELL
- MP-1 — DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW MONITORING POINT
- MP-10S — DESIGNATION AND APPROXIMATE LOCATION OF ABANDONED MONITORING POINT
- MP-6D — DESIGNATION AND APPROXIMATE LOCATION OF INTERMEDIATE MONITORING POINT
- IJ-1 — DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW INJECTION WELL
- IJ-6 — DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW–INTERMEDIATE INJECTION WELL
- MW-6 — DESIGNATION AND LOCATION OF INTERMEDIATE MONITORING WELL
- MW-34 — DESIGNATION AND LOCATION OF DEEP MONITORING WELL

876.88 — GROUNDWATER ELEVATION (FT., MSL)

GROUNDWATER ELEVATION ISOCONTOUR INTERVAL IN FT., MSL (DASHED WHERE INFERRED)

ARROW INDICATES GENERALIZED GROUNDWATER FLOW DIRECTION

CONTOUR INTERVAL = 5.0 FT., MSL
AVERAGE HYDRAULIC GRADIENT = 0.015 FT/FT

NOTES:
1) FT., MSL = FEET, MEAN SEA LEVEL
2) NM = NOT MEASURED
3) * = INDICATES RESULT NOT INCLUDED IN GENERATION OF ISOCONTOURS

SOURCE:
SITE MAP AND FEATURES OBTAINED FROM *BOUNDARY AND TOPOGRAPHIC SURVEY UNIVERSAL INSTRUMENTS CORPORATION 29 INDUSTRIAL PARK DRIVE TOWN OF KIRKWOOD BROOME COUNTY NEW YORK STATE* PREPARED BY HAWK ENGINEERING OF BINGHAMTON, NEW YORK
OCTOBER 7, 1996
MONITORING WELLS OBTAINED FROM HULBERT ENGINEERING AND LAND SURVEYING, DPC, AUGUST 28, 2015 AND UPDATED ON MARCH 28, 2018 AND SEPTEMBER 30, 2019

0 110 FT.
APPROXIMATE SCALE

FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK

SHALLOW GROUNDWATER ELEVATION ISOCONTOURS SEPTEMBER 24, 2019

VERINA Engineering, P.C.

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\\server01\Shared\JOBFILES\5101-DOVER\5101.0002 - Dover Kirkwood, NY\CAD\2019\5101.0002-Figure-002-ISO-SH-2019-01.dwg LAYOUT: ISO SAVED: 11/25/2019 2:43 PM BY: CLAUDIO STABILE

N

EXPLANATION

- MW-2 — DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW MONITORING WELL
- MW-1 — DESIGNATION AND APPROXIMATE LOCATION OF ABANDONED MONITORING WELL
- MP-1 — DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW MONITORING POINT
- MP-10S — DESIGNATION AND APPROXIMATE LOCATION OF ABANDONED MONITORING POINT
- MP-6D — DESIGNATION AND APPROXIMATE LOCATION OF INTERMEDIATE MONITORING POINT
- IJ-1 — DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW INJECTION WELL
- IJ-6 — DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW–INTERMEDIATE INJECTION WELL
- MW-6 — DESIGNATION AND LOCATION OF INTERMEDIATE MONITORING WELL
- MW-34 — DESIGNATION AND LOCATION OF DEEP MONITORING WELL

880.04 GROUNDWATER ELEVATION (FT., MSL)

GROUNDWATER ELEVATION ISOCONTOUR INTERVAL IN FT., MSL (DASHED WHERE INFERRED)

CONTOUR INTERVAL = 5.0 FT., MSL
AVERAGE HYDRAULIC GRADIENT = 0.028 FT/FT

NOTES:
1) FT., MSL = FEET, MEAN SEA LEVEL
2) NM = NOT MEASURED
3) * = INDICATES RESULT NOT INCLUDED IN GENERATION OF ISOCONTOURS

SOURCE:
SITE MAP AND FEATURES OBTAINED FROM *BOUNDARY AND TOPOGRAPHIC SURVEY UNIVERSAL INSTRUMENTS CORPORATION 29 INDUSTRIAL PARK DRIVE TOWN OF KIRKWOOD BROOME COUNTY NEW YORK STATE* PREPARED BY HAWK ENGINEERING OF BINGHAMTON, NEW YORK OCTOBER 7, 1996
MONITORING WELLS OBTAINED FROM HULBERT ENGINEERING AND LAND SURVEYING, DPC, AUGUST 28, 2015 AND UPDATED ON MARCH 28, 2018 AND SEPTEMBER 30, 2019

0 110 FT.
APPROXIMATE SCALE

FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK

INTERMEDIATE GROUNDWATER ELEVATION ISOCONTOURS SEPTEMBER 24, 2019

VERINA Engineering, P.C.

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\\server01\Shared\JOBFILES\5101-DOVER\5101.0002 - Dover Kirkwood, NY\CAD\2019\5101.0002-Figure-003-ISO-INT-2019-01.dwg LAYOUT: ISO SAVED: 11/25/2019 2:41 PM BY: CLAUDIO STABILE

N

F

FORMER ABOVEGROUND STORAGE TANK

A

PXA-6

BUILDING

PXA1-5

A1

PXA1-3

D

PXD-3

PXD-4

PXD-6

PXD-7

PXD-14

PXD-8

B

PXB-5

PXB-9

PXB-4

PXB-7

PXB-10

PXB-6

PXB-3

PXB-8

PXB-1

PXB-2

C

PXC-7

PXC-8

PXC-11

PXE-10

PXE-1

PXE-3

PXE-8

PXE-12

PXE-2

E

FORMER DRUM STORAGE SHED

EXPLANATION

PX-A-6 ● DESIGNATION AND APPROXIMATE LOCATION OF POST–EXCAVATION SOIL SAMPLE

A DESIGNATION AND APPROXIMATE LOCATION OF FORMER SOIL EXCAVATION AREA

SOURCE:
SITE MAP AND FEATURES OBTAINED FROM *BOUNDARY AND TOPOGRAPHIC SURVEY UNIVERSAL INSTRUMENTS CORPORATION 29 INDUSTRIAL PARK DRIVE TOWN OF KIRKWOOD BROOME COUNTY NEW YORK STATE* PREPARED BY HAWK ENGINEERING OF BINGHAMTON, NEW YORK
OCTOBER 7, 1996
EXCAVATIONS AND SAMPLING LOCATIONS OBTAINED FROM *REMEDIAL ACTION REPORT, FIGURES 3-10* PREPARED BY BLASLAND, BOUCK & LEE, INC. DATED MARCH 2004

0 50 FT.

APPROXIMATE SCALE

FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK

LOCATIONS OF POST-EXCAVATION SOIL SAMPLES WHICH EXCEED SCOs

VERINA Engineering, P.C.

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N

MW-24

Sample Date:	3/19/10	12/21/12	9/22/15	9/13/16	9/13/17	9/18/18	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	4.2 J	ND	ND	ND	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND	ND	ND	ND
PCE	**150**	**22**	2.8 J	**9.8**	0.30 J	2.5 J	0.57 J
TCE	5 J	ND	ND	ND	ND	ND	ND
VC	ND	ND	ND	ND	ND	ND	ND

MP-11

Sample Date:	10/28/11	12/19/11	2/15/12	4/19/12	6/21/12	9/19/12	12/18/12	3/13/13	9/4/13	3/18/14	9/17/14	3/16/15	9/22/15	3/15/16	9/13/16	9/13/17	9/18/18	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	**5.4**	**15**	**24**	**30**	**29**	**38**	**60**	**52**	**43 D**	**34**	ND	2.3 J	ND	ND	ND	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND	0.23 J	ND	0.35 J	0.30 J	0.80 DJ	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCE	**11**	**25**	**32**	**41**	**52**	**86**	**110**	**170**	**200 D**	**220**	3.1 J	**67**	ND	3.4 J	4.1	7.7	ND	ND
TCE	0.28 J	0.36 J	0.36 J	0.34 J	0.49 J	0.99 J	1.0 J	1.4 J	1.8 DJ	1.6 J	ND	ND	ND	ND	ND	ND	ND	ND
VC	**9.2**	**18**	**22**	**32**	**31**	**32**	**44**	**23**	**26 D**	**17**	ND	ND	ND	ND	ND	ND	ND	ND

MP-4

Sample Date:	3/16/10	12/19/11	2/15/12	4/18/12	6/19/12	9/19/12	12/20/12	3/14/13	9/4/13	3/15/14	9/17/14	3/17/15	9/22/15	3/16/16	9/14/16	3/21/17	9/13/17	3/23/18	9/19/18	3/18/19	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND (ND)	ND	ND (ND)	ND (ND)	ND (ND)	ND (ND)	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND (ND)	ND	ND (ND)	ND (ND)	ND (ND)	ND (ND)	ND	ND	ND
PCE	**9500**	**11000**	**6500**	**8200**	**11000 D**	**7700**	**8500 (9000)**	**13000 D**	**11000**	**12000**	**10000**	**970 (1200)**	**3000 D**	**1400 (1300)**	**2500 (2800)**	**820 (810)**	**1300 (1300)**	**2400**	1.0 J	**2400 D**	
TCE	ND	**32 J**	ND	ND	ND	ND	**ND (12 J)**	**26 DJ**	ND	ND	ND	ND (ND)	ND	ND (ND)	ND (ND)	ND (ND)	ND (ND)	ND (ND)	ND	0.29 J	
VC	ND	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND (ND)	ND	ND (ND)	ND (ND)	ND (ND)	ND (ND)	ND (ND)	ND	ND	

MW-16

Sample Date:	3/17/10	12/21/11	2/15/12	4/19/12	6/21/12	9/20/12	12/19/12	3/13/13	9/4/13	3/18/14	9/18/14	3/16/15	9/22/15	3/15/16	9/14/16	3/20/17	9/13/17	3/23/18	9/20/18	3/19/19	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	4.0 J	4.5 J	4.7 J	3.4 J (3.8 DJ)	2.8 J	2.7 J	2.9 J	2.9 DJ	2.0 J	1.9 J	1.3 J	1.1 J	ND	0.34 J	ND	ND	ND	2.8	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.8	ND	ND	ND
PCE	**260**	**280**	**250**	**200 (190 D)**	**210**	**200**	**180**	**200 D**	**160**	**150**	**140**	**100**	**43**	**46**	**6.5**	**32**	**60**	**220**	ND	0.66 J	**80**
TCE	**5.8 J**	**6.5 J**	**5.3 J**	4.0 J (4.3 DJ)	4.4 J	4.5 J	4.3 J	4.2 DJ	3.6 J	3.6 J	2.4 J	2.1 J	0.39 J	0.69 J	ND	ND	0.28 J	3.5	3.6	ND	ND
VC	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

MW-12

Sample Date:	10/28/11	12/20/11	2/15/12	4/19/12	6/19/12	9/19/12	12/18/12	3/14/13	9/4/13	3/18/14	9/18/14	3/16/15	9/21/15	3/15/16	9/13/16	3/20/17	9/13/17	3/23/18	9/19/18	3/19/19	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	4.5 J	4.5 J	2.7 J	2.2 J	1.4 J	2.9 J	2.5 J	2.0 J	2.2 J	1.9 J	1.1 J	0.93 J	0.78 J	0.71 J	ND	ND	ND	ND	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCE	**78**	**77**	**51**	**36**	**28**	**79**	**48**	**34**	**49**	**27**	**31**	**26**	**15**	**13**	ND	**17**	**4.6**	**5.1**	**12**	ND	ND
TCE	4.4 J	3.9 J	2.8 J	2.1 J	1.6 J	3.7 J	2.7 J	1.8 J	2.7 J	1.4 J	1.2 J	0.88 J	0.54 J	0.44 J	ND	ND	ND	ND	ND	ND	ND
VC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

IJ-10

Sample Date:	10/28/11	12/20/11	2/14/12	4/18/12	6/21/12	9/20/12	12/20/12	3/14/13	9/3/14	3/19/14	9/17/14	3/17/15	9/22/15	3/15/16	9/13/16	3/21/17	9/12/17	3/23/18	9/20/18	3/18/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	**380**	**300**	**260**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND
trans-1,2-DCE	0.70 J	2.5 J	4.1 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND
PCE	**200**	**310**	**230**	ND	ND	ND	ND	ND	2.0 J	0.92 J	1.5 J	ND	ND	ND (ND)	ND	**7.6 J**	ND	**8.1**	ND	ND
TCE	**150**	**110**	**88**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND
VC	1.1 J	2.0 J	**3.0 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND

MW-5

Sample Date:	11/18/14	9/21/15
VOC (µg/L):	RESULT	RESULT
cis-1,2-DCE	ND	ND
trans-1,2-DCE	ND	ND
PCE	**45**	**44**
TCE	2.3 J	0.38 J
VC	ND	ND

MW-5

Sample Date:	3/18/10	12/19/11	2/16/12	4/18/12	6/19/12	9/20/12	12/20/12	3/14/13	9/3/13	3/19/14	9/17/14	3/17/15	9/21/15	3/15/16	9/13/16	3/20/17	9/13/17	3/23/18	9/18/18	3/18/19	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
1,1-DCE	ND	2.9 J	3.2 DJ	3.1 J	3.3 J	ND (ND)	ND	ND	3.0 J	ND (3.1 J)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-DCE	**31**	**38**	**27 DJ**	**33**	**29**	**21 J (23 J)**	**15 J**	**19 J**	**23 J**	**20 J (20 J)**	**14 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCE	**860**	**1100 D**	**830 D**	**730**	**950**	**710 (700)**	**620**	**920**	**970**	**540 (640)**	**890**	ND	**11**	**280 D**	ND	**29**	**7.8**	1.6	**86**	ND	ND
TCE	**28**	**42**	**29 DJ**	**32**	**42**	**29 (31)**	**25**	**28**	**36**	**33 J (33)**	**32**	ND	ND	0.58 J	ND	ND	ND	ND	ND	ND	ND
VC	**6.7 J**	**13 J**	**8.5 DJ**	**11 J**	**6.6 J**	**3.0 J (3.9 J)**	2.0 J	**3.0 J**	**4.1 J**	**4.7 J (5.1 J)**	1.7 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

MW-17

Sample Date:	3/18/10	12/27/12	9/24/13	11/18/14	9/15/16	3/23/18	3/18/19	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	ND	ND	ND	ND	ND	0.23 J	ND
trans-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND
PCE	1.9 J	1.5 J	1.8 J	1.8 J	3.7	2.2	0.79 J	0.73 J
TCE	ND	ND	0.24 J	0.28 J	ND	ND	ND	0.22 J
VC	ND	ND	ND	ND	ND	ND	ND	ND

MW-2

Sample Date:	3/17/10	12/27/12	3/16/15	3/15/16	3/20/17	3/23/18	3/18/19	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	1.2 J	3.3 J	1.6 J	4.9	0.74 J	0.31	2.6	4.2
trans-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND
PCE	**17**	**39**	3.1 J	2.5	4.0	3.0	0.43 J	1.5
TCE	2.0 J	**5.3**	1.8 J	4.1	2.6	1.4	2.4	3.7
VC	ND	ND	ND	ND	ND	ND	ND	ND

MW-38

Sample Date:	9/21/15	9/14/16	9/12/17	9/19/18	9/26/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	1.3 J	1.2	1.3	0.99 J	2.1
trans-1,2-DCE	ND	ND	ND	ND	ND
PCE	**89**	**110**	**58**	**71**	**55**
TCE	**5.2**	**7.0**	**6.4**	**5.2**	4.6
VC	ND	ND	ND	ND	ND

MW-39

Sample Date:	9/25/19
VOC (µg/L):	RESULT
cis-1,2-DCE	ND
trans-1,2-DCE	ND
PCE	0.75 J
TCE	3.5
VC	ND

MP-14

Sample Date:	10/31/11	12/21/11	2/15/12	4/19/12	6/20/12	9/20/12	12/18/12	3/14/13	9/5/13	3/19/14	9/18/14	3/16/15	9/21/15	3/16/16	9/14/16	3/21/17	9/13/17	3/23/18	9/19/18	3/18/19	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	0.98 J	1.1 J	2.2 J (1.3 J)	1.1 J	1.2 J	1.1 J	1.2 J	1.6 J	1.2 J	1.9 J	1.2 J	1.2 J	0.66 J	1.3	ND	ND	ND	0.51 J	ND	ND	ND
trans-1,2-DCE	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCE	**30**	**37**	**29 (27)**	**25**	**30**	**30**	**27**	**32**	**32**	**37**	**45**	**53**	**50**	**89**	**10**	**15**	**26**	**25**	**33**	**9.7**	**9.0**
TCE	1.6 J	2.0 J	1.7 (1.5 J)	1.2 J	1.6 J	1.6 J	1.5 J	1.6 J	1.5 J	1.9 J	1.9 J	1.7 J	0.71 J	1.9	ND	ND	0.38 J	0.45	1.1	ND	ND
VC	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

MW-30

Sample Date:	3/15/10	12/21/11	3/15/12	6/20/12	9/20/12	12/20/12	9/24/13	9/19/14	9/20/15	9/12/16	9/12/17
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	0.32 J	ND	0.30 J	ND	ND	ND	ND	0.51 J	0.93 J	0.59 J
trans-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCE	**7.5**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TCE	ND	0.37 J	ND	0.35 J	0.28 J	0.28 J	ND	ND	0.59 J	0.57 J	0.51 J
VC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

MW-37

Sample Date:	3/16/10	9/19/14	9/20/15	9/12/16	9/12/17
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	ND	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND	ND
PCE	ND	**8**	**17**	**27**	1.1
TCE	ND	0.38 J	0.52 J	1.3	ND
VC	ND	ND	ND	ND	ND

MW-27

Sample Date:	9/20/15	9/14/16	9/12/17	3/23/18	3/18/19	9/26/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	**15**	**14**	**11**	1.5	**11**	**20**
trans-1,2-DCE	ND	ND	ND	ND	ND	ND
PCE	**20**	**34**	1.3	2.8	0.55 J	0.54 J
TCE	**7.7**	**6.7**	0.51 J	0.53	0.57 J	0.54 J
VC	ND	ND	ND	ND	ND	ND

MP-10D

Sample Date:	3/15/10	12/20/11	3/15/12	6/20/12	9/21/12	12/19/12	9/23/13
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	ND	ND	ND	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND	ND	ND	ND
PCE	ND	ND	ND	ND	ND	ND	ND
TCE	ND	ND	ND	ND	ND	ND	ND
VC	ND	ND	ND	ND	ND	ND	ND

MW-31

Sample Date:	3/16/10	12/28/12	9/24/13	11/18/14	12/18/15	9/12/16	9/11/17	9/18/18	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	0.73 J	0.85 J	0.42 J	0.38 J (0.37 J)	0.49 J	ND	0.44 J	0.48 J	0.37 J
trans-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCE	ND	ND	ND	ND	ND	ND	ND	ND	ND
TCE	ND	0.47 J	0.33 J	0.38 J (0.39 J)	0.80 J	0.44 J	0.61 J	0.35 J	ND
VC	ND	ND	ND	ND	ND	ND	ND	ND	ND

MW-28

Sample Date:	3/15/10	12/20/11	3/15/12	6/20/12	9/21/12	12/19/12	3/15/13	9/4/13	3/20/14	9/19/14	3/17/15	9/21/15	3/16/16	9/13/16	3/21/17	9/13/17	9/19/18	3/19/19	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	**66**	4.3 J	**53**	**54**	**52**	**40**	**47**	**50**	**55**	**26**	**12**	2.2 J	2.4	ND	ND	ND	ND	ND	**8.0**
trans-1,2-DCE	ND	ND	3.5 J	3.4 J	2.2 J	1.8 J	2.4 J	3.3 J	2.4 J	0.65 J	0.56 J	ND	ND	ND	ND	ND	ND	ND	ND
PCE	**270**	**340**	**52**	**47**	**180**	**190**	**170**	**110**	**43**	**36**	**41**	3.8 J	**11**	**7.5**	0.41	ND	1.8 J	ND	**9.7**
TCE	**110**	**8.5 J**	**49**	**48**	**77**	**64**	**60**	**53**	**50**	**27**	**12**	3.1 J	2.1	0.31 J	ND	ND	ND	ND	**7.0**
VC	ND	ND	0.55 J	0.58 J	0.32 J	ND	0.41 J	0.42 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

MW-18

Sample Date:	3/15/10	12/29/12	9/24/13	9/19/14	9/18/18
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	ND	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND	ND
PCE	ND	ND	ND	ND	ND
TCE	ND	ND	ND	ND	ND
VC	ND	ND	ND	ND	ND

MP-8D

Sample Date:	3/15/10	12/20/11	3/16/12	6/20/12	9/21/12	12/19/12	9/23/13	9/19/14	9/21/15	9/13/16	9/12/17	9/18/18	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,2-DCE	ND	ND	ND (ND)	ND	ND	0.86 J	ND	ND	ND	ND	ND	0.68 J	0.47 J
PCE	ND	0.45 J	ND (ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TCE	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
VC	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

MP-8S

Sample Date:	3/15/10	12/20/11	3/16/12	6/20/12	9/21/12	12/19/12	3/15/13	9/4/13	9/19/14	9/21/15	9/13/16	9/12/17	9/19/18	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	**69**	**81**	**64**	**86**	**93**	**79**	**87**	**85**	**81**	**64**	**52**	**78**	**23 (77)**	**74**
trans-1,2-DCE	**6.6**	**7.5**	**5.6**	**5.6**	**9.0**	**7.3**	**7.9**	**7.3**	**6.3**	3.7 J	3.1	4.9	1.7 (5.0)	4.4
PCE	**13**	**49**	**31**	**31**	**64**	**51**	**68**	**68**	**65**	**23**	**25**	**26**	**19 (38)**	**24**
TCE	**36**	**51**	**34**	**58**	**63**	**59**	**61**	**61**	**59**	**25**	**30**	**32**	**15 (38)**	**30**
VC	1.5 J	1.9 J	1.5 J	1.7 J	1.7 J	1.8 J	1.9 J	1.2 J	0.84 J	0.46 J	0.36 J	0.74 J	ND (0.71 J)	0.68 J

MP-2

Sample Date:	3/17/10	12/27/12	3/16/15	3/15/16	3/20/17	3/23/18	3/18/19	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	1.2 J	3.3 J	1.6 J	4.9	0.74 J	0.31	2.6	4.2
trans-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND
PCE	**17**	**39**	3.1 J	2.5	4.0	3.0	0.43 J	1.5
TCE	2.0 J	**5.3**	1.8 J	4.1	2.6	1.4	2.4	3.7
VC	ND	ND	ND	ND	ND	ND	ND	ND

MP-3D

Sample Date:	9/23/13	9/18/14	3/23/18	3/18/19	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	1.2 J	0.85 J	0.32	0.63 J	0.55 J
trans-1,2-DCE	ND	ND	ND	ND	ND
PCE	ND	ND	ND	ND	ND
TCE	ND	ND	ND	ND	ND
VC	0.40 J	ND	ND	ND	ND

IJ-8

Sample Date:	3/23/18	3/19/19
VOC (µg/L):	RESULT	RESULT
cis-1,2-DCE	ND	ND
trans-1,2-DCE	ND	ND
PCE	0.36	ND
TCE	ND	ND
VC	ND	ND

MW-29

Sample Date:	3/19/10	12/27/12	9/25/13
VOC (µg/L):	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	ND	ND
trans-1,2-DCE	ND	ND	ND
PCE	ND	ND	ND
TCE	ND	ND	ND
VC	ND	ND	ND

IJ-4

Sample Date:	12/21/11	2/15/12	4/18/13	6/21/12	9/19/12	12/20/12	3/14/13	9/4/13	3/18/14	9/17/14	3/17/15	9/22/15	3/15/16	9/13/16	3/20/17	9/13/17	3/23/18	9/19/18	3/18/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	**200 J**	**240 J**	ND	2.8 J	ND	ND	ND	ND	ND	0.34 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCE	**7300**	**7200**	ND	**1200 D**	ND	ND	ND	ND	**190**	ND	ND	ND	ND	ND	ND	ND	4.8	ND	ND
TCE	ND	**100 J**	**120 J**	4.0 J	ND	ND	ND	0.39 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
VC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

MW-13

Sample Date:	9/22/15	9/14/16	9/11/17	9/19/18	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	ND	ND	ND	
trans-1,2-DCE	ND	ND	ND	ND	
PCE	**17**	**33**	**19**	**13**	**6.3**
TCE	0.59 J	1.4	0.60 J	0.99 J	0.54 J
VC	ND	ND	ND	ND	

MW-12

Sample Date:	3/19/10	12/27/12	12/28/12	9/18/14
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND
PCE	ND	ND	ND	ND
TCE	ND	ND	ND	ND
VC	ND	ND	ND	ND

MW-14

Sample Date:	9/26/19
VOC (µg/L):	RESULT
cis-1,2-DCE	ND
trans-1,2-DCE	ND
PCE	ND
TCE	ND
VC	ND

MW-11

Sample Date:	3/18/10	9/18/14
VOC (µg/L):	RESULT	RESULT
cis-1,2-DCE	ND	ND
trans-1,2-DCE	ND	ND
PCE	ND	ND
TCE	ND	ND
VC	ND	ND

MW-7A

Sample Date:	3/16/10	12/19/11	2/14/12	4/18/12	6/19/12	9/20/12	12/20/12	3/15/13	9/4/13	3/18/14	9/17/14	3/17/15	9/22/15	3/15/16	9/14/16	3/20/17	9/13/17	3/23/18	9/19/18	3/19/19	9/26/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND (ND)
trans-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND (ND)
PCE	**1700**	**2300 D**	**2700**	**2500**	**2700**	**1600**	**1100 (1200)**	**1900 D**	**650 (660 D)**	**240**	**780 D**	**35 (37)**	4.1 J	**780 D**	ND (ND)	**44**	**6.2**	**140**	**330 D**	**120**	0.87 J (0.66 J)
TCE	ND	3.7 J	**5.8 J**	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND (ND)	ND	0.22 J	ND (ND)	ND	ND	ND	ND	ND	ND (ND)
VC	ND	ND	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND (ND)	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND (ND)

MW-13

Sample Date:	10/28/11	12/19/11	2/15/12	4/18/12	6/19/12	9/20/12	12/20/12	3/15/13	9/4/13	3/18/14	9/17/14	3/17/15	9/22/15	3/15/16	9/14/16	3/20/17	9/13/17	3/23/18	9/18/18	9/25/19
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCE	ND	1.2 J	3.7 J	0.62 J	0.60 J (0.44 J)	ND	0.61 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TCE	1.2 J	0.9 J	0.5 J	0.38 J	0.50 J (0.51 J)	0.51 J	0.41 J	0.32 J	0.33 J	ND	ND	0.26 J	ND	ND	ND	ND	ND	ND	ND	ND
VC	ND	ND	ND	ND	ND (ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

IJ-1

Sample Date:	12/20/11	2/14/12	4/18/12	6/21/12	9/20/12	12/20/12	9/3/13	9/17/14	9/22/15	9/13/16	9/12/17	9/18/18
VOC (µg/L):	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
cis-1,2-DCE	1.0 J	1.2 DJ	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCE	**190**	**180 D**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TCE	1.6 J	2.0 DJ	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
VC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

MP-6S

Sample Date:	9/19/18	3/18/19	9/26/19
VOC (µg/L):	RESULT	RESULT	RESULT
cis-1,2-DCE	ND	ND (ND)	2.3 J
trans-1,2-DCE	ND	ND (ND)	ND
PCE	**260**	**330 D (360 J)**	**430**
TCE	0.90 J	ND (ND)	3.0
VC

N

COLESVILLE ROAD

INDUSTRIAL PARK DRIVE

MW-9

MW-14

MW-1

MW-23

MW-4

MW-29

MW-10

MW-13

MW-12

MW-11

BUILDING

1 2 3 4 5 6 7

EXPLANATION

MW-2 DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELL

MW-1 DESIGNATION AND APPROXIMATE LOCATION OF ABANDONED MONITORING WELL

BUILDING DEED NOTICE AREAS

EXTERIOR DEED NOTICE AREAS

DEPTH TO PCE–AFFECTED SOIL

1. 4 FEET
2. 6 FEET
3. 8 FEET
4. 8 FEET
5. 5 FEET
6. 7 FEET
7. 3 FEET

SOURCE:
SITE MAP AND FEATURES OBTAINED FROM *BOUNDARY AND TOPOGRAPHIC SURVEY UNIVERSAL INSTRUMENTS CORPORATION 29 INDUSTRIAL PARK DRIVE TOWN OF KIRKWOOD BROOME COUNTY NEW YORK STATE* PREPARED BY HAWK ENGINEERING OF BINGHAMTON, NEW YORK
OCTOBER 7, 1996

0 50 FT.

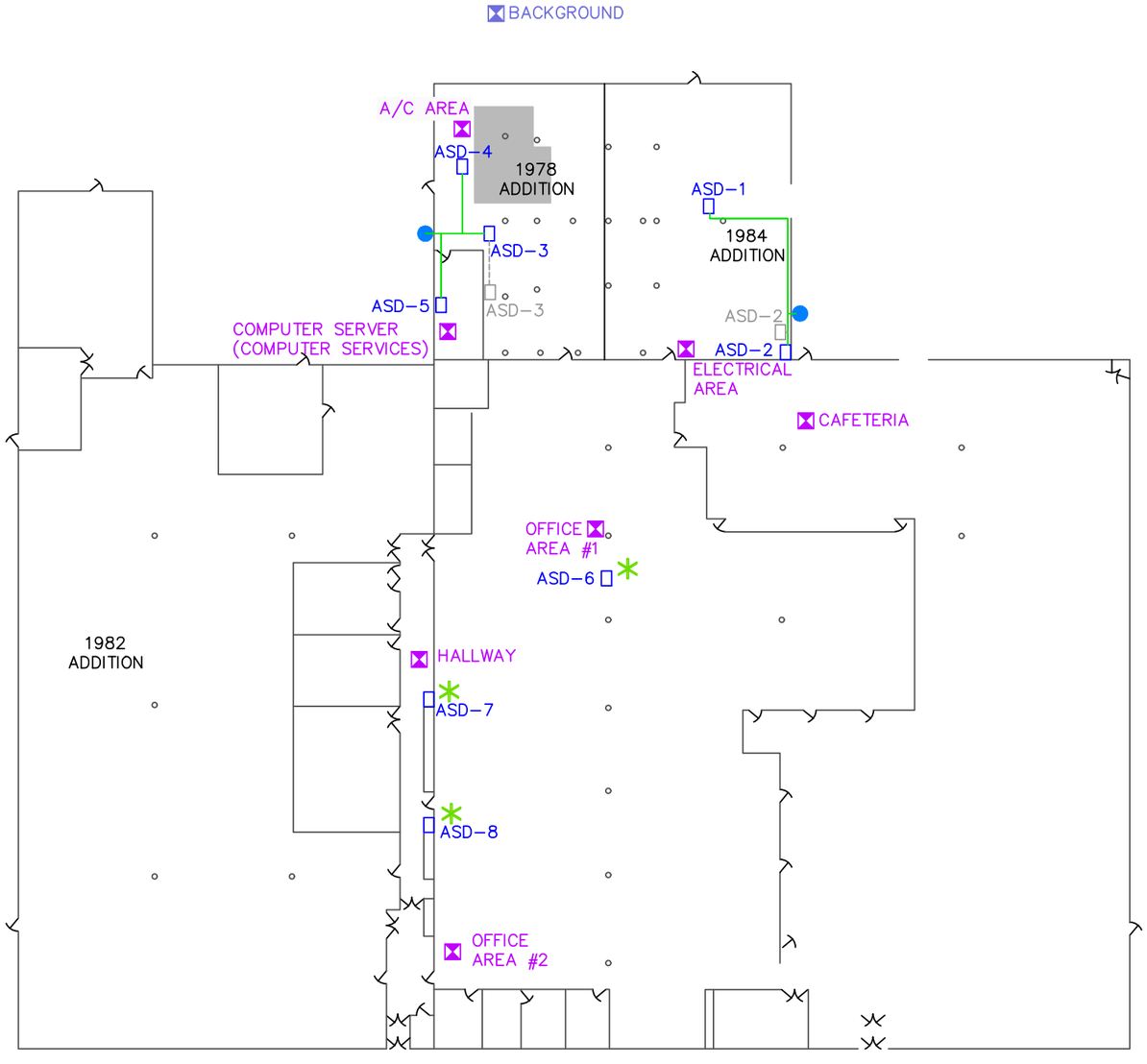
APPROXIMATE SCALE

FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK

DEED NOTICE AND SOIL CAP SYSTEM AREAS

VERINA Engineering, P.C.

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N

EXPLANATION

- EXISTING SUB-SLAB DEPRESSURIZATION POINT LOCATION
- EXISTING ASD PIPING RUN
- PREVIOUS SUB-SLAB DEPRESSURIZATION POINT LOCATION
- PREVIOUS ASD PIPING RUN
- EXTERIOR FAN AND EXHAUST LOCATION
- VERTICAL BUILDING POST
- INACCESSIBLE AREA
- INDOOR AIR SAMPLING LOCATION AND DESIGNATION
- AMBIENT (OUTDOOR) AIR SAMPLING LOCATION AND DESIGNATION
- DEDICATED FAN LOCATED ON RISER PIPE

SOURCE:
BUILDING LAYOUT DIGITIZED FROM PHOTOCOPY OF DRAWING FAXED FROM UNIVERSAL INSTRUMENTS CORPORATION FACILITIES DEPARTMENT.
NO FILE NAME OR SCALE PROVIDED.

DRAWING NOT TO SCALE

FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK

ASD SYSTEM LOCATION AND LAYOUT MAP AND INDOOR AIR SAMPLING LOCATIONS

VERINA Engineering, P.C.

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Tables

Table 1 Post-Excavation Soil Samples Exceeding SCOs, Former Dover Electronics Site, Kirkwood, New York

Sample ID	PX-A-6	PX-B-1	PX-B-2	PX-B-3	PX-B-4	**NYSDEC**	**NYSDEC**
Laboratory ID	649463	650174	650175	650176	650177	**Unrestricted Use**	**Industrial Use**
Date Sampled	6/17/2003	6/18/2003	6/18/2003	6/18/2003	6/18/2003	**SCOs**	**SCOs**
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Tetrachloroethene	1.7	6.9	17.0	5.7	30.0	1.3	300

Sample ID	PX-B-5	PX-B-6	PX-B-7	PX-B-8	PX-B-9	**NYSDEC**	**NYSDEC**
Laboratory ID	650178	650179	650180	650181	650182	**Unrestricted Use**	**Industrial Use**
Date Sampled	6/18/2003	6/18/2003	6/18/2003	6/18/2003	6/18/2003	**SCOs**	**SCOs**
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1,1-Dichloroethene				1.4		0.33	1000
Tetrachloroethene	5.7	120.0 D	13.0	5	52.0 D	1.3	300

Sample ID	PX-B-10	PX-E-1	PX-E-2	PX-E-3	PX-E-8	**NYSDEC**	**NYSDEC**
Laboratory ID	650183	649727	649730	649731	649739	**Unrestricted Use**	**Industrial Use**
Date Sampled	6/18/2003	6/17/2003	6/17/2003	6/17/2003	6/17/2003	**SCOs**	**SCOs**
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Tetrachloroethene	7.7	5.4	4.9	6.4	2.7	1.3	300

Sample ID	PX-E-11	PX-E-12	PX-A1-3	PX-A1-5	PX-C-7	**NYSDEC**	**NYSDEC**
Laboratory ID	653667	653668	649748	651555	650565	**Unrestricted Use**	**Industrial Use**
Date Sampled	7/1/2003	7/1/2003	6/17/2003	6/24/2003	6/19/2003	**SCOs**	**SCOs**
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Tetrachloroethene	14.0	2.0	5.3	18.0	4.7	1.3	300

Sample ID	PX-C-8	PX-C-11	PX-D-2	PX-D-3	PX-D-4	**NYSDEC**	**NYSDEC**
Laboratory ID	650566	652398	651154	651155	651156	**Unrestricted Use**	**Industrial Use**
Date Sampled	6/19/2003	6/26/2003	6/23/2003	6/23/2003	6/23/2003	**SCOs**	**SCOs**
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Tetrachloroethene	1.9	1.6	4.6	17.0	2.8	1.3	300

Sample ID	PX-D-6	PX-D-7	PX-D-14			**NYSDEC**	**NYSDEC**
Laboratory ID	651158	651159	652408			**Unrestricted Use**	**Industrial Use**
Date Sampled	6/23/2003	6/23/2003	6/26/2003			**SCOs**	**SCOs**
Units	mg/kg	mg/kg	mg/kg			mg/kg	mg/kg
Tetrachloroethene	3.5	5.3	86.0			1.3	300

Notes:

ND = Not detected

mg/kg = Milligrams per kilogram

NYSDEC = New York State Department of Environmental Conservation

SCOs = Soil Cleanup Objectives (6 NYCRR Part 375)

All samples collected by Blasland, Bouck & Lee, Inc. and analyzed by Columbia Analytical Services of Rochester, New York.

Table 2 Monitoring Well Construction Details, Former Dover Electronics Site, Kirkwood, New

Monitoring Well/Point ID	Top of Casing (ft, MSL)	Screened Interval (ft, bgs)	Well Diameter (in.)	Water Bearing Unit
MW-2	863.28	5-15	2	Shallow
MW-3	859.16	5-15	2	Shallow
MW-5	864.68	5-20	2	Shallow
MW-6	863.67	15-35	2	Intermediate
MW-7A	882.74	7-17	2	Shallow
MW-8	899.21	30-60	2	Intermediate
MW-9	923.94	30-60	2	Shallow
MW-11	918.87	52-62	2	Intermediate
MW-12	912.31	63-73	2	Intermediate
MW-13	912.14	39-49	2	Shallow
MW-14	915.40	62-72	2	Intermediate
MW-15	899.38	36-46	2	Shallow
MW-16	878.87	18-28	2	Shallow
MW-17	859.29	8-18	2	Shallow
MW-18	857.34	8-18	2	Shallow
MW-19	859.59	8-18	2	Shallow
MW-21	883.22	31-41	2	Intermediate
MW-22	861.62	17-22	2	Intermediate
MW-23	916.62	40.5-50.5	2	Shallow
MW-24	907.66	35-45	2	Shallow
MW-25R	856.91	34-39	2	Intermediate
MW-26	859.04	22.5-27.5	2	Intermediate
MW-27	860.01	16.5-26.5	2	Shallow
MW-28	859.09	15-25	2	Shallow
MW-29*	917.36	39-49	2	Shallow
MW-30	857.69	15-25	2	Shallow
MW-31*	856.90	13-23	2	Shallow
MW-32	861.18	15.1-25.1	2	Shallow
MW-33	863.64	15-25	2	Shallow
MW-34***	857.03	53-58	2	Deep
MW-35*	856.89	32-37	2	Intermediate
MW-36	857.19	14-24	2	Shallow
MW-37	857.71	31-36	2	Intermediate
MW-38	862.70	20-25	2	Intermediate
MW-39	857.74	42-47	2	Intermediate
MP-1	912.63	31-41	1	Shallow
MP-2	911.00	34-44	1	Shallow
MP-3D	910.59	46-56	1	Intermediate
MP-4	883.65	17-27	1	Shallow
MP-5	881.66	14-24	1	Shallow
MP-6S	875.67	14-24	1	Shallow
MP-6D	873.83	39-49	1	Intermediate
MP-8S	857.40	13-23	1	Shallow
MP-8D	857.20	44-54	1	Intermediate
MP-11	875.80	20-30	2	Shallow
MP-12	876.60	15-25	2	Shallow
MP-13	884.30	15-25	2	Shallow
MP-14	867.80	15-25	2	Shallow
IJ-1	-	15-25	6	Shallow
IJ-2	908.9	30-45	6	Shallow
IJ-3	909.4	30-45	6	Shallow
IJ-4	-	10-25	6	Shallow
IJ-5	-	10-25	6	Shallow
IJ-6	-	10-20, 30-40	6	Shallow-Intermediate
IJ-7	909.00	30-45	6	Shallow
IJ-8	909.20	30-45	6	Shallow
IJ-9	909.50	30-45	6	Shallow
IJ-10	880.70	10-25	6	Shallow

Notes:

-: Not available

ft, MSL = Feet above mean sea level

ft, bgs = Feet below ground surface

in. = Inches

Gray shading indicates well has been abandoned.

Appendices

Appendix A

Site Contact Information	
Contact	**Phone Number / E-Mail Address**
Property Owner: LDCS, LLC Contact: Lisa Babcock	(607) 754-7472 accounting@mmcweb.com
On-Site Access Coordination: Modern Marketing Concepts, Inc. Contact: Joe Fiacco	(607) 761-6482 jfiacco@mmcglobal.com
Responsible Party: Dover Corporation Contact: Maria Post	(630) 743-5051 mpost@dovercorp.com
Responsible Party Engineer: D. Robert Gan, Ph.D., P.E. Verina Engineering, P.C.	(908) 864-4400 rgan@vcg-llc.com
NYSDEC: Jenelle Gaylord NYSDEC – Project Manager	(518) 402-9791 jenelle.gaylord@dec.ny.gov
NYSDEC: Kelly Lewandowski NYSDEC- Site Control	(518) 402-9553 Kelly.lewandowski@dec.ny.gov
NYSDEC: Harry Warner NYSDEC – Regional HW Engineer	(315) 426-7519 Harry.warner@dec.ny.gov

Responsibilities of Owner and Remedial Party

The responsibilities for implementing the Site Management Plan ("SMP") for the former Dover Electronics site (the "site"), number 7-04-026, are divided between the site owner(s) and a Remedial Party, as defined below. The owner(s) is/are currently listed as:

LDCS, LLC (the "owner")
Contact: Lisa Babcock
Address: 29 Industrial Park Drive
Binghamton, New York 13904

Solely for the purposes of this document and based upon the facts related to a particular site and the remedial program being carried out, the term Remedial Party ("RP") refers to any of the following: certificate of completion holder, volunteer, applicant, responsible party, and, in the event the New York State Department of Environmental Conservation ("NYSDEC") is carrying out remediation or site management, the NYSDEC and/or an agent acting on its behalf. The RP is:

Dover Corporation (the "Remedial Party")
Contact: Maria Post
Address: 3005 Highland Parkway
Suite 200
Downers Grove, Illinois 60515

Nothing on this page shall supersede the provisions of an Environmental Easement, Consent Order, Consent Decree, agreement, or other legally binding document that affects rights and obligations relating to the site.

Site Owner's Responsibilities:

1. The owner shall follow the provisions of the SMP as they relate to future construction and excavation at the site.

2. In accordance with a periodic time frame determined by the NYSDEC, the owner shall periodically certify, in writing, that all Institutional Controls set forth in the Deed Restriction remain in place and continue to be complied with. The owner shall provide a written certification to the RP, upon the RP's request, in order to allow the RP to include the certification in the site's Periodic Review Report (PRR) certification to the NYSDEC.

3. In the event the site is delisted, the owner remains bound by the Deed Restriction and shall submit, upon request by the NYSDEC, a written certification that the Deed Restriction are is in place and has been complied with.

4. The owner shall grant access to the site to the RP and the NYSDEC and its agents for the purposes of performing activities required under the SMP and assuring compliance with the SMP.

5. The owner is responsible for assuring the security of the remedial components located on its property to the best of its ability. In the event that damage to the remedial components or vandalism is evident, the owner shall notify the site's RP and the NYSDEC in accordance with the timeframes indicated in Section 1.3 - Notifications.

6. In the event some action or inaction by the owner adversely impacts the site, the owner must notify the site's RP and the NYSDEC in accordance with the time frame indicated in Section 1.3 - Notifications and coordinate the performance of necessary corrective actions with the RP.

7. The owner must notify the RP and the NYSDEC of any change in ownership of the site property (identifying the tax map numbers in any correspondence) and provide contact information for the new owner of the site property. 6 NYCRR Part contains notification requirements applicable to any construction or activity changes and changes in ownership. Among the notification requirements is the following: Sixty days prior written notification must be made to the NYSDEC. Notification is to be submitted to the NYSDEC Division of

Environmental Remediation's Site Control Section. Notification requirements for a change in use are detailed in Section 2.4 of the SMP. A 60-Day Advance Notification Form and Instructions are found at *http://www.dec.ny.gov/chemical/76250.html.*

8. Until such time as the NYSDEC deems the vapor mitigation system unnecessary, the owner shall operate the system, pay for the utilities for the system's operation, and report any maintenance issues to the RP and the NYSDEC.

9. In accordance with the tenant notification law, within 15 days of receipt, the owner must supply a copy of any vapor intrusion data, that is produced with respect to structures and that exceeds NYSDOH or OSHA guidelines on the site, whether produced by the NYSDEC, RP, or owner, to the tenants on the property. The owner must otherwise comply with the tenant and occupant notification provisions of Environmental Conservation Law Article 27, Title 24.

Remedial Party Responsibilities

1. The RP must follow the SMP provisions regarding any construction and/or excavation it undertakes at the site.

2. The RP shall report to the NYSDEC all activities required for remediation, operation, maintenance, monitoring, and reporting. Such reporting includes, but is not limited to, periodic review reports and certifications, electronic data deliverables, corrective action work plans and reports, and updated SMPs.

3. Before accessing the site property to undertake a specific activity, the RP shall provide the owner advance notification that shall include an explanation of the work expected to be completed. The RP shall provide to (i) the owner, upon the owner's request, (ii) the NYSDEC, and (iii) other entities, if required by the SMP, a copy of any data generated during the site visit and/or any final report produced.

4. If the NYSDEC determines that an update of the SMP is necessary, the RP shall update the SMP and obtain final approval from the NYSDEC. Within 5 business days after NYSDEC approval, the RP shall submit a copy of the approved SMP to the owner(s).

5. The RP shall notify the NYSDEC and the owner of any changes in RP ownership and/or control and of any changes in the party/entity responsible for the operation, maintenance, and monitoring of and reporting with respect to any remedial system (Engineering Controls). The RP shall provide contact information for the new party/entity. Such activity constitutes a Change of Use pursuant to 375-1.11(d) and requires 60-days prior notice to the NYSDEC. A 60-Day Advance Notification Form and Instructions are found at *http://www.dec.ny.gov/chemical/76250.html.*

6. The RP shall notify the NYSDEC of any damage to or modification of the systems as required under Section 1.3 - Notifications of the SMP.

7. The RP is responsible for the proper maintenance of any installed vapor intrusion mitigation systems associated with the site, as required in Appendix E (Operation, Monitoring and Maintenance Manual) of the SMP.

8. The RP is responsible for the proper monitoring and maintenance of any installed drinking water treatment system associated with the site, as required in Appendix E (Operation, Monitoring and Maintenance Manual).

9. Prior to a change in use that impacts the remedial system or requirements and/or responsibilities for implementing the SMP, the RP shall submit to the NYSDEC for approval an amended SMP.

10. Any change in use, change in ownership, change in site classification (*e.g.*, delisting), reduction or expansion of remediation, and other significant changes related to the site may result in a change in responsibilities and, therefore, necessitate an update to the SMP and/or updated legal documents. The RP shall contact the Department to discuss the need to update such documents.

Change in RP ownership and/or control and/or site ownership does not affect the RP's obligations with respect to the site unless a legally binding document executed by the NYSDEC releases the RP of its obligations.

Future site owners and RPs and their successors and assigns are required to carry out the activities set forth above.

Appendix B

EXCAVATION WORK PLAN

Former Dover Electronics Site
Kirkwood, New York
NYSDEC Site No. 7-04-026






VERINA Engineering, P.C.

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FIGURES

Figure 1 – Site Map with Truck Transport Route

1.0 – PURPOSE

The intent of this Excavation Work Plan (EWP) is to outline the procedures required to be implemented in the event the cover system is breached, penetrated or temporarily removed, or any underlying remaining contamination is disturbed. Procedures for the inspection of this cover are provided in the Monitoring and Sampling Plan included in the Site Management Plan (SMP). Any work conducted pursuant to the EWP must also be conducted in accordance with the procedures defined in the Health and Safety Plan (HASP) and associated Community Air Monitoring Plan (CAMP) prepared for the site.

2.0 – INTRODUCTION

2.1 – GENERAL

The Former Dover Electronics Site is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. The Scope of Work at this site includes monthly active subslab depressurization (ASD) system inspections, monthly in-situ chemical oxidation (ISCO) injections, monthly ISCO system inspection, monthly soil cap system inspection, annual groundwater monitoring and annual indoor air sampling.

2.2 – NOTIFICATIONS

At least 15 days prior to the start of any activity that is anticipated to encounter remaining contamination, the site owner or their representative will notify the New York State Department of Environmental Conservation (NYSDEC). Table 1 below includes contact information for the above notification. The information on this table will be updated as necessary to provide accurate contact information. A full listing of site-related contact information is provided in Appendix A of the SMP.

Table 1: Contact Information

Jenelle Gaylord NYSDEC – Project Manager	(518) 402-9791 jenelle.gaylord@dec.ny.gov
Harry Warner NYSDEC – Regional HW Engineer	(315) 426-7519 Harry.warner@dec.ny.gov
Kelly Lewandowski NYSDEC- Site Control	(518) 402-9553 Kelly.lewandowski@dec.ny.gov

* Note: Notifications are subject to change and will be updated as necessary.

This notification will include:

- A detailed description of the work to be performed, including the location and areal extent of excavation, plans/drawings for site re-grading, intrusive elements or utilities to be installed below the soil cover, estimated volumes of contaminated soil to be excavated and any work that may impact an engineering control;
- A summary of environmental conditions anticipated to be encountered in the work areas, including the nature and concentration levels of contaminants of concern, potential presence of grossly contaminated media, and plans for any pre-construction sampling;
- A schedule for the work, detailing the start and completion of all intrusive work;
- A summary of the applicable components of this EWP;

- A statement that the work will be performed in compliance with this EWP and 29 CFR 1910.120;
- A copy of the contractor's HASP, in electronic format, if it differs from the HASP provided in Appendix C of the SMP;
- Identification of disposal facilities for potential waste streams; and
- Identification of sources of any anticipated backfill, along with all required chemical testing results.

3.0 – SOIL SCREENING METHODS

Soil screening will be performed by the Responsible Party's (RP's) Environmental Consultant (EC) using a photoionization detector (PID) during all excavations into known or potentially contaminated material (remaining contamination). Soil screening will be performed when invasive work is done and will include all excavation and invasive work performed during development, such as excavations for foundations and utility work, after issuance of the Certificate of Completion (COC).

Based on previous environmental data and screening results, soils will be segregated into material that requires off-site disposal and material that requires testing to determine if the material can be reused on-site as soil beneath a cover or if the material can be used as cover soil. Further discussion of off-site disposal of materials and on-site reuse is provided in Section 5.0 of this EWP.

4.0 – SOIL STAGING METHODS

Soil stockpiles will be continuously encircled with a berm and/or silt fence. Hay bales will be used as needed near catch basins, surface waters and other discharge points. Stockpiles will be kept on top of and covered at all times with appropriately anchored tarps. Stockpiles will be routinely inspected and damaged tarp covers will be promptly replaced. Stockpiles will be inspected at a minimum once each week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the site and available for inspection by the NYSDEC.

5.0 – EXCAVATION

5.1 – MATERIALS EXCAVATION AND LOAD OUT

5.1.1 – General

The EC will oversee all invasive work and the excavation and load-out of all excavated material. The owner of the property and RP (if applicable) and its contractors are responsible for safe execution of all invasive and other work performed under this Plan. The presence of utilities and easements on the site will be investigated. The EC will determine whether a risk or impediment to the planned work under the SMP is posed by utilities or easements on the site.

All transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Loaded vehicles leaving the site will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements). Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used.

5.1.2 – Truck Wash

A truck wash will be operated on-site, as appropriate. All outbound trucks will be washed at the truck wash before leaving the site until the activities performed under this section are complete. Truck wash waters will be collected and disposed of off-site in an appropriate manner. Locations where vehicles enter or exit the site shall be inspected daily for evidence of off-site soil tracking. The EC will be responsible for ensuring that all egress points for truck and equipment transport from the site are clean of dirt and other materials derived from the site during intrusive excavation activities. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to site-derived materials.

5.1.3 – Truck Transport Routes

Truck transport routes are as follows: When leaving the site from any of the 4 exit points, head NW on Industrial Park Rd (or CR-181) towards Colesville Rd. To head northbound on I-81 and westbound on I-86 or NY-17, turn right onto Colesville Rd. Then, turn right onto Corporate Rd. From Corporate Rd, turn right onto the on-ramp for I-81N, NY-17W, and I-86W. Alternatively, to head southbound on I-81 and eastbound on I-86 or NY-17, turn left onto Colesville Rd. From Colesville Rd, turn left onto US-11 S. Next, bear left off of US-11 S and continue until exits are presented towards I-81, I-86, and NY-17. The map that correlates with the instructions above can be found in Figure 1 of this Appendix.
All trucks loaded with site materials will exit the vicinity of the site using only these approved truck routes. These are the most appropriate routes and take into account:

- limiting transport through residential areas and past sensitive sites;
- use of city mapped truck routes;
- prohibiting off-site queuing of trucks entering the facility;
- limiting total distance to major highways;
- promoting safety in access to highways; and
- overall safety in transport;

Trucks will be prohibited from stopping and idling in the neighborhood outside the project site.

5.2 – EXCAVATED MATERIALS

All material excavated and removed from the site will be treated as contaminated and regulated material and will be transported and disposed in accordance with all local, State (including 6NYCRR Part 360) and Federal regulations. If disposal of material from this site is proposed for unregulated off-site disposal (i.e. clean soil removed for development purposes), a formal request with an associated plan will be made to the NYSDEC. Unregulated off-site management of materials from this site will not occur without formal NYSDEC approval.

Off-site disposal locations for excavated soils will be identified in the pre-excavation notification. This will include estimated quantities and a breakdown by class of disposal facility if appropriate, i.e. hazardous waste disposal facility, solid waste landfill, petroleum treatment facility, C/D recycling facility, etc. Actual disposal quantities and associated documentation will be reported to the NYSDEC in the Periodic Review Report (PRR). This documentation will include: waste profiles, test results, facility acceptance letters, manifests, bills of lading and facility receipts.

Non-hazardous historic fill and contaminated soils taken off-site will be handled, at minimum, as a Municipal Solid Waste per 6NYCRR Part 360-1.2. Material that does not meet Unrestricted SCOs is prohibited from being taken to a New York State recycling facility (6NYCRR Part 360-16 Registration Facility).

The EC will ensure that procedures defined for materials reuse in the SMP are followed and that unacceptable material does not remain on-site. Contaminated on-site material, including historic fill and contaminated soil, that is acceptable for reuse on-site will be placed below the demarcation layer or impervious surface, and will not be reused within a cover soil layer, within landscaping berms, or as backfill for subsurface utility lines. Any demolition material proposed for reuse on-site will be sampled for asbestos and the results will be reported to the NYSDEC for acceptance. Concrete crushing or processing on-site will not be performed without prior NYSDEC approval. Organic matter (wood, roots, stumps, etc.) or other solid waste derived from clearing and grubbing of the site will not be reused on-site.

6.0 – FLUIDS MANAGEMENT

All liquids to be removed from the site, including but not limited to, excavation dewatering, decontamination waters and groundwater monitoring well purge and development waters, will be handled, transported and disposed in accordance with applicable local, State, and Federal regulations. Dewatering, purge and development fluids will not be recharged back to the land surface or subsurface of the site, and will be managed off-site, unless prior approval is obtained from NYSDEC. Discharge of water generated during large-scale construction activities to surface waters (i.e. a local pond, stream or river) will be performed under a State Pollutant Discharge Elimination System (SPDES) permit.

7.0 – BACKFILL FROM OFF-SITE SOURCES

All materials proposed for import onto the site will be approved by the qualified environmental professional and will be in compliance with provisions in this SMP prior to receipt at the site. A Request to Import/Reuse Fill or Soil form, which can be found at HTTP://WWW.DEC.NY.GOV/REGULATIONS/67386.HTML, will be prepared and submitted to the NYSDEC project manager allowing a minimum of 5 business days for review. Additionally, imported soil, as definited in Table 5.4(e)10 in DER-10, will be tested for VOCs, SVOCs, inorganics, pesticides, and PCBs and as requested by the NYSDEC project manager.

All imported soils will meet the backfill and cover soil quality standards established in 6NYCRR 375-6.7(d). All backfill used at the Site will be consisted with the backfill requirements provided in DER-10. Soils that meet 'exempt' fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this site, will not be imported onto the site without prior approval by NYSDEC. Solid waste will not be imported onto the site.

Trucks entering the site with imported soils will be securely covered with tight fitting covers. Imported soils will be stockpiled separately from excavated materials, and will be placed on top of and covered with plastic sheeting to prevent dust releases. Soil stockpiles should not be more than six (6) feet high to allow them to be easily covered.

8.0 – SOIL CAP RESTORATION

After the completion of soil removal and any other invasive activities the cover system will be restored in a manner that complies with the Record of Decision and the Soils Management Plan. The existing soil cap system is comprised of a minimum of clean native and/or imported fill covered by 4 to 6 inches of asphalt base and a 2-inch thick layer of asphalt. The demarcation layer will be replaced to provide a visual reference to the top of the remaining contamination zone, the zone that requires adherence to special conditions for disturbance of remaining contaminated soils defined in this SMP. If the type of cover system changes from that which exists prior to the excavation (i.e., a soil cover is replaced by asphalt), this will constitute a modification of the cover element of the remedy and the upper surface of the remaining contamination. A figure showing the modified surface will be included in the subsequent PRR and in an updated SMP.

9.0 – STORMWATER POLLUTION PREVENTION

Barriers and hay bale checks will be installed and inspected once a week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the site and available for inspection by the NYSDEC. All necessary repairs shall be made immediately. Accumulated sediments will be removed as required to keep the barrier and hay bale check functional. All undercutting or erosion of the silt fence toe anchor shall be repaired immediately with appropriate backfill materials. Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering. Erosion and sediment control measures identified in the SMP shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Silt fencing or hay bales will be installed around the entire perimeter of the construction area.

10.0 – EXCAVATION CONTINGENCY PLAN

If underground tanks or other previously unidentified contaminant sources are found during post-remedial subsurface excavations or development related construction, excavation activities will be suspended until sufficient equipment is mobilized to address the condition. Sampling will be performed on product, sediment and surrounding soils, etc. as necessary to determine the nature of the material and proper disposal method. Chemical analysis will be performed for a full list of analytes (TAL metals; TCL volatiles and semi-volatiles, TCL pesticides and PCBs), unless the site history and previous sampling results provide a sufficient justification to limit the list of analytes. In this case, a reduced list of analytes will be proposed to the NYSDEC for approval prior to sampling.

Identification of unknown or unexpected contaminated media identified by screening during invasive site work will be promptly communicated by phone to NYSDEC's Project Manager. Reportable quantities of petroleum product will also be reported to the NYSDEC spills hotline. These findings will be also included in the PRR.

11.0 – COMMUNITY AIR MONITORING PLAN

A CAMP has been created to address the community health and safety which identifies measures and/or actions to ensure that the public living and working near the Site are protected from exposure to site contaminants during intrusive activities and/or remedial actions. It is proposed that a minimum of three temporary monitoring stations will be positioned around the intrusive activity work areas, consisting of an upwind and two downwind locations on both sides of the work area. The locations of the air monitoring stations will depend on where the work area is located, and will be adjusted on a daily or more frequent basis based on actual wind directions to provide an upwind and at least two downwind monitoring stations.

Per the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan, a CAMP requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. Because ground intrusive activities (e.g. soil excavation and handling, trenching, and well installations) will be conducted during the construction, continuous monitoring will be required for all ground intrusive activities. The following sections describe the specific monitoring procedures for particulates and VOCs.

11.1 – PARTICULATE MONITORING

The particulate monitoring will be conducted during all ground intrusive activities. The monitoring will be performed continuously using both real-time monitoring equipment and visual observations. At each monitoring station, monitoring equipment capable of measuring particulate matter smaller than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes or less, will be set up at heights approximately 4 feet to 5 feet above land surface (i.e., the breathing zone). The equipment will also be equipped with an audible alarm to indicate exceedance of the action level. An audible alarm on the downwind particulate monitoring device will be set at 100 micrograms per cubic meter ($\mu g/m^3$) above the background level (i.e., the upwind location). Upwind concentrations will be measured at the start of each workday and periodically throughout the day to establish background conditions.

The wind direction will be recorded to ensure that CAMP equipment is located appropriately based upon the wind direction. The particulate monitoring equipment will be calibrated at the start of each day and throughout the day if it is necessary.

The monitoring response levels and actions are summarized below.

- If the downwind PM-10 particulate level is 100 $\mu g/m^3$ greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques shall be employed. Work may continue with dust suppression techniques, provided that downwind PM-10 particulate 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.

- After implementation of dust suppression techniques, if downwind PM-10 particulate levels are greater than 150 $\mu g/m^3$ above the upwind level for 15-minute average, work must be stopped and the activities shall be reevaluated. Work can resume provided that dust suppression techniques and/or other control measures reduce the downwind PM-10 particulate level to within 150 $\mu g/m^3$ of the upwind level successfully and prevent visible dust migration.

- There may be situations where visible dust is generated by excavation activities and migrates to downwind locations but is not detected by the monitoring equipment at or above the action levels. Therefore, if visible dust is observed leaving the working area, dust suppression techniques will be employed.

The locations of monitoring equipment and all air monitoring data will be recorded in the onsite files and will be available for NYSDEC and NYSDOH personnel to review.

11.2 – VOLATILE ORGANIC COMPOUND MONITORING

VOCs will be monitored at the downwind perimeter of the immediate work area on a continuous basis. The VOC monitoring component of the CAMP will only be implemented at the work areas that are known or suspected to contain VOCs. Upwind concentrations will be measured at the start of each workday and periodically thereafter (not less than three times per day) to establish background conditions. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment (An RAE Systems MiniRAE 2000 VOC monitor using a PID or equivalent) will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the response levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities in the area of concern must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind perimeter of the work area or half the distance to the nearest potential receptor is below 5 ppm over background for the 15-minute average.

- If the organic vapor level is more than 25 ppm at the perimeter of the work area, activities must be shutdown.

The locations of monitoring equipment and all air monitoring data will be recorded in the onsite files and will be available for NYSDEC and NYSDOH personnel to review. Exceedances of action levels listed in the CAMP will be reported to NYSDEC and NYSDOH Project Managers.

12.0 – CONTROL PLANS

12.1 – ODOR CONTROL PLAN

This odor control plan is capable of controlling emissions of nuisance odors off-site [and on-site, if there are residents or tenants on the property]. Specific odor control methods to be used on a routine basis will include oxidation of odors, absorption, use of odor neutralizers, sanitation, and cleaning and scrubbing when possible. If nuisance odors are identified at the site boundary, or if odor complaints are received, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. NYSDEC and NYSDOH will be notified of all odor events and of any other complaints about the project. Implementation of all odor controls, including the halt of work, is the responsibility of the remedial party's Remediation Engineer, and any measures that are implemented will be discussed in the PRR.

All necessary means will be employed to prevent on- and off-site nuisances. At a minimum, these measures will include:

- limiting the area of open excavations and size of soil stockpiles;
- shrouding open excavations with tarps and other covers; and
- using foams to cover exposed odorous soils. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include:
- direct load-out of soils to trucks for off-site disposal; use of chemical odorants in spray or misting systems; and,
- use of staff to monitor odors in surrounding neighborhoods.

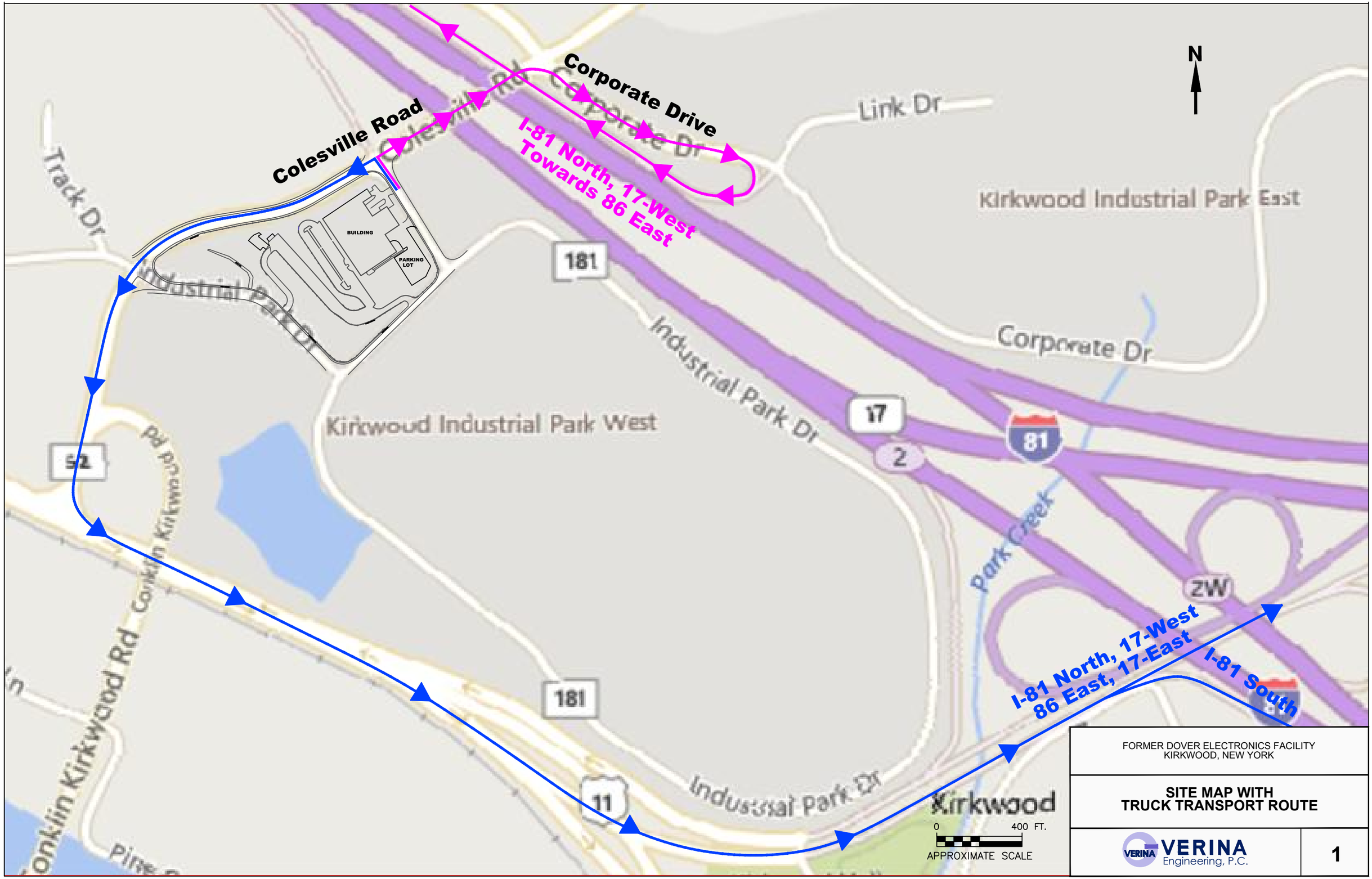
If nuisance odors develop during intrusive work that cannot be corrected, or where the control of nuisance odors cannot otherwise be achieved due to on-site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering the excavation and handling areas in a temporary containment structure equipped with appropriate air venting/filtering systems.

12.2 – DUST CONTROL PLAN

A dust suppression plan that addresses dust management during invasive on-site work will include, at a minimum, the items listed below:

- Dust suppression will be achieved through the use of a dedicated on-site water truck for road wetting. The truck will be equipped with a water cannon capable of spraying water directly onto off-road areas including excavations and stockpiles.
- Clearing and grubbing of larger sites will be done in stages to limit the area of exposed, vegetated soils vulnerable to dust production.
- Gravel will be used on roadways to provide a clean and dust-free road surface.
- On-site roads will be limited in total area to minimize the area required for water truck sprinkling.

Figures



FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK

SITE MAP WITH TRUCK TRANSPORT ROUTE

VERINA Engineering, P.C.

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Appendix C

SITE-SPECIFIC HEALTH AND SAFETY PLAN

Former Dover Electronics Site
Kirkwood, New York
NYSDEC Site No. 7-04-026






VERINA Engineering, P.C.

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ATTACHMENTS

Attachment 1- HASP Acknowledgement Form

Attachment 2- VERINA Tailgate Safety Meeting Checklist

Attachment 3 - Typical Site Control Layout

Attachment 4 - VERINA Incident Report

Attachment 5 - Heat Stress Safety Information

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Attachment 7 - Insect/Arachnid/Snake Safety Information

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Attachment 10 - Emergency Contact Information

Attachment 11- Basic First Aid Procedures

1.0 – GENERAL INFORMATION

1.1 – INTRODUCTION

This Site-Specific Health & Safety Plan (HASP) has been prepared for the use of VERINA Consulting Group, LLC (VERINA) and its employees and supplements the Health and Safety training that each VERINA employee receives. This HASP also identifies the minimum safety requirements for various activities to be performed by VERINA employees. The health and safety guidelines in this Plan were prepared to encompass typically known hazards associated with job sites on a regular basis.

Compliance with this HASP is required by all employees of VERINA.

Assistance in implementing this plan can be obtained from the Project Manager and/or Site Safety Officer. This Plan is not intended to be used by any other contractor or personnel of any such contractor. This Plan may not address the specific health and safety needs or requirements of any other such contractor and its employees.

The content of this HASP may change or undergo revision based upon additional information made available to health and safety (H&S) personnel, monitoring results, or changes in the scope of work. If additional hazards are encountered, the level of personal protection will be evaluated and the Health and Safety Plan will be modified as necessary. Any changes proposed must be reviewed by, and are subject to approval of, the Project Manager.

Always refer to the most current site-specific HASP for each project to properly identify and address specific hazards.

1.2 – GENERAL SITE RESPONSIBILITIES

The general responsibilities for onsite personnel are listed below:

1. Project Manager:
    - Description: Reports to upper-level management, reviews and approves HASP and HASP revisions, has authority to direct emergency response operations, assumes total control over site activities.
    - Responsibilities: Prepares and organizes review of site tasks and scope of work, potential or actual hazards, the health and safety plan, and the field team. Obtains permission for site access from clients, coordinates with appropriate officials, tenants, and subcontractors. Ensures work plan is complete and on schedule. Prepares final incident reports and supporting documentation. Serves as liaison with between client, public, government officials.
    - Required Training/Surveillance: 40-hour HAZWOPER with annual 8-hour refresher training (29 CFR 1910.120), 8-hour HAZWOPER Supervisor training, and medical surveillance participant.
2. Field Supervisor:
    - Description: Responsible for directing field team operations and safety measures.
    - Responsibilities: Drafts HASP, coordinates with field staff to manage and execute field operations and scope of work, enforces safety procedures, coordinates with SSO to

determine personal protective equipment (PPE) levels and appropriate safety measures, documents and maintains field records, reports to project manager.

- Required Training/Surveillance: 40-hour HAZWOPER with annual 8-hour refresher training (29 CFR 1910.120), 8-hour HAZWOPER Supervisor training, and medical surveillance participant

3. Site Safety Officer (SSO):

    - Description: Oversees field team in relation to health and safety protocols.
    - Responsibilities: Implements health and safety measures as prescribed in the HASP, enforces the HASP, conducts initial and daily safety meetings, recommends work stoppage if unsafe conditions are noted, monitors field team for signs of stress or exposure, maintains PPE, knows emergency procedures, routes, and contacts, calls authorities during emergencies, writes up draft incident reports, reports to project manager.
    - Required Training/Surveillance: 40-hour HAZWOPER with annual 8-hour refresher training (29 CFR 1910.120) and medical surveillance participant.

1.3 – SITE-SPECIFIC PERSONNEL - MEDICAL MONITORING

VERINA personnel are enrolled in a medical monitoring program that is in compliance with 29 CFR 1910.120 (f)(2) *et seq*.

1.4 – COVERED TASKS

This Site-Specific Health and Safety Plan address hazards associated with the following activities:

- Soil Cap Monitoring and Maintenance
- ASD System Operation and Maintenance
- Sodium Permanganate Mixing
- Sodium Permanganate AST Refill and Tank Maintenance
- ISCO Manual Injections
- Well Repair and Development
- Groundwater Sampling
- Indoor Air Sampling

2.0 – GENERAL HEALTH AND SAFETY REQUIREMENTS

2.1 – PERSONNEL MEDICAL CLEARANCE

The Former Dover Electronics Site is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. The Scope of Work at the site includes Monthly ASD inspections, monthly ISCO injections, monthly ISCO system inspection, monthly soil cap system inspection, annual groundwater monitoring and annual indoor air sampling.

2.2 – HAZARD TRAINING

All personnel working on-site who have potential exposures to health or safety hazards shall be thoroughly trained as specified in OSHA Regulations 29 CFR 1910.120(e). VERINA personnel also receive hazard specific, technical and craft-related training throughout the year.

At the time of job assignment, special training will be provided to on-site personnel who may be exposed to unique or special hazards not covered by the initial 40-hour basic health and safety course. If unique or special hazards are unexpectedly encountered, specialized training will be provided before work proceeds. VERINA's Project Manager will provide records of training and related certificates upon request and will assure that required training is received by site workers as needed.

2.3 – PERSONAL HYGIENE & SAFETY

Good personal hygiene must be practiced by field personnel to avoid ingesting contaminants. Smoking, eating, drinking, chewing tobacco or toothpicks, applying cosmetics, storing food or food containers, and having open fires will not be permitted within a 50-foot radius from the work area.

2.4 – INITIAL HEALTH AND SAFETY MEETING

The VERINA SSO will hold an initial site safety meeting with all field personnel, both VERINA personnel and subcontractors, before work activities begin at the site. At this meeting, provision and review of the HASP by all personnel will be verified and documented. The VERINA SSO will reiterate important aspects of the HASP, such as chemical hazards, required PPE, safe work procedures, and emergency response protocols. The SSO will also ask all field personnel if they have any questions regarding the HASP or site work and will take the time to thoroughly respond to any such questions. At the conclusion of the meeting, all VERINA personnel will be required to sign the acknowledgement page to indicate compliance with the provisions of the HASP. New workers to the site shall receive a full briefing of the HASP by the SSO, and be required to sign, prior to beginning work. The acknowledgement page is located in Attachment 1 and should not be removed from this document. Additional pages may be added as necessary to accommodate all site workers. Subcontractors and other non-VERINA personnel will be required to sign the Tailgate Safety Meeting Checklist provided in Attachment 2.

2.5 – DAILY SAFETY BRIEFINGS

During field operations, tailgate safety meetings will be held and documented at the start of each day by the VERINA SSO to review and plan specific health and safety aspects of scheduled work. All field personnel who are following this HASP are required to attend these briefings. Potential subjects that may be discussed are: types of hazards; pathways of

exposure; levels of protection; contamination avoidance; prohibitions; work procedures; work zones; emergency response procedures; and, specific on site area/work tasks of concern. Items covered during tailgate safety meetings will be logged on VERINA's Tailgate Safety Meeting Checklist. A copy of this checklist is provided in Attachment 2.

2.6 – CONTROLLED WORK ZONES

Three work zones may be established for each task, including an Exclusion Zone, a Contaminant Reduction Zone (CRZ), and a Support Zone.

- The Exclusion Zone is defined as the area on site where contamination is suspected. This is also the zone where all activities related to site investigation or remediation are taking or will take place.
- The CRZ is defined as the area where equipment and workers are to be decontaminated as they leave the Exclusion Zone. The CRZ will also serve as the area where decontamination of tools and equipment will take place and may be a separate zone as dictated by the SSO.
- The Support Zone is defined as the command area and may serve as a staging and storage area for supplies and chemical storage and handling.

The location and extent of the work zones may be modified as necessary as site investigation or work activities change. For sites that do not require three work zones, the area(s) where work shall be performed shall be called the Exclusion Zone. Keep all non-essential personnel out of the work area and out of the Exclusion Zone.

The boundaries of the Exclusion Zone, CRZ and Support Zone or Work Zone may be marked using cones, caution tape, barricades, or signs. A depiction of a typical site control layout is included as Attachment 3.

2.7 – STOP WORK AUTHORITY

All onsite workers have the right and are encouraged to stop any on-site work whenever they feel conditions are unsafe and to assist in correcting these conditions. Any recognized unsafe conditions should be immediately reported to the SSO. Whenever the SSO determines the workplace conditions present an uncontrolled risk of injury or illness to workers, the SSO will issue a stop-work order and an immediate resolution shall be sought. Upon issuance of a stop-work order, the SSO shall implement corrective action so that operations may be safely resumed. Should the unsafe condition be unable to be corrected immediately, all site work shall be suspended until such time that to the unsafe condition has been resolved. Resumption of safe operations is the primary objective; however, operations shall not resume until the SSO has concurred that workplace conditions meet acceptable safety standards.

2.8 – INCIDENT REPORTING

VERINA's SSO will promptly notify the Project Manager and Field Supervisor of emergencies, accidents and/or injuries (including near-misses) **after** contacting local emergency services, if needed.

A VERINA Health & Safety Incident Report will be filed for any incident involving personnel working at this site. Situations covered by this policy include, but are not limited to, fires, explosions, illnesses, injuries and motor vehicle collisions. These reports must be sent to VERINA's Managing Principal within 24 hours of the incident. All subcontractors will also

receive copies of such reports within 24 hours of the incident. Worker's Compensation Insurance reports for VERINA employees must be filed within 48 hours of each incident or illness that results from work-related activities requiring medical attention beyond first aid. The VERINA Health & Safety Incident Report is included in Attachment 4.

3.0 – HAZARD ANALYSIS

This section presents all assessment of the general, chemical, physical, and biological hazards that may be encountered on a jobsite. It is the employee's responsibility to be aware of the hazards and to implement safe work practices to minimize exposure.

3.1 – PHYSICAL AGENTS

Physical hazards on the jobsite can vary from physical injury from slips, trips, falls, cuts, sprains, etc., while performing field activities in various weather and site conditions, when near heavy equipment, operating machinery and vehicular traffic, to hazards created by the tasks performed. These hazards include the following:

3.1.1 – Temperature Extremes

Many jobsites include outdoor activities, which exposes workers to weather and temperature extremes. Workers should be aware of the potential hazards of working in hot or cold environments and to dress appropriately. Working schedules should be modified to allow for rest breaks. Upon the onset of discomfort due to the heat or cold, onsite workers should take regular five to ten minute breaks. Please note that New Jersey Department of Environmental Protection (NJDEP) statute prohibits idling an engine for more than three minutes. This statute includes the use of a vehicle for the purpose of warming or cooling employees. As such, all VERINA employees and subcontractors should identify a resting place in advance to warm up or cool down.

Hot Temperatures

Heat stress is a significant potential hazard, which is greatly exacerbated with the use of PPE. The potential hazards of working in hot environments include dehydration, sunburn, cramps, heat rash, heat exhaustion, and heat stroke. If onsite workers exhibit symptoms of heat exhaustion or heat stroke, they should seek immediate medical attention. Workers should drink plenty of fluids, apply sunscreen to exposed areas of skin, and take breaks in cool, shady areas. Refer to Attachment 5 for specific information on working safely in hot environments.

Cold Temperatures

Workers may be exposed to the hazards of working in a cold environment. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia, as well as slippery surfaces, brittle equipment, poor judgment, and unauthorized procedural changes. In order to prevent frostbite, hypothermia, trench foot and immersion foot, the workers are responsible for dressing warmly in layers with thick socks, gloves, and appropriate head and face gear. If discomfort continues and the onsite workers start to exhibit the signs of frostbite, hypothermia, trench foot or immersion foot, they should seek immediate medical attention. Refer to Attachment 6 for specific information on working safely in cold environments.

3.1.2 – Weather Hazards

The SSO will be attentive to daily weather forecasts for the project area each morning. Predicted weather conditions of potential field impact are to be included in safety briefings for that day. Changes in the weather should initiate a review and update of planned field activities

as necessary. Weather-related hazards will directly correlate to the type of weather involved. Hot, dry weather may cause greater dust emissions, particularly during intrusive activities. Rain may increase slip/trip hazards, particularly for ground workers.

Severe weather can occur with little warning. Employees will be vigilant for the potentials for storms, lightning, high winds, and flash flood events. Additionally, lightning strikes during electrical storms could also be a potential hazard, especially when working with overhead equipment, such as a drill rig. The following procedures will be implemented once thunder is heard or lightning spotted:

1) If thunder is heard, all site personnel are to be alert for any visible lightning flashes. The SSO will observe the storm front and track the direction it is moving. The SSO will continue to observe the storm front until it passes or until the prevailing direction is determined to be away from the site.

2) If lightning is observed, the SSO is to be notified. When the next lightning flash is observed, a "second" count shall be initiated from the time the lightning is observed until the thunder from the strike is heard.

3) The following action guidelines shall be implemented based on the result of the "second" count:

   10 seconds or more between lightning and thunder: the SSO will continually observe the storm front. If the front is moving away, work may continue. If the front is moving towards the site, the SSO will initially place workers on alert for potential evacuation.

   Less than 10 seconds between lightning and thunder: the SSO will issue a stop-work order and all workers will take shelter (preferably in a closed building). Workers will stay away from trees, utility poles and other tall objects/structures. Work can be re-initiated once the front has passed by and thunder has not been heard for 15 minutes.

4) If lightning is observed and the storm front is moving away from or around the site and is > 20 miles away, work will be permitted to continue. The location of the storm can be confirmed via internet access to a local weather website that has a Doppler radar tracking system.

NOTE: All site operations utilizing tall, and/or metal equipment, such as drilling masts and cranes, shall be discontinued immediately upon the observation of lightning or thunder, and personnel will be directed away from these units. Other site activities can continue based on the steps outlined above.

3.1.3 – Noise Exposure

Noise is a potential hazard associated with the operation of heavy equipment, power tools, pumps, and generators. Hearing protection is required when noise levels exceed the Time Weighted Average of 85 decibels over an 8-hour period. However, workers are encouraged to utilize hearing protection at any point noise levels reach uncomfortable levels. All VERINA employees will have access to proper hearing protection while onsite.

3.1.4 – Hand and Power Tools

In order to complete various tasks on projects, workers may need to utilize hand and/or power tools. The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool itself, fire, and electrocution. Proper personal protective equipment shall be worn while utilizing hand and

power tools. Workers shall inspect all tools prior to use to ensure proper working order. Any tool which exhibits damage, such as (but not limited to) bent or broken components, dull cutting surfaces, broken or missing safety features, and frayed electrical cords shall be taken out of service immediately and replaced.

3.1.5 – Slips, Trips, and Falls

Working in and around the site will pose slip, trip, and fall hazards due to equipment, piping, electrical cords, trenches/excavations, slippery surfaces that may be oil covered, or surfaces that are wet from rain or ice. Good housekeeping at the site must be maintained at all times. Work areas shall be continually policed for identification of unnecessary debris and unused equipment. Workers shall not approach within five feet of excavations which exceed five feet in depth.

3.1.6 – Fires/Explosions

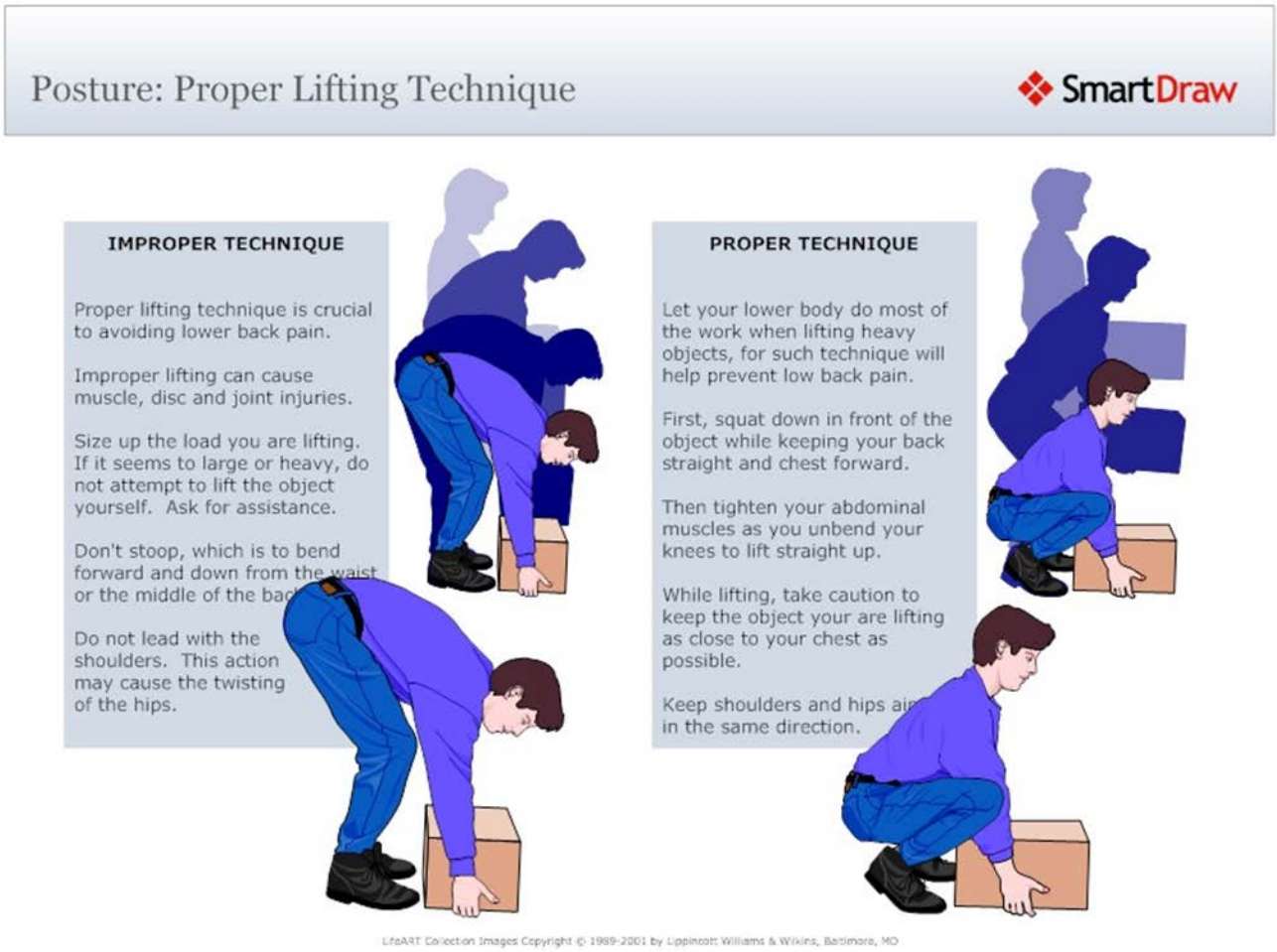
Fires can be prevented by adhering to the following precautions:

- No smoking in the work area;
- No use of flame or spark-producing equipment in the vicinity of flammable/explosive materials or atmospheres;
- Good housekeeping and storage of material;
- Storage of flammable liquids and gases away from oxidizers;
- Shutting off engines while refueling;
- Grounding and bonding metal containers during transfer of flammable liquids;
- Use of UL-approved flammable storage cans;
- Fire extinguishers rated at least 10 pounds ABC located on all heavy equipment, in all vehicles/trailers, and near all hot work activities.

3.1.7 – Material Handling

Manual lifting of heavy objects may be required. Failure to follow proper lifting techniques can result in back injuries and strains. Back injuries are a serious concern as they are the most common workplace injury, often resulting in lost or restricted work times, and long treatment and recovery periods. Proper lifting techniques include lifting with the legs, and not with the back, and requesting assistance with large, heavy, and bulky objects.

Whenever possible, heavy objects should be lifted and moved by mechanical devices 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.



3.1.8 – Working Near Heavy Equipment

Personnel working in the immediate vicinity of heavy equipment (e.g., excavators, loaders, drill rigs, etc.) may encounter physical hazards resulting from contact with equipment. Field personnel should be aware of the presence of these hazards at all times and take appropriate action to avoid them. Due to the limited ability to communicate when wearing respiratory protection, the risk is increased. Workers must be careful to communicate with heavy equipment operators regarding their location, and should maintain a safe distance from operating equipment at all times. Prior to working around heavy equipment, the site personnel will review appropriate hand signals with the operators. On sites where heavy equipment is in operation, all personnel shall wear safety vests to increase visibility. Workers shall also stay out of the swing radius of any rotating machine and remain in full view of the operator. At sites where heavy equipment is operated within confined areas, a designated and dedicated spotter will provide communication to and from the equipment operator regarding the location of all other personnel, equipment, material, and structures.

3.1.9 – Utilities

Prior to the start of any intrusive work, a survey of the location of above-ground and underground utilities and other structures will be completed by the contractor/subcontractor

responsible for completing intrusive activities. No intrusive work shall be conducted within five (5) feet from any marked utility, unless hand cleared first to ensure safety. Workers should also be mindful of the location of manholes, cleanouts, street valves, etc. that represent a buried utility, which may or may not be marked. All personnel should be familiar with the color-coding for each utility type as shown below:

Red	Electric Power Lines, Cables, Conduit & Lighting Cables
Yellow	Gas, Oil, Steam, Petroleum or Gaseous Materials
Orange	Communication, Telephone or Cable TV, Alarm or Signal Lines,
Blue	Potable Water
Green	Sewers and Drain Lines
Purple	Reclaimed Water, Irrigation and Slurry Lines
Pink	Temporary Survey Markings
White	Proposed Excavation

3.1.10 – Vehicular Traffic

Site activities may be conducted in, or near, an active roadway where vehicular and pedestrian traffic will be present. Appropriate precautions to protect on-site workers and civilians shall be used, including the use of cones and/or barricades. All personnel working in or near an active roadway must wear high-visibility safety vests. Personnel shall also be aware of pedestrians and vehicles prior to entering/exiting a site. Police oversight for traffic control should also be considered and employed where prudent or required by local ordinance.

3.1.11 – Buddy System

All field personnel will use the buddy system when working within any controlled work area. Personnel belonging to another organization on-site can serve as “buddies” for VERINA

personnel. Visual contact shall be maintained between buddies at all times, and buddies must observe each other for signs of stress/fatigue/damage in PPE, and for signs of physical or chemical exposure.

3.1.12 – Biological Hazards

During the course of the project, there is a potential for workers to come into contact with biological hazards such as animals, insects, and plants, which may expose workers to skin irritants and blood-borne pathogens

3.1.13 – Animals

During site operations, animals such as dogs, cats, birds, and rodents may be encountered. Workers shall use discretion and avoid all contact with animals. Bites and scratches from dogs and cats can be painful, and if the animal is rabid, the potential for contracting rabies exists. Contact with bird and/or rodent droppings may lead to contracting bacterial and/or viral infections, such as Hantavirus, psittacosis, and histoplasmosis. Proper personal protective equipment, such as disposable gloves and respiratory protection should be worn when contact with these materials is expected and unavoidable.

3.1.14 – Insects

Insects, including bees, wasps, hornets, mosquitoes, spiders, and ticks may be present at the site. Some individuals may have a severe allergic reaction to an insect bite or sting that can result in a life-threatening condition. In addition, mosquito and tick bites can also expose workers to West Nile virus and Lyme disease. To reduce exposure, particularly in rural or wooded environments, workers should be aware not to disturb any hives or nests and should not hit or swat at any stinging insect in flight. Spray insecticides can be used to clear insects from the work area.

To protect against encounters with mosquitoes, ticks, and other pests, workers should apply insect repellant (preferably containing diethyltoluamide, or “DEET”) to exposed, and clothed, areas of the body. Workers should also wear light colored clothing, which will make any insect on his/her body easier to see and remove. Workers should check themselves for ticks regularly when working in a rural/wooded area and immediately upon exiting the work site. Workers who possess a severe allergy to insect bites or stings are responsible for providing their own immediate response medications and be trained in their administration (e.g. epinephrine injections). Refer to Attachment 7 for detailed information on protection from insects.

3.1.15 – Venomous Animals

Some animals have the ability to inject venom. These include various types of spiders, and snakes. The two more venomous spiders likely to be encountered are the Black Widow and Brown Recluse. Both spiders prefer dark conditions. The Black Widow prefers moist conditions, and the Brown Recluse dry. Other spiders possess venom but they are not harmful to humans. Venomous snakes have limited distributions, and generally avoid humans, so in most areas workers are unlikely to encounter them, however, workers should remain aware of snake’s preferred habitats and remain vigilant when venturing into these areas. Venomous snakes native to the northeast region include the Northern Copperhead and the Timber Rattlesnake.

If bitten by any of these animals, special care should be taken to treat the wound as it may lead to complications due to the toxin. A bite from a venomous snake, which may inject varying degrees of toxic venom, should always be considered a medical emergency. Bites from a black widow should also be treated as medical emergencies. All other bites should be reported, proper first aid implemented, and the wound progression tracked. Refer to Attachment 7 for detailed information on protection from venomous animals.

3.1.16 – Plants

Working in rural/wooded areas presents workers with the potential hazard of irritating plants, such as thorn bushes, poison ivy, and poison oak. Workers should be trained to identify these plants and avoid contact with them. Workers should wear long sleeves and long pants when working in rural/wooded areas to reduce exposure. Refer to Attachment 8 for specific information on identifying and minimizing exposure to irritating plants native to the northeast region.

3.1.17 – Chemical Hazards

If hazardous chemicals are to be used, or potentially encountered at the site, workers can be exposed by inhalation, ingestion, or direct contact during activities. The chemical hazards associated with the site will be identified in the site-specific HASP and conveyed to all site workers during safety briefings and tailgate meetings. General steps to avoid exposure to chemicals include:

- Proper storage of chemicals when not in use;
- Maintaining an upwind position;
- Use of personal protective equipment;
- Avoiding direct contact with contaminated media;
- Implementation of monitoring equipment;
- Slow equipment down to prevent dusting;
- Use of water to prevent or minimize the generation of dust;
- Following decontamination procedures; and
- Washing hands prior to eating or using tobacco products.

3.1.18 – Dust and Odor Control

If dust generation is anticipated, specific mitigation controls shall be employed. If dust is observed reaching or approaching the site boundary, activities causing the dust will be immediately stopped. Dust control measures (water spray, soil covers, slower work pace, or change in work activities) will be employed prior to resuming work.

In the event that an unanticipated odor is observed, the SSO will immediately assess site conditions and determine the probable cause or causes. Appropriate odor mitigation measures will be employed. These measures may include covering sediment piles, deploying odor-suppressing foam, implementation of air monitoring or discontinuing activities that are generating the odor.

3.1.19 – Spill Prevention

The following procedures will be used to prevent or contain spills:

- All hazardous material will be stored in appropriate/compatible containers;
- Tops/lids will be placed back on containers immediately after use;
- Containers of hazardous materials will be stored appropriately away from moving equipment.

At least one spill response kit, which will include an appropriately-sized and constructed, empty container, materials to allow for booming or diking the area to minimize the size of the spill, and appropriate clean-up material (i.e. speedy-dri) shall be available at each work site (more as needed).

- All hazardous commodities in use (i.e. fuels, solvents) shall be properly labeled;
- Containers shall only be lifted using equipment specifically manufactured for that purpose.

Complete Safety Data Sheets (SDS) for all hazardous materials to be used or encountered at the site shall be kept in the site-specific Health and Safety Plan, as well as in all chemical storage areas onsite. Workers will be advised to the location of the MSDS and encouraged to review them prior to transporting, handling, or working near hazardous materials. Safety Data Sheets for common materials at VERINA sites are included in Attachment 9.

4.0 – EXPOSURE MONITORING

Regular monitoring of the atmosphere in and around the work area will help to quantitatively determine if the personal protective equipment is adequate to protect personnel and determine if site activities are having an adverse effect on the environment within the immediate vicinity. A proper monitoring program includes the use of specific instruments and the establishment of action levels. Each site-specific Health and Safety Plan will include a monitoring program designed to address the contaminants likely to be encountered at the site, corresponding instrumentation to monitor those contaminants, and action levels for each compound. The SSO will have the authority to establish and adjust the Exclusion Zone, as well as halt all site activities, based on the results to the air monitoring program. The sections below describe general monitoring techniques for key contaminant groups as well as typical action levels and responses based on OSHA-established exposure limits.

4.1 MONITORING EQUIPMENT CALIBRATION AND MAINTENANCE

All monitoring instruments shall be calibrated daily according to the manufacturer's specification. The process, details, and results of the calibrations shall be logged in the field book, along with the make, model, and serial number of each instrument. Calibration checks should also be used at various points throughout the day to ensure accuracy. These checks shall also be performed according to the instrument manufacturer's specifications.

Any instrument which does not calibrate or operate properly must be replaced immediately. Work shall not be conducted unless proper monitoring for all potential contaminants can be implemented.

4.2 DETERMINATION OF BACKGROUND LEVELS

Background levels for each contaminant should be established prior to beginning site activities. The background levels are determined by monitoring the atmosphere upwind of the work area and recording the results. Background levels will be established at the beginning of the work day and checked several throughout the day to account for changes in regional activity and weather/wind patterns.

4.3 VOLATILE ORGANIC COMPOUNDS

The presence of volatile organic compounds will be monitored using a photo-ionization detector (PID). The PID should use the appropriate lamp capable of detecting all VOC compounds which may be encountered during work. PID monitoring will be conducted every 30 minutes, or whenever there is any indication that concentrations have changed (odors, visible gases, appearance of impacted drill cuttings, etc.) since the last regular measurement.

4.4 SEMI-VOLATILE ORGANIC COMPOUNDS, PCBs, PESTICIDES, AND METALS

Personnel can be exposed to the presence of semi-volatile organic compounds (SVOCs), PCBs, pesticides, and metals through airborne dust created during intrusive activities, such as excavations in dry soils. Real-time, airborne dust and particulate readings shall be monitored during these activities. Dust monitors should be employed both in the work area, as well as positions downwind. Readings shall be collected and logged every 30 minutes, or more often if conditions change.

4.5 ACTION LEVELS

Parameter	Location and Interval	Action Level	Response
Hydrocarbons, VOCs, SVOCs	Every 30 minutes in the breathing zone, or whenever conditions change Confined spaces will require initial and continuous monitoring	<1 ppm	Continue Level D work and continued monitoring (not applicable for initial assessment of unknown drums or containers)
		≥1 ppm	Stop work for a period of 10 minutes. If readings return to background, work continues with Level D with monitoring. If readings do not change, don Level C PPE and continue monitoring.
		≥5 ppm	Stop work and contact the PM
Dust, Mist, Aerosols	Every 30 minutes in the breathing zone, or whenever conditions change. In addition, site perimeter monitoring may be initiated based on elevated air monitoring results	<1 mg/m^3	Continue Level D work and continue monitoring
		≥1 mg/m^3	Stop work for a period of 10 minutes. I readings return to background, work continues with Level D with monitoring. If readings do not change, don Level C PPE and continue monitoring. Employ dust suppression activities
		≥3 mg/m^3	Stop work and contact the PM

4.6 SITE-SPECIFIC CONTAMINATION OF CONCERN

Previous environmental investigations have indicated the presence of the following contaminants of concern:

Parameter	CAS Number	Media	Maximum Concentration	Location
Tetrachloroethene (PCE)	127-18-4	Groundwater (GW)	13,000 ug/L	Site Groundwater
Trichloroethene (TCE)	79-01-6	GW	150 ug/L	Site Groundwater
Cis-1,2-Dichloroethene	156-59-2	GW	380 ug/L	Site Groundwater
Trans-1,2-Dichloroethene	156-60-5	GW	9 ug/L	Site Groundwater
Vinyl Chloride	75-01-4	GW	44 ug/L	Site Groundwater

4.7 HAZARDOUS MATERIALS

List any specific hazardous materials which may be used or encountered during site work. Safety Data Sheets included in Attachment 9.

Compound	CAS Number	Location
Acetone	67-64-1	Decon Solutions
Acetylene Gas	74-86-2	Welding/Metal Cutting Setups
Diesel Fuel	68476-34-6	Vehicles; Heavy Equipment; Tanks/Tankers; Spare Containers
No. 2 Fuel Oil	68476-30-2	Tanks, Tanker Trucks; Drums
Gasoline	86290-81-5	Vehicles; Small Equipment; Tanks/Tankers; Spare Containers
Hydrochloric Acid	7647-01-0	Sample Preservation/Lab Bottles
Isobutylene	115-11-7	Calibration Gas Cylinders
n-Hexane	110-54-3	Decon Solutions
Nitric Acid	7697-37-2	Decon Solutions; Sample Preservation/Lab Bottles
Sodium Permanganate	10101-50-5	ISCO Injection Solutions, ISCO Manual Injection Buckets and AST
Sodium Thiosulfate	10102-17-7	Sample Preservation/Lab Bottles, ISCO Neutrailizng Solution

5.0 – PERSONAL PROTECTIVE EQUIPMENT

The purpose of PPE is to provide a barrier, which will shield or isolate individuals from the chemical and/or physical hazards that may be encountered during work activities. The site-specific HASP will list the general requirements for selection and usage of PPE based on the particular hazards likely to be encountered at that particular site. The PPE prescribed in a site-specific HASP will be available to all VERINA field personnel. All workers onsite shall be properly trained in the selection, inspection, use, care, and maintenance of the required PPE. The following requirements will also be met, in accordance with OSHA regulations:

1) Facial hair must not come between the sealing surface of the respirator face piece and the face; facial hair must not interfere with the proper fit and function of the respirator.
2) Contact lenses will not be worn on-site.
3) Eyeglasses must not interfere with the proper fit of PPE such as respirators and goggles.
4) No eating, drinking or smoking will be allowed in any area where respiratory protection is required.

5.1 – GENERAL LEVELS OF PPE

Selection of the PPE will be specified for a given project based on a review of known or suspected hazards, routes of potential exposure (inhalation, skin absorption, ingestion, and skin or eye contact) and the effectiveness of personal protective equipment in providing a barrier to these hazards. In addition, PPE will be selected to match the work requirements and task-specific conditions of the job, and to provide adequate protection without causing unnecessary discomfort or physical impairment to the worker.

All VERINA personnel will wear <u>Level D</u> PPE at this site.

Level D - A work uniform affording minimal protection: used for nuisance contamination only.

1. Nitrile Gloves.
2. Safety glasses or chemical splash goggles.
3. Boots with steel toe.
4. High-visibility safety vest when working near roadways.
5. Tyvek suit and face shield only when filling AST.
6. Hard hat when working with overhead equipment

5.2 – DONNING AND DOFFING PROCEDURES

The following information is to provide field personnel with helpful hints that, when applied, make the donning and doffing of PPE a more safe and manageable task:

- Never cut disposable booties from your feet with basic utility knives. This has resulted in workers cutting through the booty and the underlying sturdy leather work boot, resulting in significant cuts to the legs/ankles. Use a pair of scissors or a package/letter opener (cut above and parallel with the work boot) to start a cut in the edge of the booty, then proceed by manually tearing the material down to the sole of the booty for easy removal.

- When applying duct tape to PPE interfaces (wrist, lower leg, around respirator, etc.) and zippers, leave approximately one inch at the end of the tape to fold over onto itself. This will make it much easier to remove the tape by providing a small tab to grasp while still wearing gloves. Without this fold, trying to pull up the tape end with multiple gloves on may be difficult and result in premature tearing of the PPE.
- Have a "buddy" check your ensemble to ensure proper donning before entering controlled work areas. Without mirrors, the most obvious discrepancies can go unnoticed and may result in a potential exposure situation.
- Never perform personal decontamination with a pressure washer

5.3 – AIR-PURIFYING RESPIRATORS

The use of an Air-Purifying Respirator (APR) may be required during site activities based upon the known and/or potential hazards. All VERINA employees performing work where a respirator may be required shall be trained in the use and care of a respirator and fit tested annually to ensure proper protection of the equipment. It is the employee's responsibility to inspect his/her respirator regularly to ensure proper protection. A seal check should be done upon donning the APR following these steps:

1) Lightly place the palm over the exhalation valve cover. Exhale gently. The body of the respirator should bulge slightly outward from your face. If any leakage is detected around the face seal, readjust the head harness straps and repeat the test until there is no leakage. If leakage is detected other than in the face seal, the condition must be investigated and corrected before another test is made.
2) Next, lightly place the palms or some impervious material, like plastic or plastic wrap over APR. Inhale gently. The APR should collapse against the face.

The respirator must pass the User Seal Check before the respirator is used. The respirator will not furnish protection unless all inhaled air is drawn through suitable cartridges or filters.

VERINA employees must select and use the appropriate purifying cartridge based upon the potential exposure. It is the responsibility of the Project Manager to provide onsite employees with proper respirator cartridges sufficient to protect against all known and potential hazards. The Project Manager will also prepare a change schedule as part of the site-specific HASP which indicates how often cartridges should be replaced. A cartridge's useful service life is defined by how long it provides adequate protection from harmful chemicals in the air. The service life of a cartridge depends upon many factors, including environmental conditions, breathing rate, cartridge filtering capacity, and the amount of contaminants in the air.

5.4 – DECONTAMINATION PROCEDURES

The process of decontamination helps to minimize the risk of exposure by ensuring contaminants are not introduced into areas where unprotected workers are present.

5.4.1 – GENERAL REQUIREMENTS

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities (e.g., avoid sitting or leaning on, walking through, dragging equipment through or over, tracking, or splashing potential or known contaminated/impacted materials, etc.).

All personal decontamination activities shall be performed with an attendant (buddy) to provide assistance to personnel that are performing decontamination activities. Depending on specific site hazards, attendants may be required to wear a level of protection that is equal to the required level in the Exclusion Zone (EZ).

All persons and equipment entering the EZ shall be considered contaminated, and thus, must be properly decontaminated prior to entering the Support Zone.

Decontamination procedures may vary based on site conditions and nature of the contaminant(s). If chemicals or decontamination solutions are used, care should be taken to minimize reactions between the solutions and contaminated materials. In addition, personnel must assess the potential exposures created by the decontamination chemical(s) or solutions. The applicable Material Safety Data Sheet (MSDS) must be reviewed, implemented, and filed by personnel contacting the chemicals/solutions.

All contaminated PPE and decontamination materials shall be contained, stored and disposed of in accordance with site-specific requirements determined by site management.

5.4.2 – DECONTAMINATION EQUIPMENT

The equipment required to perform decontamination may vary based on site-specific conditions and the nature of the contaminant(s). The following equipment is commonly used for decontamination purposes:

- Soft-bristle scrub brushes or long-handled brushes to remove contaminants;
- Hoses, buckets of water or garden sprayers for rinsing;
- Large plastic/galvanized wash tubs or children's wading pools for washing and rinsing solutions;
- Large plastic garbage cans or similar containers lined with plastic bags for the storage of contaminated clothing and equipment;
- Metal or plastic cans or drums for the temporary storage of contaminated liquids; and
- Paper or cloth towels for drying protective clothing and equipment.

5.4.3 – PERSONAL/EQUIPMENT DECONTAMINATION

All equipment leaving the EZ shall be considered contaminated and must be properly decontaminated to minimize the potential for exposure and off-site migration of impacted materials. Such equipment may include, but is not limited to, sampling tools, heavy equipment, vehicles, PPE, support devices (e.g., hoses, cylinders, etc.), and various handheld tools.

All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of PPE required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors. Following equipment decontamination, employees may be required to follow the proper personal decontamination procedures above.

Personnel decontamination should consist of the following PPE removal procedure:

1. For Overbootie Removal

- Grasp top of overbootie and roll downward (inside out)
- Using gloved hands, place booties in receptacle

2. For Suit Removal

- Unzip suit and remove arms, turning inside-out
- Slide suit down, over waist
- Slide suit downward over legs, and step out
- Using gloved hands, grasp inside of suit, and place in receptacle.

3. For Glove removal:

- Grasp the cuff of the dominant hand and pull glove over the bulk of the hand, leaving the fingers inside the glove.
- Use the dominant hand to grasp the cuff of the non-dominant hand and pull the glove completely off (inside-out) and place inside of the dominant hand glove.
- Once removed, employee should only touch the inside material of the dominant hand glove.
- Thoroughly wash hands.

4. For APR Removal

- Remove cartridges and place in receptacle
- Loosen straps, grasp back strap and face piece, and doff mask
- Decon mask and hang to dry

All employees who are expected to don respiratory protection must have successfully passed a qualitative or quantitative fit-test within the past year for the brand, model and size respirator they plan to don. If worn, respirators will be cleaned after each use with respirator wipe pads and will be stored in plastic bags after cleaning. Respirators will be thoroughly cleaned using disinfectant material within one week following any respirator use. Refer to the cleaning instructions provided with the respirator or specified in the OSHA regulations at 29 CFR 1910.134.

For larger equipment, a high-pressure washer may need to be used. Some contaminants require the use of a detergent or chemical solution and scrub brushes to ensure proper decontamination. Before permitted to leave the site, heavy equipment and trucks will be visually inspected for signs of contamination. If contamination is present, the equipment must be decontaminated

For smaller equipment, use the following steps for decontamination:

1. Remove majority of visible gross contamination in EZ.
2. Wash equipment in decontamination solution with a scrub brush and/or power wash heavy equipment.
3. Rinse equipment.
4. Visually inspect for remaining contamination.
5. Follow appropriate personal decontamination steps outlined above.

All decontaminated equipment shall be visually inspected for contamination prior to leaving the Contaminant Reduction Zone (CRZ). Signs of visible contamination may include an oily sheen, residue or contaminated soils left on the equipment. All equipment with visible signs of contamination shall be discarded or re-decontaminated until clean. Depending on the nature of the contaminant, equipment may have to be analyzed using a wipe method or other means.

6.0 – EMERGENCY RESPONSE PLAN

IN CASE OF EMERGENCY, DIAL 911 AS SOON AS POSSIBLE!!!

This section establishes procedures and provides information for use during a project emergency. Emergencies happen unexpectedly and quickly, and require an immediate response; therefore, contingency planning and advanced training of staff is essential. Specific elements of emergency support procedures that are addressed in the following subsections include communications, local emergency support units, preparation for medical emergencies, first aid for injuries incurred onsite, record keeping, and emergency site evacuation procedures.

General emergencies potentially encountered at a jobsite may include:

- Fire
- Acute chemical exposures
- Physical injuries to site personnel
- Large chemical spills

The SSO, Field Supervisor, and Project Manager must be notified as soon as possible of any on-site emergency or potential emergency including fire, explosive conditions or OSHA-recordable physical injury. Response equipment is to be provided and available for each project and personnel are to be trained and qualified to respond to the types of emergencies described within this plan. For emergency responses outside of this plan, municipal or contracted response personnel and agencies will be used. A comprehensive list of all emergency contacts for this site, along with directions to the nearest urgent care medical facility is included in Attachment 10.

6.1 – PRE-EMERGENCY PLANNING

As part of the initial Health and Safety briefing prior to beginning work at the site, the SSO will make all workers aware of the location of the nearest hospital with an emergency room/urgent care facility. The site-specific HASP shall also have clear directions from the site to the nearest hospital along with a route map. The site-specific HASP shall also contain a listing of non-emergency phone numbers for local authorities (e.g. police, fire, utility companies).

The initial safety briefing will also cover the location of emergency response equipment, such as first aid kits, fire extinguishers, and spill containment kits.

6.2 – EMERGENCY RECOGNITION AND PREVENTION

6.2.1 – Fires

In the event of a fire or explosion, procedures will include immediate evacuation of the site and notification of the Project Manager. Portable fire extinguishers will be provided at the work site. The locations of all available fire extinguishers will be made known to all site personnel prior to starting work. No personnel shall fight a fire beyond the stage where it can be put out using a portable fire extinguisher.

6.2.2 – Chemical Exposures

The following are standard procedures to treat chemical exposure. Other specific procedures detailed on the Material Safety Data Sheet (MSDS) will be followed, when necessary.

EYE: Use copious amount of potable water from eye-wash kits for at least 15 minutes.

SKIN CONTACT: Wash affected areas with mild soap and rinse thoroughly, then provide appropriate medical attention. Skin shall be rinsed for 15 minutes if contact with caustics, acids, or hydrogen peroxide occurs. Affected items of clothing shall also be removed from contact with skin.

INHALATION: Move affected personnel to fresh air, upwind of work zone.

INGESTION: Contact Poison Control Center immediately, do not induce vomiting

If a person experiences any acute symptoms of exposure, such as dizziness, nausea, shortness of breath, or recognizes any of them in a fellow worker, work will stop immediately and, the necessary measures to mitigate the exposure will be taken. Medical evaluation by a physician will also be sought. Immediately report all such incidents to the SSO and Project Manager.

6.2.3 – Significant Vapor Release

The following steps will be taken to reduce exposure in the event of a significant vapor release at the site:

- Move all personnel to an upwind location. All non-essential personnel shall evacuate.
- Upgrade to Level C Respirator Protection.
- Downwind perimeter locations shall be monitored for volatile organics.
- If the release poses a potential threat to human health of the environment in the community, the NJDEP's Spill Hotline will be called (1-877-WARN-DEP).
- Local emergency response coordinators will be notified.

6.2.4 – Physical Injuries

First-aid equipment will be available onsite. The location of first aid kits will be made known to all site workers during the initial health and safety briefing. Unless they are in immediate danger, severely injured persons will not be moved until paramedics can attend to them. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instruction that can be obtained from doctors or paramedics, before an emergency-response squad arrives at the site or before the injured person can be transported to a hospital, will be followed closely. Personnel with current first aid and/or CPR certification will be identified. Basic first aid procedures for treatment of minor physical injuries can be found in Attachment 11. All incidents shall be reported to the SSO and Project Manager.

6.2.5 – Decontamination During Medical Emergencies

If emergency life-saving first aid, and/or medical treatment is required, normal decontamination procedures may need to be abbreviated or omitted. The SSO or designee will accompany contaminated victims to the medical facility to advise on matters involving decontamination when necessary. The outer garments can be removed if they do not cause delays, interfere

with treatment or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed on site, a plastic barrier placed between the injured individual and clean surfaces should be used to help prevent contamination of the inside of ambulances and/or medical personnel. Outer garments may then be removed at the medical facility. No attempt will be made to wash or rinse the victim if his/her injuries are life threatening, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material which could also cause severe injury of loss of like to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed.

6.2.6 – Spill Control and Response

All small spills/environmental releases shall be contained as close to the source as possible. Whenever possible, the MSDS will be consulted to assist in determining proper waste characterization and the best means of containment and cleanup. For small spills, sorbent materials such as sand, sawdust or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Any acid/caustic spills should be diluted or neutralized carefully prior to attempting recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. All spill containment materials will be properly disposed. An exclusion zone of 50 to 100 feet around the spill area should be established depending on the size of the spill.

All contractor vehicles shall have spill kits on them with enough material to contain and absorb the worst-case spill from that vehicle. All vehicles and equipment shall be inspected prior to being admitted on site. Any vehicle or piece of equipment that develops a leak will be taken out of service and removed from the job site.

All subcontractor employees as well as VERINA employees will be 40-Hour OSHA HAZWOPER trained, as well as current annual 8-HOUR refreshers.

The following seven steps shall be taken in the event of a spill:

1. Determine the nature, identity, and amounts of major spills.
2. Make sure all unnecessary persons are removed from the spill area.
3. Notify the SSO and Project Manager immediately
4. Use proper PPE.
5. If a flammable liquid, gas, or vapor is involved, remove all ignition sources and use non-sparking and/or explosion-proof equipment to contain or clean up the spill (diesel-only vehicles, air-operated pumps, etc.)
6. If possible, try to stop the leak with appropriate materials.
7. Remove all surrounding materials that can react or compound with the spill.

6.3 – EMERGENCY EVACUATION, ROUTE AND RALLY POINT

An evacuation route and rally point will be established prior to beginning work onsite. All personnel will be made known of the evacuation route and rally point during the initial health and safety briefing. In the event of an emergency requiring full or partial evacuation from the project site, all personnel will proceed directly to the rally point along the established evacuation route, where they will remain until the emergency is dealt with by first responders. The SSO will

account for all project personnel. No personnel shall re-enter the site without the expressed approval by first responders.

VERINA personnel will not participate in emergency responses requiring evacuation but will assist by providing technical information and expertise as it pertains to chemical and material knowledge to assist emergency responders who are taking responsive measures for fire, injuries, recovery and spill response.

After an emergency has occurred at the site, the causes and responses to that emergency shall be thoroughly investigated, reviewed and documented by VERINA's SSO and project manager. This documentation is to be submitted to the VERINA's principal within 24 hours of the incident.

6.4 – EMERGENCY COMMUNICATION GUIDELINES

Call 911 immediately and administer first aid measures to the victim if safe to do so. Move victim to a safe area if injury does not involve the neck or spine. Remove contaminated clothing and rinse contaminated areas with large amounts of water. Once the victim is stabilized, notify the Project Manager.

7.0 – RECORDKEEPING

The following is a summary of required health and safety logs, reports, and recordkeeping.

7.1 – HEALTH AND SAFETY ACKNOWLEDGEMENT

Each site-specific Health and Safety Plan will include a signature page for each worker to acknowledge that the hazards of the work have been identified and health and safety procedures have been adequately explained. Every worker onsite must sign the acknowledgement page prior to being permitted to work on that site.

7.2 – DAILY SAFETY MEETINGS (TAILGATE TALKS)

Completed Tailgate Safety Meeting Checklists will be maintained by the SSO. The Checklist is located in Attachment 2.

7.3 – INCIDENT REPORTS

The incident reporting and investigation during site work shall be completed will all applicable information as possible. Completed Incident Reporting forms will be maintained by the SSO. The Incident Report is located in Attachment 4.

Attachment 1

VERINA Consulting Group, LLC

VERINA HASP Acknowledgement Form

By signature, the personnel identified below hereby acknowledge that they have reviewed this Health and Safety Plan (HASP) and agree to comply with the requirements contained herein as well as the applicable provisions of 29 CFR Parts 1910 and 1926. Furthermore, in reviewing and accepting this HASP, as currently written, the undersigned agree that, to the best of their knowledge, this HASP adequately identifies the activities and hazards associated with work at this site and describes the appropriate and necessary precautions and protections for site workers required by the applicable OSHA statues and regulations.

Print Name	Signature	Date
Print Name	Signature	Date
Print Name	Signature	Date
Print Name	Signature	Date
Print Name	Signature	Date
Print Name	Signature	Date
Print Name	Signature	Date
Print Name	Signature	Date
Print Name	Signature	Date

Attachment 2

VERINA Daily Tailgate Safety Meeting Checklist

Job Name: _____ Date: _____

Job Number: _____ Scope of Work: _____

Job Location: _____ Meeting Conducted By: _____

Daily Safety Topics		
____ Review today's SOW	____ Site Set Up and Exclusion Zones	____ Identify Slip/Trip/Fall Hazards
____ Discuss Safety Equipment and Procedures	____ Medical Emergency Procedures	____ Identify Jobsite Hazards
-Safety Shower and Eyewash	-Minor: Treat On Site	____ Spill Control Plan
-Emergency Shut-off Locations	-Severe: Call 911/Hospital	-ID Drains & Release Routes, Protect
-Fire Extinguisher and First Aid Kit	____ PPE Requirements	-PPE for Spill Control
____ Stop Work Authority and Triggers	____ MSDS/HASP/JHA Location	-Surfacing Issues
____ Weather Forecast and Limitations	____ Safe Practices for Chemical Handling	____ Near Misses/Safety Alerts

1st Day of Work Safety Topics			
RECOGNIZED HAZARDS		HAZARD CONTROLS/BEST PRACTICES	
____ Dust/Fumes/Mist	____ Heavy Lifting	____ Ventilation/Isolation	____ HASP/MSDS Review
____ Chemical Contact/Exposure	____ High Pressure Hazards	____ Barriers/Signs	____ PPE
____ Damaged/Missing Tools	____ Struck By/Line of Fire	____ Rest Periods/Hydration	____ Specialized Equipment
____ Site Limitations	____ Temperature Hazards	____ Buddy System	____ Repair, Replace, or Remove
____ Public Exposure/Traffic	____ Utility Lines	____ Guards/Insulation/Distance	____ Other:

1) List Job Steps 2) Identify Hazards 3) Identify Preventative Actions 4) Conditions Which Trigger STOP WORK

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE ACTIONS
STOP WORK TRIGGERS:		

PPE Requirements

Job/Position	Goggles	Gloves	Face Protection	Protective Clothing	Resp. Protection	Other

Comments/Questions/Additions: _____

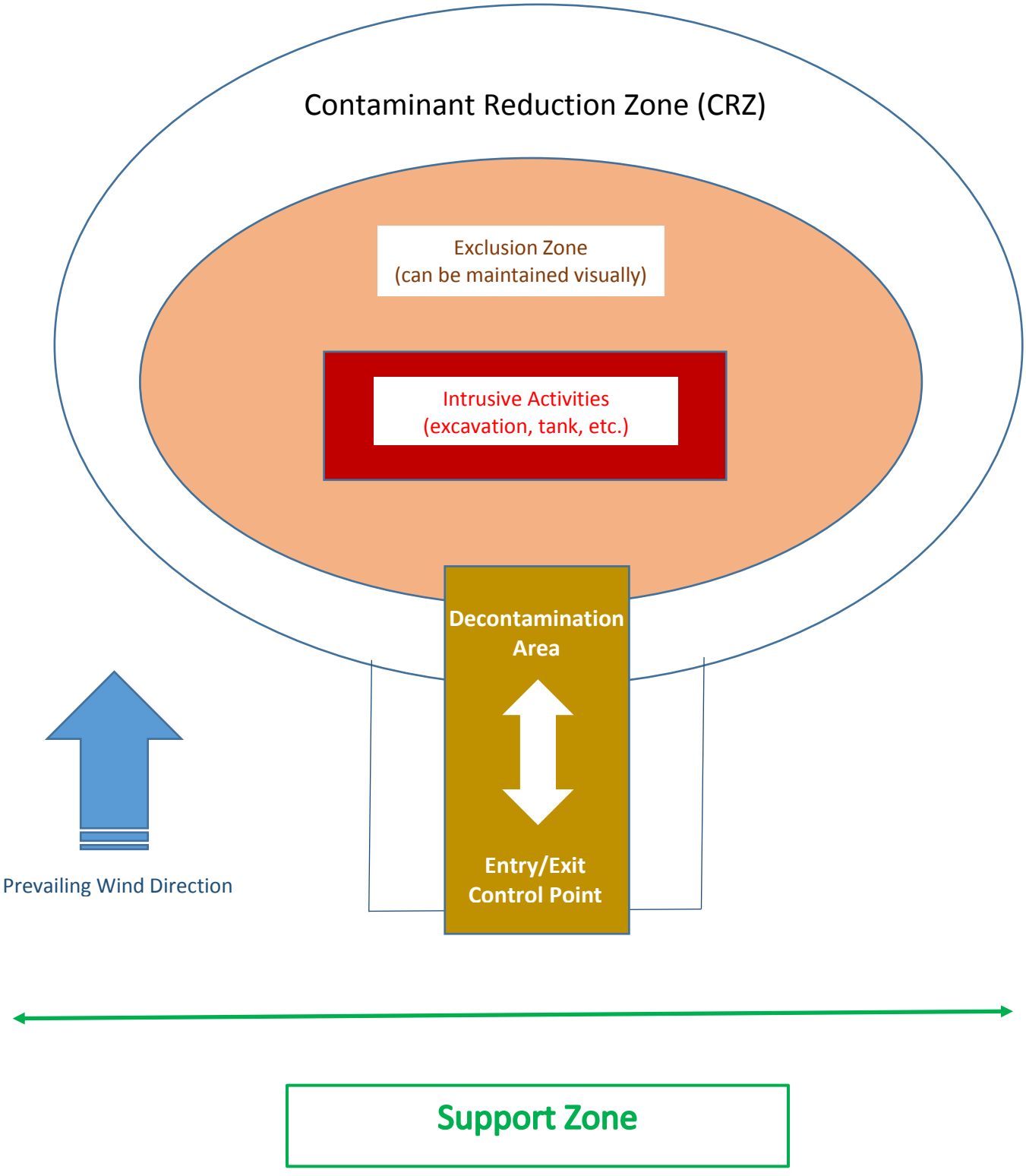
Meeting Participants

NAME	COMPANY	SIGNATURE

Attachment 3

VERINA Consulting Group, LLC

Typical Site Control Layout



Attachment 4

VERINA EMPLOYEE EXPOSURE/INJURY INCIDENT REPORT
(Submit a Separate Report for Each Employee and/or Incident)

Date of Incident: _____

Injured/Exposed Employee's Name:_____

Sex: M _____ F _____ Age: _____

Project: _____

Project No: _____

Incident:_____

_____

Type: Possible Exposure _____ Confirmed Exposure _____ Physical Injury _____

Location:_____

Date of Incident: _____ Time of Incident: _____

Weather Conditions During Incident:_____

_____

Hazardous Materials Potentially Encountered (give name and description):

_____

_____

_____

Immediate Response_____

_____

_____

Completed By:_____ _____
Print Name Title

._____ _____
Signature Date

Attachment 5

Using the Heat Index: A Guide for Employers

Introduction

Outdoor workers who are exposed to hot and humid conditions are at risk of heat-related illness. The risk of heat-related illness becomes greater as the weather gets hotter and more humid. This situation is particularly serious when hot weather arrives suddenly early in the season, before workers have had a chance to adapt to warm weather.

For people working outdoors in hot weather, both air temperature and humidity affect how hot they feel. The **"heat index"** is a single value that takes both temperature and humidity into account. The higher the heat index, the hotter the weather feels, since sweat does not readily evaporate and cool the skin. The heat index is a better measure than air temperature alone for estimating the risk to workers from environmental heat sources.

Heat-related illness can be prevented.

Heat Index	Risk Level	Protective Measures
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91° to 103°F	Moderate	Implement precautions and heighten awareness
103° to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

OSHA does not have a specific standard that covers working in hot environments. Nonetheless, under the OSH Act, employers have a duty to protect workers from recognized serious hazards in the workplace, including heat-related hazards. This guide helps employers and worksite supervisors prepare and implement hot weather plans. It explains how to use the heat index to determine when extra precautions are needed at a worksite to protect workers from environmental contributions to heat-related illness. Workers performing strenuous activity, workers using heavy or non-breathable protective clothing, and workers who are new to an outdoor job need additional precautions beyond those warranted by heat index alone.

Workers new to outdoor jobs are generally most at risk for heat-related illnesses. For example, Cal/OSHA investigated 25 incidents of heat-related illness in 2005. In almost half of the cases, the worker involved was on their first day of work and in 80% of the cases the worker involved had only been on the job for four or fewer days. That's why it's important to gradually increase the workload or allow more frequent breaks to help new workers and those returning to a job after time away build up a tolerance for hot conditions. Make sure that workers understand the risks and are "acclimatized".

Two primary sources of heat for workers: Workers become overheated from two primary sources: (1) the environmental conditions in which they work and (2) the internal heat generated by physical labor. Heat-related illnesses occur when the body is not able to lose enough heat to balance the heat generated by physical work and external heat sources. Weather conditions are the primary external heat sources for outdoor workers.

Outdoor workers include any workers who spend a substantial portion of the shift outdoors. Examples include construction workers, agricultural workers, baggage handlers, electrical power transmission and control workers, and landscaping and yard maintenance workers. These workers are at risk of heat-related illness when the heat index is high. Additional risk factors are listed below. *These must be taken into consideration even when the heat index is lower.*

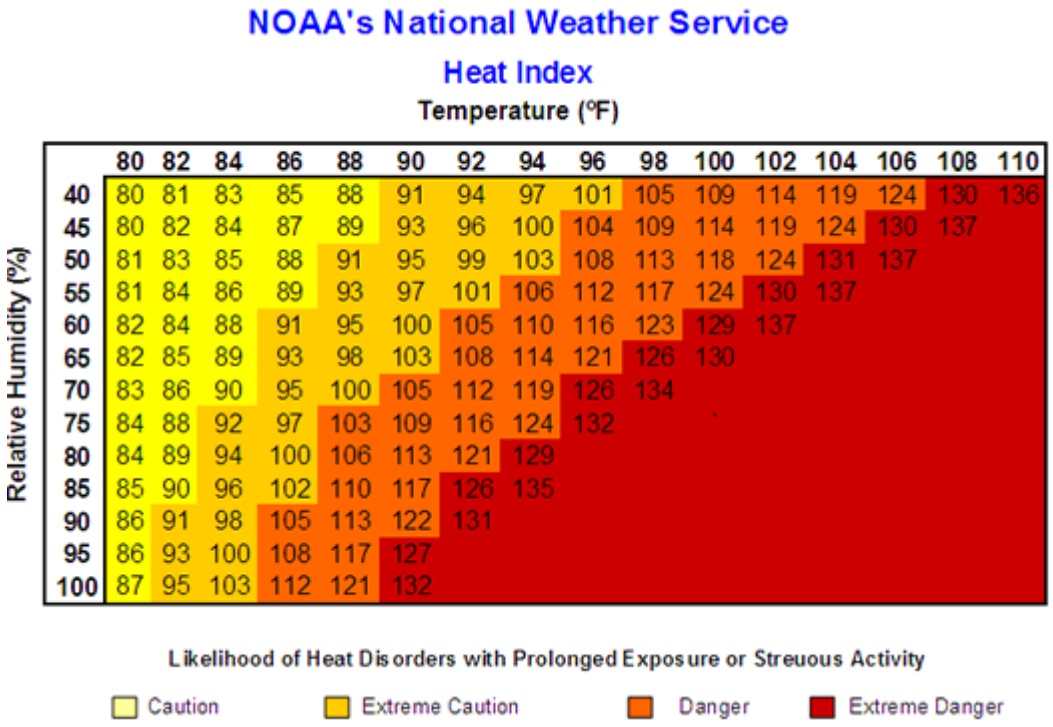
- Work in direct sunlight
- Perform prolonged or strenuous work
- Wear heavy protective clothing or impermeable suits

*This guidance is advisory in nature and informational in content. It is not a standard or regulation, and it neither creates new legal obligations nor alters existing obligations created by OSHA standards or the Occupational Safety and Health Act. Pursuant to the OSH Act, employers must comply with safety and health standards and regulations issued and enforced either by OSHA or by an OSHA-approved State Plan. In addition, the Act's General Duty Clause, Section 5(a)(1), requires employers to provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm.

Using the Heat Index: A Guide for Employers

About the Heat Index

The U.S. National Oceanographic and Atmospheric Administration (NOAA) developed the heat index system. The heat index combines both air temperature and relative humidity into a single value that indicates the apparent temperature in degrees Fahrenheit, or how hot the weather will feel. The higher the heat index, the hotter the weather will feel, and the greater the risk that outdoor workers will experience heat-related illness. NOAA issues heat advisories as the heat index rises. To learn more about the heat index, visit NOAA's website.



Why humidity matters: Relative humidity is a measure of the amount of moisture in the air. Sweat does not evaporate as quickly when the air is moist as it does in a dry climate. Since evaporation of sweat from the skin is one of the ways the human body cools itself on a hot day, high humidity reduces our natural cooling potential and we feel hotter. Low humidity can also be a problem for outdoor workers in hot, desert-like climates. Sweat evaporates very rapidly in low humidity, which can lead to severe dehydration if a person does not drink enough water throughout the day.

IMPORTANT NOTE: The heat index values were devised for shady, light wind conditions, **and exposure to full sunshine can increase heat index values by up to 15° Fahrenheit**. To account for solar load, added precautions are recommended. See Protective Measures to Take at Each Risk Level.

NOAA issues extreme heat advisories to indicate when excessive, extended heat will occur. The advisories are based mainly on predicted heat index values:

- *Excessive Heat Outlook*: issued when the potential exists for extended excessive heat (heat index of 105-110°F) **over the next 3-7 days**. This is a good time to check on supplies, such as extra water coolers, and refresh worker training.

- *Excessive Heat Watch*: issued when excessive heat could occur within the **next 24 to 72 hours**, but the timing is uncertain.

- *Excessive Heat Warning*: issued when the heat index will be high enough to be **life threatening in the next 24 hours**. This warning indicates that the **excessive heat is imminent or has a very high probability of occurring**.

- *Excessive Heat Advisory*: similar to an Excessive Heat Warning, but less serious. This is issued when the heat index could be **uncomfortable or inconvenient, but is not life threatening if precautions are taken**.

Using the Heat Index: A Guide for Employers

Using the Heat Index to Protect Workers

The heat index can be used to help determine the risk of heat-related illness for outdoor workers, what actions are needed to protect workers, and when those actions are triggered. Depending on the heat index value, the risk for heat-related illness can range from lower to very high to extreme. As the heat index value goes up, more preventive measures are needed to protect workers. Heat index values are divided into four bands associated with four risk levels. These bands differ from those appearing in the NOAA Heat Index chart, which was developed for the public. The NOAA bands have been modified for use at worksites:

Heat Index	Risk Level	Protective Measures
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91°F to 103°F	Moderate	Implement precautions and heighten awareness
103°F to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

Important consideration: NOAA devised the heat index values for shaded conditions and light winds. **Full sunshine can increase heat index values by up to 15° Fahrenheit**. Strenuous work and the use of heavy or specialized protective clothing also have an additive effect. As a result, the risk at a specific heat index could be higher than that listed in the table above if the work is in direct sunlight without a light breeze, or if work involves strenuous tasks or the use of heavy or specialized protective clothing. Extra measures, including implementing precautions at the next risk level, are necessary under these circumstances.

The employer's response at the four risk levels is the subject of the remainder of this guide. The steps employers should take in response to an elevated heat index are the same type of steps that they would follow to address other hazards in the workplace:

- Develop an illness prevention plan for outdoor work based on the heat index
- Train your workers how to recognize and prevent heat-related illness
- Track the worksite heat index daily; communicate it and the required precautions to workers
- Implement your plan; review and revise it throughout the summer

STEP 1: Develop a heat-related illness prevention plan before heat index levels rise.

Use the Protective Measures to Take at Each Risk Level to inform your planning. The plan should address:

Plan Element	Heat Index Risk Level			
	Lower (Caution)	Moderate	High	Very High/Extreme
Supplies (ensuring adequate water, provisions for rest areas, and other supplies)	✓	✓	✓	✓
Emergency planning and response (preparing supervisors and crews for emergencies)	✓	✓	✓	✓
Worker acclimatization (gradually increasing workloads; allowing more frequent breaks as workers adapt to the heat)	✓	✓	✓	✓
Modified work schedules (establishing systems to enable adjustments to work schedules)		✓	✓	✓
Training (preparing workers to recognize heat-related illness and preventive measures)	✓	✓	✓	✓
Physiological, visual, and verbal monitoring (using direct observation and physiological monitoring to check for signs of heat-related illness)		✓	✓	✓

Review the pages of this guide to learn more about what you can do to protect workers from heat-related illness. Use checklists to assist in planning ahead and in daily planning.

STEP 2: Train workers before it gets hot. Train workers about safe work practices before heat index levels go up. Prepare workers so that they recognize the signs and symptoms of heat-related illness, how to prevent it, and what to do if someone has symptoms. ***Reinforce the training on hot days***.

> For heat-related illness prevention training tools and resources, go to Training Resources. OSHA's factsheets and worksite posters (in English and Spanish) can help in communicating key messages about heat safety and health.

STEP 3: Track the weather for the worksite daily and assess the risk to workers. Know how hot it will be during scheduled work activities and use this information to determine which preventive measures should be taken.

Check with the **National Weather Service** to get the current or predicted heat index values and see a map of areas under excessive heat warning across the U.S. The heat index is also announced by television and radio stations as part of the local weather. Monitor weather reports daily to remain prepared for high heat index levels. Monitor weather reports daily to remain prepared for high heat index levels. **Use OSHA's Heat Smartphone App** to check the heat index for your worksite and see reminders about the protective measures for the specified risk level.

STEP 4: Implement your plan when the heat index is at or above 80° Fahrenheit. Adjust risk level based on site conditions (direct sunlight vs. shaded, with breeze), work load, and type of protective clothing.

See **Summary of Employer Actions** at each risk level.

Using the Heat Index: A Guide for Employers

Protective Measures to Take at Each Risk Level

Use the protective measures described for each risk level to help you plan ahead, and schedule and train your workers so that everyone is prepared to work safely as the heat index rises.

Actions for Low Risk Conditions: Heat Index Less Than 91°F
Actions for Moderate Risk Conditions: Heat Index is 91°F to 103°F
Actions for High Risk Conditions: Heat Index is 103°F to 115°F
Actions for Very High to Extreme Risk Conditions: Heat Index Greater Than 115°F

Summary of Risk Levels and Associated Protective Measures

The most critical actions employers should take to help prevent heat-related illness at each risk level:

Heat Index	Risk Level	Protective Measures
<91°F	Lower (Caution)	▪ Provide drinking water ▪ Ensure that adequate medical services are available ▪ Plan ahead for times when heat index is higher, including worker heat safety training ▪ Encourage workers to wear sunscreen **If workers must wear heavy protective clothing, perform strenuous activity or work in the direct sun, additional precautions are recommended to protect workers from heat-related illness.***
91°F to 103°F	Moderate	In addition to the steps listed above: ▪ Remind workers to drink water often (about 4 cups/hour)** ▪ Review heat-related illness topics with workers: how to recognize heat-related illness, how to prevent it, and what to do if someone gets sick ▪ Schedule frequent breaks in cool, shaded area ▪ Acclimatize workers ▪ Set up buddy system/instruct supervisors to watch workers for signs of heat-related illness **If workers must wear heavy protective clothing, perform strenuous activity or work in the direct sun, additional precautions are recommended to protect workers from heat-related illness.***

		▪ **Schedule activities at a time when the heat index is lower** ▪ **Develop work/rest schedules** ▪ **Monitor workers closely**
103°F to 115°F	High	In addition to the steps listed above: ▪ Alert workers of high risk conditions ▪ Actively encourage workers to drink plenty of water (about 4 cups/hour)** ▪ Limit physical exertion (e.g. use mechanical lifts) ▪ Have a knowledgeable person at the worksite who is well-informed about heat-related illness and able to determine appropriate work/rest schedules ▪ Establish and enforce work/rest schedules ▪ Adjust work activities (e.g., reschedule work, pace/rotate jobs) ▪ Use cooling techniques ▪ Watch/communicate with workers at all times **When possible, reschedule activities to a time when heat index is lower**
>115°F	Very High to Extreme	**Reschedule non-essential activity for days with a reduced heat index or to a time when the heat index is lower** **Move essential work tasks to the coolest part of the work shift; consider earlier start times, split shifts, or evening and night shifts. Strenuous work tasks and those requiring the use of heavy or non-breathable clothing or impermeable chemical protective clothing should not be conducted when the heat index is at or above 115°F.** If essential work must be done, in addition to the steps listed above: ▪ Alert workers of extreme heat hazards ▪ Establish water drinking schedule (about 4 cups/hour)** ▪ Develop and enforce protective work/rest schedules ▪ Conduct physiological monitoring (e.g., pulse, temperature, etc) ▪ Stop work if essential control methods are

		inadequate or unavailable.

*The heat index is a simple tool and a useful guide for employers making decisions about protecting workers in hot weather. It does not account for certain conditions that contribute additional risk, such as physical exertion. Consider taking the steps at the next highest risk level to protect workers from the added risks posed by:

- Working in the direct sun (can add up to 15°F to the heat index value)
- Wearing heavy clothing or protective gear

**Under most circumstances, fluid intake should not exceed 6 cups per hour or 12 quarts per day. This makes it particularly important to reduce work rates, reschedule work, or enforce work/rest schedules.

Using the Heat Index: A Guide for Employers

Actions for Lower (Caution) Risk Conditions: Heat Index is Less Than 91°F

Most people can work safely when the heat index is <91°F with only basic measures for worker safety and health, as required by the OSH Act. As minimum measures, employers have a duty to:

- **Provide adequate amounts of drinking water** in convenient, visible locations close to the work area.
- **Ensure that adequate medical services are available.** Where medical services (e.g., emergency medical services, clinic, hospital) are not available within 3-4 minutes, have appropriately trained personnel and adequate medical supplies on site. The trained personnel should have a valid certificate in first aid training from the American Red Cross or equivalent training. (A first aid certificate is required at maritime and construction worksites.)

Additional precautions are advisable based on site conditions, work load, and protective clothing use:

- **Take actions described for Moderate Risk Conditions (91°F - 103°F) if heat index is close to 91°F OR work is being conducted in direct sunshine or without a light breeze**.
- **Follow additional precautions for workers wearing heavy or non-breathable clothing or impermeable chemical protective clothing** because they are at greater risk even when the risk to other workers is lower. Workers in heavy, non-breathable or "impermeable" protective clothing can experience heat-related illness at temperatures as low as 70°F. Monitor them closely for signs of heat-related illness and see the section on Taking Added Precautions for High Risk Conditions.
- **Acclimatize new and returning workers performing strenuous work. These individuals may be at high risk for heat-related illness, even when the heat index is low.**
- **Check the weather forecast regularly** in warm seasons to learn if more extreme hot weather conditions are predicted. Make sure your hot weather plans are in place and that workers are trained *before*

Heat Index	Risk Level	Protective Measures
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91°F to 103°F	Moderate	Implement precautions and heighten awareness
103°F to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

hot outdoor work begins. **Train workers** on how to recognize symptoms of heat-related illness, individual risk factors for heat-related illness, how to prevent it, and what to do if someone has symptoms so they are prepared when hotter, higher-risk work conditions arise.

- **Encourage workers to wear sunscreen and use other protections from direct sunlight**. Provide shade, hats, and sunscreen, when possible. Sunburn reduces the skin's ability to release excess heat, making the body more susceptible to heat-related illness.

Drinking Water
Water should have a palatable (pleasant and odor-free) taste and water temperature should be 50°F to 60°F, if possible.

Sanitation standard 29 CFR 1910.141 requires that employers provide "potable water" at work sites, which is water that meets the drinking water standards of the state or local authority having jurisdiction, or water that meets the quality standards prescribed by the U.S. EPA's drinking water regulations (40 CFR Part 141).

Using the Heat Index: A Guide for Employers

Actions for Moderate Risk Conditions: Heat Index is 91°F to 103°F

At the moderate risk level some precautions in addition to those already mentioned are needed to prevent heat-related illness. Review heat-related illness signs and precautions with workers. Remind workers to drink water. Provide workers opportunities to rest in cool, shaded areas. Be aware of conditions that could increase risk.

- **Alert workers to the heat index anticipated for the day and identify each precaution in place at the work site to reduce the risk of heat-related illness.**
- **Provide adequate amounts of cool water and disposable cups** in convenient, visible locations close to the work area.
- **Remind workers to drink small amounts of water often** (before they become thirsty). A good rule of thumb is to drink about 4 cups of water every hour when the heat index suggests a moderate risk level.
- **Ensure that adequate medical services are available**. Where medical services (e.g., emergency medical services, clinic, hospital) are not available within 3-4 minutes, you must have appropriately trained personnel and adequate medical supplies on site. The trained personnel should have a valid certificate in first aid training from the American Red Cross or equivalent training. (A first aid certificate is required at maritime and construction worksites.)
- **Respond to heat-related illness and medical emergencies without delay**. **Workers who show symptoms of heat-related illness need immediate attention. Treating milder symptoms (headache, weakness) early by providing rest in a shaded area and cool water to drink can prevent a more serious medical emergency. Call 911 immediately if a worker loses consciousness or appears confused or uncoordinated. These are signs of possible heat stroke. *Heat stroke is fatal if not treated immediately.***
- **Review heat-related illness signs and symptoms and site-specific precautions during daily meetings or toolbox talks**. Be sure everyone knows procedures for responding to possible heat-related illness.
    - What steps to follow if a worker exhibits signs and symptoms of heat-related illness

Heat Index	Risk Level	Protective Measures
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91°F to 103°F	Moderate	Implement precautions and heighten awareness
103°F to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

- Who to call for medical help
- Who will provide first aid until the ambulance arrives

The resources under Educational Resources are useful training tools for daily meetings and toolbox talks.

- **Schedule frequent rest breaks in cool, shaded areas**.

  Provide air conditioned or shaded areas close to the work area.
  Set up temporary shade when working in open fields or areas without easy access to shade or air conditioning.

- **Acclimatize new and returning workers**. Gradually increase the workload or allow more frequent breaks to help new and returning workers build up a tolerance for hot conditions over time. **If the heat index increases suddenly, allow all workers more frequent breaks for a few days while they become accustomed to the warmer conditions**.

- **Implement actions for the High Risk Conditions (103°F - 115°F) if heat index approaches 103°F OR work is strenuous, in direct sunlight, or involves the use of heavy or non-breathable clothing or impermeable chemical protective clothing.**

- **Set up a buddy system**, if possible, to enable workers to look out for signs and symptoms of heat-related illness in each other. Often, a worker will not recognize his own signs and symptoms.

- **Instruct supervisors to watch workers for signs of heat-related illness.** Check routinely to make sure workers are making use of water and shade and not experiencing heat-related symptoms.

- **Encourage workers to wear sunscreen and use other protections from direct sunlight**. Provide shade, hats, and sunscreen, when possible. Sunburn reduces the skin's ability to release excess heat, making the body more susceptible to heat-related illness. Repeated overexposure to sunlight also leads to skin cancer.

Drinking Water
Water should have a palatable (pleasant and odor-free) taste and water temperature should be 50°F to 60°F, if possible.

Other Drinks
Encourage workers to choose water over soda and other drinks containing caffeine and high sugar content. These drinks may lead to dehydration. Drinks with some flavoring added may be more palatable to workers and thereby improve hydration. Encourage workers to avoid drinking alcohol during hot weather.

Using the Heat Index: A Guide for Employers

Actions for High Risk Conditions: Heat Index is 103°F to 115°F

As the heat index rises above 103°F, there is a **high risk** for heat-related illness, so additional measures to protect workers are needed. Increase rest periods and designate a knowledgeable person (well-informed on heat-related illness) at the worksite to determine appropriate work/rest schedules. Reduce work load and pace strenuous work tasks. Remind workers to drink plenty of water every 15 to 20 minutes.

- **Alert workers to the heat index anticipated for the day and identify each precaution in place at the work site to reduce the risk of heat-related illness**. Review heat-related illness signs and symptoms during daily meetings or toolbox talks.

  Be sure everyone knows procedures for responding to possible heat-related illness.

  - What steps to follow if a worker exhibits signs and symptoms of heat-related illness
  - Who to call for medical help
  - How to give clear directions to the worksite
  - Who will provide first aid until the ambulance arrives

> The resources under Educational Resources are useful training tools for daily meetings and toolbox talks.

- **Provide plenty of cool drinking water and disposable cups** in convenient, visible locations close to the work area.

- **Actively encourage workers to drink small amounts of water often** (before they become thirsty). They should drink about 4 cups of water every hour while the heat index is 103 to 115°F. Workers will need the greatest amount of water if they must work in direct sunshine, during peak exertion, and during the hottest part of the day.

  Under most circumstances extended hourly fluid intake should not exceed 6 cups per hour or 12 quarts per day. To maintain worker hydration, it is particularly important to reduce work rates, reschedule work for a time when the heat index is lower, or enforce work/rest schedules when work must continue during periods of extreme risk for heat-related illness.

Heat Index	Risk Level	Protective Measures
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91°F to 103°F	Moderate	Implement precautions and heighten awareness
103°F to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

- **Ensure that adequate medical services are available**. Where medical services (e.g., emergency medical services, clinic, hospital) are not available within 3-4 minutes, have appropriately trained personnel and adequate medical supplies on site. The trained personnel should have a valid certificate in first aid training from the American Red Cross or equivalent training. (A first aid certificate is required at maritime and construction worksites.)

- **Respond to heat-related illness and medical emergencies without delay. Workers who show symptoms of heat-related illness need immediate attention. Treating milder symptoms (headache, weakness) early by providing rest in a shaded area and cool water to drink can prevent a more serious medical emergency. Call 911 immediately if a worker loses consciousness or appears confused or uncoordinated. These are signs of possible heat stroke. *Heat stroke is fatal if not treated immediately.***

- **Have a knowledgeable person onsite** who is well-informed about heat-related illness and authorized to modify work activities and the work/rest schedule as needed.

Drinking Water
Water should have a palatable (pleasant and odor-free) taste and water temperature should be 50°F to 60°F, if possible.

Other Drinks
Encourage workers to choose water over soda and other drinks containing caffeine and high sugar content. These drinks may lead to dehydration. Drinks with some flavoring added may be more palatable to workers and thereby improve hydration. Encourage workers to avoid drinking alcohol during hot weather events.

- **Establish and enforce work/rest schedules** to control heat exposure and allow workers to recover. Take into account the level of physical exertion and type of protective equipment being used.

    - Advise workers of the work/rest schedule and make sure supervisors enforce rest breaks.
    - Provide air conditioned or cool, shaded areas close to the work area for breaks and recovery periods.
    - Set up temporary shade when working in open fields or areas without easy access to shade or air conditioning.

- **Adjust work activities** to help reduce worker risk:

    - **Schedule heavy tasks** earlier in the day or at a time during the day when the heat index is lower. Consider adjusting the work shift to allow for earlier start times, or evening and night shifts.
    - Where possible, **set up shade canopies** over work areas in direct sunshine or **move jobs** that can be moved to naturally shaded areas.
    - **Permit only those workers acclimatized to heat to perform the more strenuous tasks**. Rotate physically demanding job tasks among acclimatized workers.

- **Decrease the physical demands and pace of jobs**. If heavy job tasks cannot be avoided, change work/rest cycles to increase the amount of rest time.
- **Add extra personnel to physically demanding tasks** so that the shared work load is less intense. This will lower the workers' risk of heat-related illness.
- **Rotate workers to job tasks that are less strenuous or in cooler/air conditioned setting** for part of the work shift.

- **Acclimatize workers**. Take steps that help all workers become acclimatized to the heat, particularly if the weather turns hot suddenly. Gradually increase workloads and allow more frequent breaks during the first week of work. Closely supervise new employees for the first 14 days, until they are fully acclimatized.

- **Take actions described for the Very High to Extreme Risk Conditions (>115°F) if heat index approaches 115°F AND the work is being conducted in direct sunshine**.

- **Take added precautions** if workers are wearing heavy or non-breathable clothing or impermeable chemical protective clothing. These circumstances put workers at even greater risk of heat-related illness.

    - Reschedule activities for when the heat index is lower. Consider adjusting the work shift to allow for earlier start times, or evening and night shifts.
    - Modify the site **work/rest schedules** to make sure they are protective for workers using protective clothing.
    - Physiologically monitor workers by establishing a routine to periodically check workers for physical signs (e.g., body temperature, heart rate) of possible over exposure to heat.
    - When possible, rotate workers to job tasks that do not require this type of protective clothing for part of the work shift.
    - Encourage workers to remove protective equipment that is not needed while they are on rest breaks (e.g., if the rest area is free of hazards, remove hard hat, gloves, high visibility vest, respirator, and protective suit).

Workers are at an increased risk of heat stress from personal protective equipment (PPE), especially from wearing semi-permeable (penetrable) or impermeable clothing (such as Tyvek or rubber), when the outside temperature exceeds 70°F, or while working at high energy levels. These types of clothing materials trap heat close to a worker's body. Workers should be monitored by establishing a routine to periodically check heart rate, temperature, and other physiological signs of overexposure.

- When possible, **provide workers with personal cooling measures** (e.g., water-dampened clothing, cooling vests with pockets that hold cold packs, reflective clothing, or cool mist stations), especially for workers wearing heavy or non-breathable clothing or impermeable chemical protective clothing.

- **Set up a buddy system** to enable workers to look out for signs and symptoms of heat-related illness in each other. Often, a worker will not recognize his own signs and symptoms.

- **Instruct supervisors to watch workers for signs of heat-related illness**. Check routinely (several times per hour) to make sure workers are making use of water and shade and not experiencing heat-related symptoms.

- **Maintain effective communication with your crew** at all times (by voice, observation, or electronic communications). Confirm that communication methods are functioning effectively.

- **Encourage workers to wear sunscreen and use other protections from direct sunlight**. Provide shade, hats, and sunscreen, when possible. Sunburn reduces the skin's ability to release excess heat, making the body more susceptible to heat-related illness. Repeated overexposure to sunlight also leads to skin cancer.

Using the Heat Index: A Guide for Employers

Actions for Very High to Extreme Risk Conditions: Heat Index Greater Than 115°F

Very hot and humid conditions put an extra strain on workers and greatly increase the risk of developing heat-related illness. It can develop faster and be more serious and widespread among workers. Even previously acclimatized workers are at risk for heat-related illness without protective measures. The situation is even more serious when hot weather arrives suddenly (e.g., heat wave early in the season), because the body has not had enough time to adjust to the sudden, abnormally high temperature or other extreme conditions.

In addition to the precautions already identified, extra measures are needed to protect workers under this highest risk level. Re-schedule non-essential work activities and move essential work tasks to a time during the work shift when the heat index is lower. If this is not possible, establish a water drinking schedule, enforce work/rest schedules, and be extra vigilant in monitoring workers for heat-related illness symptoms, including by using physiological monitoring and systems to enable effective communications. This requires a knowledgeable person on site who can assess heat-related safety concerns.

- **Reschedule all non-essential outdoor work for days with reduced heat index.**
- **Move essential outdoor work to the coolest part of the work shift. As able, alter the work shift to allow for earlier start times, split shifts, or evening and night shifts. Prioritize and plan essential work tasks carefully – strenuous work tasks and those requiring the use of heavy or non-breathable clothing or impermeable chemical protective clothing should not be conducted when the heat index is at or above 115°F.**
- **Stop work if essential control methods are inadequate or unavailable when the risk of heat illness is very high.**

For emergency work and essential work that cannot be rescheduled:

- **Alert workers to the heat index for the day and identify all of the precautions in place at the work site to reduce the risk of heat-related illness.** Review heat-related illness signs and symptoms during daily meetings or toolbox talks.

  Be sure everyone knows procedures for responding to possible heat-related illness.

Heat Index	Risk Level	Protective Measures
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91°F to 103°F	Moderate	Implement precautions and heighten awareness
103°F to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

- What steps to follow if a worker exhibits signs and symptoms of heat-related illness
- Who to call for medical help
- How to give clear directions to the worksite
- Who will provide first aid until the ambulance arrives

The resources under Educational Resources are useful training tools for daily meetings and toolbox talks.

- **Provide plenty of cool drinking water and disposable cups** in convenient, visible locations close to the work area.

- **Establish a clear drinking schedule to ensure that workers are drinking enough water throughout the day**. Remind workers to drink small amounts of water often (before they become thirsty). A good rule of thumb at this risk level is to drink about 4 cups of water every hour during the hottest periods. Workers will need the greatest amount of water if they must work in direct sunshine, during peak exertion, and during the hottest part of the day.

  Under most circumstances extended hourly fluid intake should not exceed 6 cups per hour or 12 quarts per day. To maintain worker hydration, it is particularly important to reduce work rates, reschedule work for a time when the heat index is lower, or enforce work/rest schedules when work must continue during periods of extreme risk for heat-related illness.

  Drinking Water
  Water should have a palatable (pleasant and odor-free) taste and water temperature should be 50°F to 60°F, if possible.

  Other Drinks
  Encourage workers to choose water over soda and other drinks containing caffeine and high sugar content. These drinks may lead to dehydration. Drinks with some flavoring added may be more palatable to workers and thereby improve hydration. Encourage workers to avoid drinking alcohol during hot weather events.

- **Ensure that adequate medical services are available**. Where medical services (e.g., emergency medical services, clinic, hospital) are not available within 3-4 minutes, have appropriately trained personnel and adequate medical supplies on site. The trained personnel should have a valid certificate in first aid training from the American Red Cross or equivalent training. (A first aid certificate is required at maritime and construction worksites.) Consider having medical services on site for an emergency and to conduct physiological monitoring.

- **Respond to heat-related illness and medical emergencies without delay**. **Workers who show symptoms of heat-related illness need immediate attention. Treating milder symptoms (headache, weakness) early by providing rest in a shaded area and cool water to drink can prevent a more serious medical emergency. Call 911 immediately if a worker loses consciousness or appears confused or uncoordinated. These are signs of possible heat stroke. *Heat stroke is fatal if not treated immediately.***

- **Have a knowledgeable person onsite** who is well-informed about heat-related illness, authorized to determine appropriate work/rest schedules, and can conduct physiological monitoring.

- **Establish and enforce a work/rest schedule** to control heat exposure and allow workers to recover. Take into account the level of physical exertion and type of protective equipment being used.

    - Advise workers of the work/rest schedule and make sure supervisors enforce rest breaks.
    - Provide air conditioned or cool, shaded areas close to the work area for breaks and recovery periods.
    - Set up temporary shade when working in open fields or areas without easy access to shade or air conditioning.
    - Encourage workers to remove protective equipment that is not needed while they are on rest breaks (e.g., if the rest area is free of hazards, remove hard hat, gloves, high visibility vest, respirator, and protective suit).

- **Adjust work activities** to help reduce worker risk:

    - **Set up shade canopies** over work areas in direct sunshine or **move jobs** that can be moved to naturally shaded areas.
    - **Permit only those workers acclimatized to heat to perform the more strenuous tasks**. Rotate physically demanding job tasks among acclimatized workers.
    - **Decrease the physical demands and pace of jobs**. If heavy job tasks cannot be avoided, change work/rest cycles to increase the amount of rest time.
    - **Add extra personnel to physically demanding tasks and those requiring the use of heavy or non-breathable clothing or impermeable chemical protective clothing** so that the shared work load is less intense. This will lower the workers' risk of heat-related illness.
    - **Rotate workers to job tasks that are less strenuous or in cooler/air conditioned setting** for part of the work shift.

- **Acclimatize workers**. Take steps that help all workers become acclimatized to the heat, particularly if the weather turns hot suddenly. Gradually increase workloads and allow more frequent breaks during the first week of work. Closely supervise new employees for the first 14 days, until they are fully acclimatized.

- **Physiologically monitor all workers** by establishing a routine to periodically check heart rate, temperature, or other physiological signs that may indicate overexposure. Use monitoring results to adjust work/rest periods. This is especially critical for workers wearing heavy or non-breathable clothing or impermeable chemical protective clothing or using other personal protective equipment.

- **Provide workers with personal cooling measures** (e.g., water-dampened clothing, cooling vests with pockets that hold cold packs, reflective clothing, or cool mist stations). This is especially critical for workers wearing heavy or non-breathable clothing or impermeable chemical protective clothing.

- **Set up a buddy system** to enable workers to look out for signs and symptoms of heat-related illness in each other. Often, a worker will not recognize his own signs and symptoms.

- **Instruct supervisors to watch workers for signs of heat-related illness.** Check routinely (several times per hour) to make sure workers are making use of water and shade and not experiencing heat-related symptoms. Extra vigilance is needed when the HI reaches very high levels.

- **Maintain effective communication with your crew** at all times (by voice, observation, or electronic communications). Confirm that communication methods are functioning effectively.

- **Encourage workers to wear sunscreen and use other protections from direct sunlight**. Provide shade, hats, and sunscreen, when possible. Sunburn reduces the skin's ability to release excess heat, making the body more susceptible to heat-related illness. Repeated overexposure to sunlight also leads to skin cancer.

Using the Heat Index: A Guide for Employers

Planning Checklists

Use the following checklists to prepare for hot weather and to make sure that all appropriate precautions are in place.

Planning Ahead for Hot Weather: Employer Checklist[1]

	Develop a list of hot weather supplies (e.g., water, shade devices, etc.). Estimate quantities that will be needed, and decide who will be responsible for obtaining and transporting supplies and checking that supplies are not running low.
	Create emergency action plan for heat-related illnesses (who will provide first aid and emergency services, if necessary).
	Develop acclimatization schedule for new workers or workers returning from absences longer than one week.
	Identify methods to gain real-time access to important weather forecast and advisory information from the National Weather Service and ensure the information is available at outdoor work sites (e.g., laptop computer, cell phone, other internet-ready device, weather radio).
	Determine how weather information will be used to modify work schedules, increase the number of water and rest breaks, or cease work early if necessary.
	Train workers on the risks presented by hot weather, how to identify heat-related illnesses, and the steps that will be taken to reduce the risk.
	Plan to have a knowledgeable person on the worksite who can develop and enforce work/rest schedules and conduct physiological monitoring, when necessary, at high and very high/extreme risk levels for heat-related illness.

[1]This table is adapted from concepts appearing in OSHA's Heat-related Illness Prevention Training Guide.

Daily Planning for Hot Weather: Employer Daily Checklist[2]

Water	Is there plenty of fresh, cool drinking water located as close as possible to the workers?	
	Are water coolers refilled throughout the day? (Has someone been designated to check and make sure water is not running low?)	
Shade	Is shade or air conditioning available for breaks and if workers need to recover?	
Training	Do workers know the:	
	Common signs and symptoms of heat-related illness?	
	Proper precautions to prevent heat-related illness?	
	Importance of acclimatization?	
	Importance of drinking water frequently (even when they are not thirsty)?	
	Steps to take if someone is having symptoms?	
Emergencies	Does everyone know who to notify if there is an emergency?	
	Can workers explain their location if they need to call an ambulance?	
	Does everyone know who will provide first aid?	
Knowledgeable Person	For high and very high/extreme heat index risk levels, is there a knowledgeable person at the worksite who is well-informed about heat-related illness and able to determine appropriate work/rest schedules and can conduct physiological monitoring as necessary?	
Physiological Monitoring	Are workers in the high or very high/extreme heat index risk levels being physiologically monitored as necessary?	
Worker Reminders	Drink water often	
	Rest in shade	
	Report heat-related symptoms early	

[2]This table is adapted from checklist (page 18) in OSHA's Heat-related Illness Prevention Training Guide.

Using the Heat Index: A Guide for Employers

Training Workers

Train workers *before* hot outdoor work begins. Tailor the training topic outline to cover employer-specific policies and worksite-specific conditions. A single worksite may have some job tasks that are low risk for heat-related illness and others that are high risk. Training will be more effective if it is matched to job tasks and conditions, and is reviewed and reinforced throughout hot weather conditions. The following training topics may be addressed in one session or in a series of shorter sessions.

Training Topics:

- Risk factors for heat-related illness.
- Different types of heat-related illness, including how to recognize common signs and symptoms.
- Heat-related illness prevention procedures.
- Importance of drinking small quantities of water often.
- Importance of acclimatization, how it is developed, and how your worksite procedures address it.
- Importance of immediately reporting signs or symptoms of heat-related illness to the supervisor.
- Procedures for responding to possible heat-related illness.
- Procedures to follow when contacting emergency medical services.
- Procedures to ensure that clear and precise directions to the work site will be provided to emergency medical services.

Factors that May Cause Heat-related Illness	
Environmental	High temperature and humidity Direct sun exposure (with no shade) or extreme heat Limited air movement (no breeze or wind)
Job-Specific	Physical exertion Use of bulky protective clothing and equipment
Personal	Dehydration Poor physical condition or ongoing health problems Kidney disease Some medications Pregnancy Lack of previous exposure to hot workplaces

	Previous heat-related illness Obesity Alcoholism

See Training Resources for heat-related illness prevention training tools and resources. Also see OSHA's Heat-Related Illness Prevention Training Guide for one tool to help you train your workers. The training guide includes instructions for teaching workers about heat hazards and a daily checklist to make sure all appropriate precautions are in place each workday. OSHA's factsheets and worksite posters (in English and Spanish) can help in communicating key messages about heat safety and health. Some labor and industry organizations offer industry-specific guidance for protecting workers, such as wildland firefighters, that face heat exposure under special circumstances. Inquire whether your industry offers any special guidance, or adapt information from industries with similar situations.

Using the Heat Index: A Guide for Employers

Preparing for and Responding to Heat-related Emergencies

How to Prepare for Heat-related Emergencies...

Employers should confirm that worksite emergency procedures include sufficient information to address hot weather emergencies.

- Have a plan in case a worker experiences heat-related illness.
- Make sure medical services are available and that workers know what to do if a fellow worker has signs and symptoms of heat-related illness.
- Be prepared to provide first aid for any heat-related illness and call emergency services (e.g., call 911) if a worker shows signs and symptoms of heat stroke.
- Be able to provide clear and precise directions to the worksite.
- Immediately respond to symptoms of possible heat-related illness – move the worker into the shade, loosen the clothing, wet and fan the skin, place ice-packs in the armpits and on the neck. Give the worker something to drink. Call emergency services if the worker loses consciousness or appears confused or uncoordinated. Have someone stay with an ill worker.
- Ensure that emergency procedures are used whenever appropriate.
- Develop a plan to reschedule or terminate work if conditions become too risky.

How to Respond to Heat-related Emergencies...

If workers report or supervisors observe signs or symptoms of heat-related illness, stop activity immediately. Take action while waiting for help. **HEAT STROKE IS A MEDICAL EMERGENCY. CALL 911 immediately if a worker shows any signs of heat stroke.**

Illness	Symptoms	First Aid*
Heat stroke	▪ Red, hot, dry skin or excessive sweating ▪ Very high body temperature ▪ Confusion ▪ Seizures ▪ Fainting	▪ Call 911 While waiting for help: ▪ Place worker in shady, cool area ▪ Loosen clothing, remove outer clothing ▪ Fan air on worker; cold packs in armpits ▪ Wet worker with cool water;

		apply ice packs, cool compresses, or ice if available ▪ Provide fluids (preferably water) as soon as possible ▪ Stay with worker until help arrives
Heat exhaustion	▪ Cool, moist skin ▪ Heavy sweating ▪ Headache ▪ Nausea or vomiting ▪ Dizziness ▪ Light headedness ▪ Weakness ▪ Thirst ▪ Irritability ▪ Fast heart beat	▪ Have worker sit or lie down in a cool, shady area ▪ Give worker plenty of water or other cool beverages to drink ▪ Cool worker with cold compresses/ice packs ▪ Take to clinic or emergency room for medical evaluation or treatment if signs or symptoms worsen or do not improve within 60 minutes. ▪ Do not return to work that day
Heat cramps	▪ Muscle spasms ▪ Pain ▪ Usually in abdomen, arms, or legs	▪ Have worker rest in shady, cool area ▪ Worker should drink water or other cool beverages ▪ Wait a few hours before allowing worker to return to strenuous work ▪ Have worker seek medical attention if cramps don't go away
Heat rash	▪ Clusters of red bumps on skin ▪ Often appears on neck, upper chest, folds of skin	▪ Try to work in a cooler, less humid environment when possible ▪ Keep the affected area dry
* Remember, if you are not a medical professional, use this information as a guide only to help workers in need.		

Using the Heat Index: A Guide for Employers

About Work/Rest Schedules

Rather than being exposed to heat for extended periods of time during the course of a job, workers should, wherever possible, be permitted to distribute the workload evenly over the day and incorporate work/rest cycles. Work/rest cycles give the body an opportunity to get rid of excess heat, slow down the production of internal body heat, slow down the heart rate, and provide greater blood flow to the skin.

For the best protection from heat-related illness, workers should spend the rest periods of the cycle in a cool place, for example in a lightly air conditioned room, trailer or vehicle, or if one is not available, then in full shade.

Rest periods do not necessarily mean that the workers are on break; these can be productive times. During the rest periods, workers may continue to perform mild or light work, such as completing paperwork, sorting small parts, attending a meeting, or receiving training (e.g., instructions for upcoming work, or a tailgate safety talk).

Have a knowledgeable person at the worksite that is well-informed about heat-related illness and able to modify work activities and the work/rest schedule as needed. When evaluating an appropriate work/rest schedule:

- Shorten work periods and increase rest periods:
    - As temperature rises
    - As humidity increases
    - When sun gets stronger
    - When there is no air movement
    - When protective clothing or gear is worn
    - For heavier work
- Assign new and un-acclimatized workers lighter work and longer rest periods. Monitor these workers more closely.

Choosing Shaded Rest Areas:
When an air conditioned space is not available, choose or create rest areas with as many of the following beneficial characteristics as possible:

- In full (complete) shade.
- Where surfaces are not warm from earlier sun (e.g., north-facing wall).
- Opened to cooling breezes, but protect workers if breezes feel uncomfortably hot, which can increase risk of heat illness.
- Free of other hazards (e.g., moving traffic, excessive noise, falling objects).
- With sufficient space for the number of workers needing rest breaks at one time.
- Near a supply of cool drinking water.
- Equipped for workers to do productive light work while

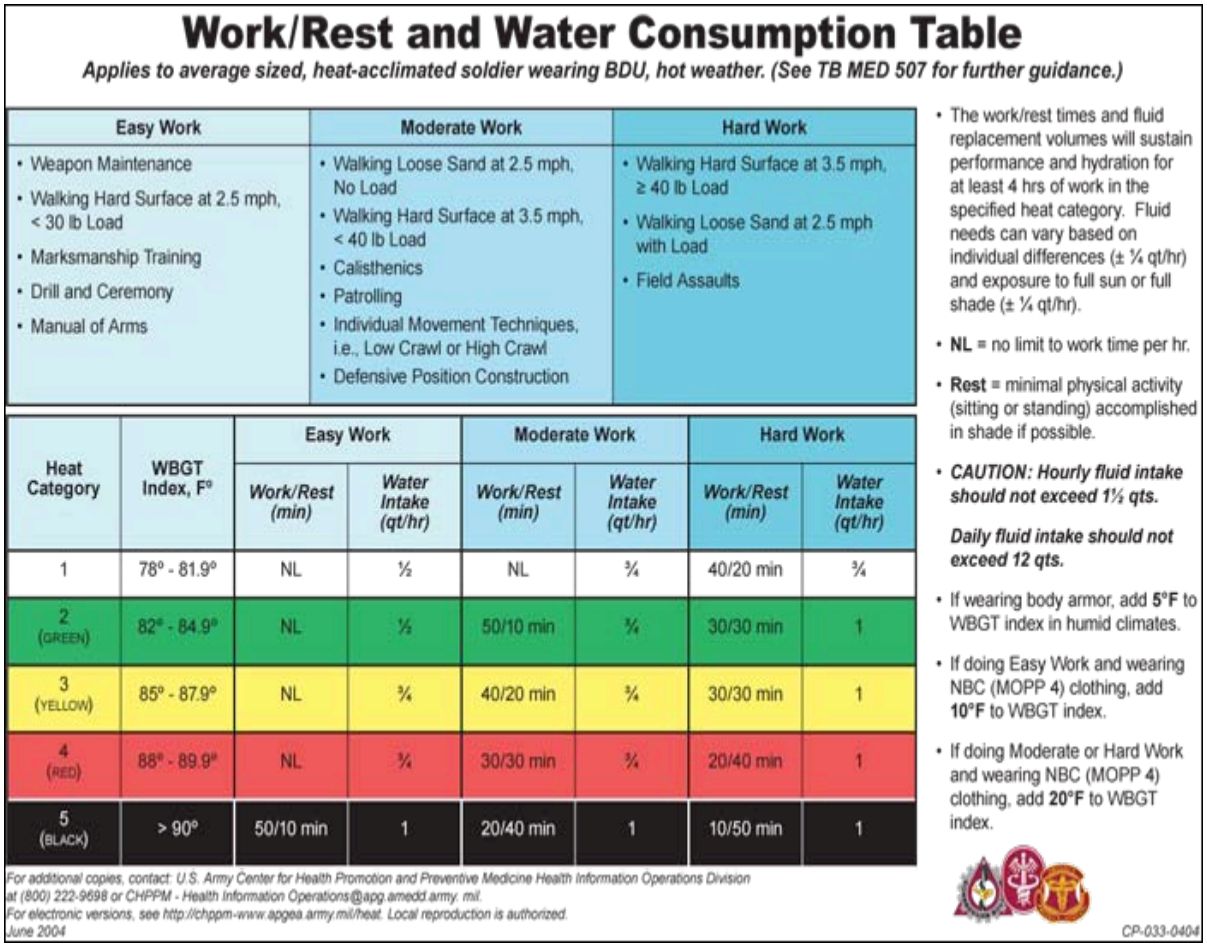
The figures and tables below are examples of general guidelines for setting work/rest schedules. When possible, more frequent shorter periods of exposure to heat are better than fewer longer exposures. This means that the work/rest schedules are often based on 1-hour cycles and might call for a rest period of 15 minutes every hour during hot weather, but 45 minutes per hour when temperature and humidity are extreme. Individual requirements may vary greatly. The work/rest schedules in these tables do not guarantee protection against heat-related illness and should not be used as a substitute for good judgment or experience. The tables generally apply to healthy, acclimatized adults under the age of 40.

Setting appropriate work rest schedules is critical for protecting workers during outdoor work. Often it requires the assistance of a trained safety and health profession. In addition to the methods provided as examples below, OSHA provides free and confidential advice to services small and medium-sized businesses in all states across the country. Contact OSHA's On-site Consultation Program for assistance in developing your heat-related illness preventions plan and work/rest schedules that are appropriate for your worksite. For more information or for additional compliance assistance contact OSHA at 1-800-321-OSHA (6742).

Methods for Developing Work/Rest Schedules

Figure 1 is the US Army Work/Rest/Water Consumption table used for setting work/rest schedules during field operations. The hydration and work/rest schedule assume an average sized, heat acclimated soldier wearing battle dress uniforms (BDU). Factors such as lack of acclimitization, poor fitness, and cumulative inadequate hydration and may increase the risk of heat-related illness and should be taken into account when using the schedules in Figure 1. This is one method for determining work/rest schedules using an alternate to the Heat Index called the Wet-Bulb Globe Temperature (WBGT). The WBGT is obtained using specialized equipment (a wet-bulb globe temperature meter, also known as a WBGT meter). The meter provides a heat reading based in part on factors similar to those NOAA uses to determine the heat index, but the WBGT reading also considers solar load (radiant heat, from sunshine) as well as how quickly moisture evaporates. WBGT meters are readily available from commercial sources of environmental monitoring and technical instruments. Several hand-held models cost less than $200 (in 2011).

FIGURE 1: US. ARMY APPROACH FOR SETTING WORK/REST SCHEDULES



Work/Rest and Water Consumption Table

Applies to average sized, heat-acclimated soldier wearing BDU, hot weather. (See TB MED 507 for further guidance.)

Easy Work	Moderate Work	Hard Work
• Weapon Maintenance • Walking Hard Surface at 2.5 mph, < 30 lb Load • Marksmanship Training • Drill and Ceremony • Manual of Arms	• Walking Loose Sand at 2.5 mph, No Load • Walking Hard Surface at 3.5 mph, < 40 lb Load • Calisthenics • Patrolling • Individual Movement Techniques, i.e., Low Crawl or High Crawl • Defensive Position Construction	• Walking Hard Surface at 3.5 mph, ≥ 40 lb Load • Walking Loose Sand at 2.5 mph with Load • Field Assaults

Heat Category	WBGT Index, F°	Easy Work		Moderate Work		Hard Work	
		Work/Rest (min)	*Water Intake (qt/hr)*	*Work/Rest (min)*	*Water Intake (qt/hr)*	*Work/Rest (min)*	*Water Intake (qt/hr)*
1	78° - 81.9°	NL	½	NL	¾	40/20 min	¾
2 (GREEN)	82° - 84.9°	NL	½	50/10 min	¾	30/30 min	1
3 (YELLOW)	85° - 87.9°	NL	¾	40/20 min	¾	30/30 min	1
4 (RED)	88° - 89.9°	NL	¾	30/30 min	¾	20/40 min	1
5 (BLACK)	> 90°	50/10 min	1	20/40 min	1	10/50 min	1

- The work/rest times and fluid replacement volumes will sustain performance and hydration for at least 4 hrs of work in the specified heat category. Fluid needs can vary based on individual differences (± ¼ qt/hr) and exposure to full sun or full shade (± ¼ qt/hr).
- **NL** = no limit to work time per hr.
- **Rest** = minimal physical activity (sitting or standing) accomplished in shade if possible.
- ***CAUTION: Hourly fluid intake should not exceed 1⅓ qts.***

  Daily fluid intake should not exceed 12 qts.
- If wearing body armor, add **5°F** to WBGT index in humid climates.
- If doing Easy Work and wearing NBC (MOPP 4) clothing, add **10°F** to WBGT index.
- If doing Moderate or Hard Work and wearing NBC (MOPP 4) clothing, add **20°F** to WBGT index.

For additional copies, contact: U.S. Army Center for Health Promotion and Preventive Medicine Health Information Operations Division at (800) 222-9698 or CHPPM - Health Information Operations@apg.amedd.army. mil.
For electronic versions, see http://chppm-www.apgea.army.mil/heat. Local reproduction is authorized.
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Table 1 (below) presents an approach for setting work/rest schedules for workers wearing normal clothing drawn from the US EPA/OSHA joint publication, *A Guide to Heat Stress in Agriculture*. Tables 1 and 2 (below) use an adjusted temperature calculation to approximate the Wet Bulb Globe Temperature (WBGT). These tables are for use where instruments which measure WBGT are unavailable. Some of the work/rest times in Table 1 for hot/dry conditions may be conservative, due to approximation of WBGT. While Tables 1 and 2 allow 13° for the full heating effect of the sun, the effect of solar heat can be greater under some conditions. Table 1 is based in part on there being perceptible air movement. Where there is little or no air movement, Table 1 is not appropriate.

TABLE 1. APPROACH FOR SETTING WORK/REST SCHEDULES FOR WORKERS WEARING NORMAL WORK CLOTHING[1]

Adjusted Temperature* (calculated)	Light Work	Moderate Work	Heavy Work
90	Normal	Normal	Normal
91	Normal	Normal	Normal
92	Normal	Normal	Normal
93	Normal	Normal	Normal
94	Normal	Normal	Normal
95	Normal	Normal	45/15[2]
96	Normal	Normal	45/15
97	Normal	Normal	40/20
98	Normal	Normal	35/25
99	Normal	Normal	35/25
100	Normal	45/15[2]	30/30
101	Normal	40/20	30/30
102	Normal	35/25	25/35
103	Normal	30/30	20/40
104	Normal	30/30	20/40
105	Normal	25/35	15/45
106	45/15[2]	20/40	Caution[3]
107	40/20	15/45	Caution[3]
108	35/25	Caution[3]	Caution[3]
109	30/30	Caution[3]	Caution[3]
110	15/45	Caution[3]	Caution[3]
111	Caution[3]	Caution[3]	Caution[3]
112	Caution[3]	Caution[3]	Caution[3]

*Note: Adjust the temperature reading as follows before going to the temperature column in the table:

Full sun (no clouds)	add 13°
Partly cloudy/overcast	add 7°
No shadows visible/work is in the shade or at night	no adjustment
For relative humidity of:	
10%	subtract 8°
20%	subtract 4°
30%	no adjustment
40%	add 3°
50%	add 6°
60%	add 9°

For example, if the temperature is 91°, it is dusk, the relative humidity is 40%, and heavy work is to be done, such as moving heavy materials with a wheelbarrow:

Start with 91° and add 3° because the humidity is 40% [91°+3°=94°]. Go to 94° in the table; under these conditions, it would be reasonable to follow a normal work schedule.

NOTES:

1. This table is based on American Conference of Governmental Industrial Hygienists limits for heat-acclimatized adults in effect at the time the document was published (1993). Assumptions include physically fit, well-rested, and fully hydrated workers under the age of 40; adequate water intake; 30% relative humidity; natural ventilation with perceptible air movement; and air temperature readings in Fahrenheit, taken in the shade, no sunshine or no shadows visible.
2. 45/15 minutes = 45 minutes work and 15 minutes rest during each hour.
3. Indicates very high levels of heat stress. Consider rescheduling activities for a time when the risk of heat illness is lower.

TABLE 2. APPROACH FOR SETTING WORK/REST SCHEDULES FOR WORKERS WEARING CHEMICAL-RESISTANT SUITS[1]

Air Temperature	Work/Rest Schedules								
	--Light Work--			--Moderate Work--			--Heavy Work--		
	Full Sun	Partly Cloudy	No Sun[2]	Full Sun	Partly Cloudy	No Sun[2]	Full Sun	Partly Cloudy	No Sun[2]
75°F	Normal Schedule	Normal Schedule	Normal Schedule	Normal Schedule	Normal Schedule	Normal Schedule	35/25[3]	Normal Schedule	Normal Schedule
80°F	30/30	Normal Schedule	Normal Schedule	20/40	Normal Schedule	Normal Schedule	10/50	40/20	Normal Schedule
85°F	15/45	40/20	Normal Schedule	10/50	25/35	Normal Schedule	Caution[4]	15/45	40/20
90°F	Caution[4]	15/45	40/20	Caution[4]	Caution[4]	25/35	Stop Work	Caution[4]	15/45
95°F	Stop Work	Stop Work	15/45	Stop Work	Stop Work	Stop Work	Stop Work	Stop Work	Stop Work

NOTES:

1. This table is based on values for heat-acclimatized adult workers under the age of 40 who are physically fit, well-rested, and fully hydrated; with the assumptions of Tyvek coveralls, gloves, boots, and a respirator being worn; adequate water intake; and air temperature readings taken in the shade. Cooling vests may enable workers to work for longer periods. Adjustments must be made when additional protective gear is worn.
2. No shadows are visible or work is in the shade or at night.
3. 35/25 = 35 minutes work and 25 minutes rest each hour.
4. Indicates very high levels of heat stress. Consider rescheduling activities for a time when the risk of heat illness is lower.

SOURCE: Adapted from: U.S. EPA/OSHA. 1993. A guide to heat stress in agriculture. EPA-750-b-92-001

Other resources with approaches and tips for setting work/rest periods include:

- OSHA's Technical Manual Table III: 4-2 offers a simple chart showing several example WBGT meter readings and the appropriate work/rest schedules for light, moderate or heavy work.

- The American Conference of Governmental Industrial Hygienists (ACGIH) describes a detailed method of determining work/rest schedules based on numerous factors including WBGT meter readings. The schedule can be adjusted for work demands and clothing type. This work/rest schedule method is published as: Heat Stress and Strain, in TLVs and BEIs, American Conference of Industrial Hygienists, Cincinnati, OH.

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Estimating Work Rates or Loads

Examples of work activities that are considered light, moderate, heavy, and very heavy:

Work Rate Category	Example Motions	Example Tasks
Rest	▪ Sitting	▪ Attending a meeting (seated) ▪ Reading instructions, completing paperwork ▪ Watching a training video
Light	▪ Sitting with light manual work with hands and arms ▪ Driving ▪ Standing with some light arm work and occasional walking ▪ Casual walking (2 miles per hour) ▪ Lifting 10 pounds fewer than eight times per minute, or 25 pounds less than four times per minute	▪ Using small bench tools or small power tools ▪ Inspecting and sorting produce ▪ Sorting light materials ▪ Assembling small parts ▪ Driving vehicle on roads ▪ Nailing
Moderate	▪ Sustained moderate hand and arm work ▪ Moderate arm and leg work ▪ Moderate arm and trunk work ▪ Moderate pushing and pulling ▪ Walking at a moderate speed ▪ Lifting 10 pounds 10 times per minute, or 25 pounds six times per minute	▪ Picking fruits and vegetables (bending, squatting) ▪ Painting with a brush ▪ Pushing or pulling lightweight carts or wheelbarrows ▪ Off road operation of trucks, tractors or construction equipment ▪ Operating an air hammer ▪ Weeding or hoeing

Heavy	▪ Intense arm and trunk work ▪ Carrying, shoveling, manual sawing ▪ Pushing or pulling heavy loads ▪ Walking at a fast pace (4 miles per hour) ▪ Lifting 10 pounds 14 times per minute, or 25 pounds 10 times per minute	▪ Transferring heavy materials, shoveling ▪ Sledgehammer work ▪ Hand mowing, digging ▪ Concrete block laying ▪ Pushing or pulling loaded hand carts or wheelbarrows
Very Heavy	▪ Very intense activity at fast to maximum pace ▪ Jogging, running or walking faster than 4 miles per hour ▪ Lifting 10 pounds more than 18 times per minute, or 25 pounds more than 13 times per minute	▪ Heavy shoveling or digging ▪ Ax work ▪ Climbing stairs, ramps or ladders

Sources:

ACGIH, 2011. Heat Stress and Strain, in TLVs and BEIs, American Conference of Industrial Hygienists, Cincinnati, OH.

Ramsey, J and Bishop, P. 2003. Hot and Cold Environments (Chapter 24), in The Occupational Environment, its Evaluation, Control, and Management (S.R. DiNardi, Editor), American Industrial Hygiene Association. [After McArdle, Katch and Katch (1996)].

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Acclimatizing Workers

Individual susceptibility to heat-related illness can vary widely between workers. Workers become gradually acclimatized when exposed to hot conditions for several weeks. Physical changes in blood vessels and in sweating occur to dissipate heat more effectively. When the **heat index** is high, special precautions are needed to protect un-acclimatized workers while they adjust, particularly on the first few days of the job.

- Develop a heat acclimatization program and plans that promote work at a steady moderate rate that can be sustained in the heat. For example, allow workers to get used to hot environments by gradually increasing exposure over at least a 5-day work period. Begin with 50% of the normal workload and time spent in the hot environment and then gradually build up to 100% by the fifth day. New workers and those returning from an absence of two weeks or more should have a 5-day minimum adjustment period. While a significant amount of acclimatization occurs rapidly in that first week, full acclimatization may take a little longer. Some workers require up to two or three weeks to fully acclimatize.

- Determine how you will lessen the intensity of workers' work during the adjustment period.

- Keep in mind that acclimatization can occur naturally for outdoor workers in a hot climate as the weather changes. However, implementing acclimatization activities is essential for new workers, workers who have been out sick or on vacation, and all workers during a heat wave. Be extra-careful with these workers and recognize immediately the symptoms of possible heat-related illness.

- During a sudden heat spike, determine how you will protect your workers from conditions resulting from sudden exposure to heat.

Why Workers Must Be Acclimatized[1]

Humans are, to a large extent, capable of adjusting to the heat. Much of this adjustment to heat, under normal circumstances, usually takes about 5 to 7 days, during which time the body will undergo a series of changes that will make continued exposure to heat more endurable. However, it may take up to several weeks for the body to fully acclimatize.

On the first day of work in a hot environment, the body temperature, pulse rate, and general discomfort will be higher. With each succeeding daily exposure, all of these responses will gradually decrease, while the sweat rate will increase. When the body becomes acclimatized to the heat, the worker will find it possible to perform work with less strain and distress.

Special Caution

Some health conditions can put workers at greater risk of heat-related illness. These include diabetes, kidney and heart problems, pregnancy, and being overweight.

Source: Adapted from Page 10 in OSHA's Heat-related Illness Prevention Training Guide.

Gradual exposure to heat gives the body time to become accustomed to higher environmental temperatures. Heat disorders in general are more likely to occur among workers who have not been given time to adjust to working in the heat or among workers who have been away from hot environments and who have gotten accustomed to lower temperatures. Hot weather conditions of the summer are likely to affect the worker who is not acclimatized to heat. Likewise, workers who return to work after a leisurely vacation or extended illness may be affected by the heat in the work environment. Whenever such circumstances occur, the worker should be gradually reacclimatized to the hot environment.

People who have not worked in hot weather for a week or more need time for their bodies to adjust. They need to take more breaks and not do too much strenuous work during their first weeks on the job.

[1]Information sources: NIOSH, Working in Hot Environments (NIOSH 86-112) "Preparing for the Heat" and OSHA's Heat-related Illness Prevention Training Guide (page 10).

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Monitoring Workers at Risk of Heat-related Illness

NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Chapter 8 (1985) offers guidance for performing physiological monitoring of workers at hot worksites. It describes the following options for worker monitoring to help manage the risk of heat-related illness:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.
    - If the heart rate exceeds 110 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 110 beats per minute at the next rest period, shorten the following work cycle by one-third.
- 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.
    - If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.
    - Do not permit a worker to wear a semi-permeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).
- Body water loss, if possible. Measure the worker's weight on a scale (ideally accurate to ±0.25 lb) at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing (changes of clothing or damp clothing can cause an inaccurate reading). The body water loss should not exceed 1.5 percent total body weight loss in a work day.

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar load and the level of physical work (see table below). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[a]		
Adjusted Temperature (see notes below)	**For workers with normal work clothes, conduct monitoring…**	**For workers wearing impermeable protective clothing conduct monitoring…**
90°F or above	After each 45 minutes of work	After each 15 minutes of work
87.5°-90°F	After each 60 minutes of work	After each 30 minutes of work
82.5°-87.5°F	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.5°F	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F	After each 150 minutes of work	After each 120 minutes of work

Notes:
[a] Assumes work levels of 250 kilocalories/hour (e.g., a moderate work level). Consider increasing the frequency for heavy work rates.

[b] Adjusted Air Temperature: Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = ta °F + (13 x % sunshine).

Measure the air temperature (ta) with a standard thermometer, with the bulb shielded from radiant heat.

Estimate the 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]For the purpose of this chart, a normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Adapted from: NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Chapter 8 (1985).

More Advanced Methods for Monitoring Workers

Employers can choose to evaluate a range of physiological responses to heat. The example above briefly mentions heart rate (pulse), oral temperature, and body water loss, but other options are also available. New types of tools (e.g., specialized sensors and personal monitors) are becoming widely available to help employers monitor workers, but effective monitoring can still be performed using simple equipment (e.g., a wrist watch). This section provides examples of the range of options available for monitoring workers.

Examples of Monitoring Options

Physiological monitoring for workers at risk of heat illness usually focuses on vital signs, individually or in any combination:

- Heat exposure history
- Pulse rate
- Temperature (oral, tympanic [ear], or core]
- Body weight
- Blood pressure
- Respiratory rate
- Alertness

The following table lists when and how each of these monitoring methods is performed.

Examples of Physiological Monitoring Used by Some Employers to Prevent Heat Illness			
Monitoring Method	**When Assessed**	**How Assessed**	**More Information**
Heat Exposure History	Before work begins, physiological monitoring may start with a brief history review	Interview or questionnaire	Recent heat illness increases the risk of a repeat occurrence, so the worker should be monitored more closely. Some workers might choose to alert their employers of medical conditions, such as kidney failure, which increase the risk of heat illness.
Pulse Rate (heart rate)	Before work begins to determine the initial baseline level and then again after heat exposure (for example in the first minute and the third minute after the work period ceases)	Count the number of beats per minute (using a wristwatch), or monitor electronically using a heart rate sensor.	The pulse rate should fall rapidly and soon approach the baseline level. The pulse will remain elevated in a worker experiencing a heat illness.
Temperature			Increased temperature indicates that the body is not cooling itself as rapidly as necessary to keep temperature from rising.
	Initial baseline and again	*Oral temperature* –	Inaccurate if the worker

	after the work period	measure with an oral thermometer (available from drug stores)	drinks cool beverages frequently (as is recommended).
	Initial baseline and again after the work period	*Tympanic temperature* – measure with an infrared thermometer (available from drug stores)	A more reliable indicator of core temperature than oral readings (Beaird, Bauman, and Leeper, 1996).
	Continuous sensing devices measure temperature during both work and rest periods	*Core temperature* – measure with electronic or color-changing sensing devices (e.g., sensors that are ingestible, in-ear, or part of skin patches)	Core temperature is the most reliable measure of body temperature. Although not widely used in the workplace, modern advances in sensing technology are making core temperature measurements increasingly practical (HQI, 2007; NASA Spinoff, 2006; Mini Mitter, no date; IonX, no date; Quest, no date).
Bodyweight	Measured as baseline and again immediately after heat exposure	Step on a bathroom scale that has good precision (consistent readings). Must wear same clothes for measurements before and after work period. Account for moisture (sweat) in the clothes	Daily bodyweight loss can indicate that the worker is not drinking a sufficient amount of water. At worksites, the need to account for moisture held in clothes damp with sweat greatly complicates this otherwise simple measure.
Blood pressure	Initial baseline and again after the work period	Blood pressure cuff	Blood pressure does not recover as quickly when a worker is suffering heat illness. Posture can also affect blood pressure in workers with heat-related illness and is the basis for some physiological monitoring

			methods.
Respiratory (breathing) rate	Initial baseline and again after the work period	Count breathes per minute using a stop watch	Breathing rate does not return to baseline as quickly when a worker is suffering heat-related illness.
Alertness	During and after the work period	Converse with the worker	Assess whether the worker shows signs of confusion, a symptom of heat-related illness.
Other monitoring methods			
Perceived skin wetness zones	After the work period	Self-evaluation by the worker	An experimental method, which showed some promise for workers wearing normal clothing doing light work, but was less effective for workers wearing impermeable protective clothing doing strenuous work (Lee, Nakao, and Tochihara, 2011).
Personal Monitors	During and after the work period	The most common include skin temperature sensors and heart rate monitors	Electronic personal monitors worn by workers can measure one or more physiological parameters and help workers judge their own condition (Buller et al, 2008; Metrosonics, no date; IonX, no date).
Sources: *NFPA, 2002. NFPA 471: Recommended Practice for Responding to Hazardous Materials Incidents, 2002 edition.* *NFPA, 2008. NFPA 473: Standard for Competencies for EMS Personnel Responding to Hazardous Materials/Weapons of Mass Destruction Incidents, 2008 edition.* *Also sources listed in "Notes Column".*			

Checklist for Worker Monitoring

OSHA provided two examples of vital signs monitoring checklists in Best Practices for Hospital-Based First Receivers of Victims from Mass Casualty Incidents (OSHA Document 3249), Appendix I – Vital Signs and PPE Checklists. These checklists were developed by employers to record monitoring results for workers who wear heavy protective equipment during chemical emergencies involving the Release of Hazardous Substances. The checklists have space for monitoring results before and after work periods. A comparison of the two measurements confirms that an individual worker's physiological state returns to baseline (pre-work) conditions before the worker begins the next work/rest cycle.

Monitoring Criteria

The criteria to which monitoring results are compared can vary depending on the workplace circumstances and some professional judgment is required. The individual performing the monitoring should be knowledgeable of the monitoring methods and which criteria to use in determine whether a worker is suffering from a heat-related illness or is ready to return to work under hot conditions.

The National Fire Protection Association published an extensive procedure and list of physiological monitoring criteria for evaluating workers at high risk of heat-related illness, particularly those wearing heavy protective clothing, in *Recommended Practice for Responding to Hazardous Materials Incidents (NFPA 471, 2002), Section 10*. Although still available for inspection online, this detailed information was withdrawn as an NFPA standard and in its place NFPA incorporated an less detailed monitoring procedure (without criteria) into the more recent *Standard for Competencies for EMS Personnel Responding to Hazardous Materials/Weapons of Mass Destruction Incidents (NFP 473, 2008), section 5.4.5*. Rather than providing specific criteria for each measurement, this 2008 edition of NFPA 473 relies on the professional judgment of the emergency medical personnel in assessing worker response to stressors encountered during hazardous materials response (primarily heat illness if the protective gear adequately protects the worker from chemical hazards). However, NFPA 471 remains an interesting reference for studying the monitoring methods that were historically considered important for evaluating workers wearing heavy protective clothing (i.e., at high risk of heat illness) and assessing their ability to continue work under those conditions.

Monitoring Workers - References cited in the table

Beaird, Bauman, and Leeper, 1996. Oral and tympanic temperatures as heat strain indicators for workers wearing chemical protective clothing. Am Ind Hyg Assoc J. 57(4):344-7 (April).

Buller et al, 2008. A real-time heat strain risk classifier using heart rate and skin temperature. Physiol Meas. 29(12):N79-85 (Dec).

HQI, 2007. CorTemp Ingestible Core Body Temperature Sensor. HQ Inc., Palmetto, Florida.

IonX, no date. Body temperature alert patch. Ionx iDOT International, LLC, Lexington Kentucky.

Lee, Nakao, and Tochihara, 2011. Validity of perceived skin wetness mapping to evaluate heat strain. Eur J Appl Physiol. Epub 4 Mar, 2011.

Metrosonics, no date. Manual #2039-003 Rev. C.

Mini Mitter, no date. VitalSense Integrated physiological monitoring system (ingestible capsule, wireless dermal temperature patch).

NASA Spinoff, 2006. Ingestible Thermometer pill aids athletes in beating the heat. Office of the Chief Technologist, NASA.

Quest, undated. Product internet web page for QUESTemp° II Personal Monitor.

Attachment 6

Working Safely in the Cold

Division of Epidemiology, Environmental and Occupational Health

Cold is an occupational health hazard for many types of workers. Some jobs at risk are listed in the box below. At this time there is no specific regulation that addresses the protection of workers from environmental cold, although the Occupational Safety and Health Administration (OSHA) and the New Jersey Public Employees Occupational Safety and Health (PEOSH) General Duty Clauses may apply in severe cases. This publication presents an overview of the health hazards of working in cold environments and contains guidelines and resources on how workers can be protected.

Like all occupational diseases, cold-related health problems are under-recognized and under-reported. Relatively few employers report workers who died or missed work as a direct result of exposure to environmental cold. From 1992 to 1997, there was a total of 27 reports of occupational fatalities caused by the cold. In 1997, out of 1,833,380 cases of nonfatal injuries involving days away from work, only 244 reports were related to exposure to environmental cold and another 143 to contact with cold objects or substances. The existing data do not cover public employees, farms with less than 11 employees, or injuries that do not result in time lost from work. Finally, the data cannot reveal the indirect toll a cold environment may exact on exposed workers.

Direct cold-related health problems

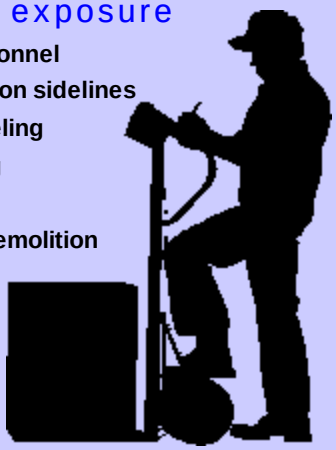
Hypothermia: Hypothermia, a drop in the body's internal temperature below 95°F, is a threat in frigid weather but can also strike at moderate temperatures. It is a medical emergency with a high fatality rate.

Frostbite: Skin, muscle, blood vessels, and nerves freeze and form ice crystals. Blood vessels become blocked with tissue debris that causes more damage. Frostbite is often irreversible and amputation is sometimes required. If the injured site heals, the victim may suffer chronic pain or numbness, excessive sweating, abnormal skin color, and joint pain. The feet, hands, ears, nose, cheeks, and penis are the most frequently injured sites.

Immersion foot: If part of the body is covered with water or wet mud that is just above freezing, the area may become chronically swollen, weak, and sensitive to the cold.

Chilblain: Red, swollen skin, usually on hands and feet, that feels hot, tender, and itchy after cold exposure.

Types of jobs at risk for cold exposure



- **Airport ground personnel**
- **Athletes, especially on sidelines**
- **Auto Repair and Fueling**
- **Bus and Taxi Driving**
- **Cold Storage**
- **Construction and Demolition**
- **Dairy Farming**
- **Fishing and Diving**
- **Ice Making**
- **Logging**
- **Maritime**
- **Meat Packing, Fresh and Frozen Food**
- **Mining, Oil and Gas Drilling**
- **Police, Fire, and Emergency Responders**
- **Postal and Other Delivery**
- **Pulp and Paper**
- **Railroad and Trucking**
- **Road Repair**
- **Ski Resorts and other Outdoor Recreation**
- **Snow and Trash Removal**
- **Utility Repair**
- **Warehousing**

Richard J. Codey
Acting Governor

New Jersey Department of Health and Senior Services
Occupational Health Service
Occupational Health Surveillance Program
PO Box 360, Trenton, NJ 08625-0360
(609) 984-1863
www.state.nj.us/health/eoh/survweb/

Fred M. Jacobs, MD, JD
Acting Commissioner

Indirect cold-related health problems

Disease flare-ups: Conditions like arthritis and asthma can be made worse in cold environments.

Increase in injuries: Cold weather can decrease dexterity, mental skills, coordination, and cause a general decline in performance that affects safety.

Strains and sprains: Working in cold weather can increase the risk of injuries to muscles and tendons, for example, back strain.

Other health effects: Sinus irritation, viral infections, chronic lung disease, arthritis.

Factors that increase danger from the cold

Air movement: High wind exposure, strong ventilation, moving through air -- as in an open vehicle.

Wetness: Wet skin, clothing or shoes from being wet with water, gasoline, alcohol, solvent, or other liquid that evaporates.

Sweating: Wet skin, clothing or shoes from sweating.

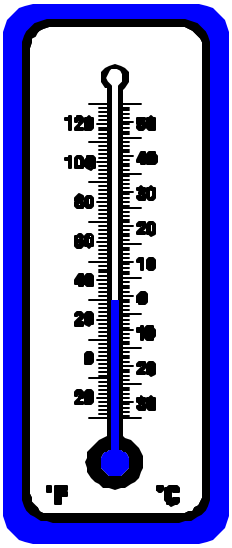
Under-dressing: Exposed fingers, cheeks, nose, ears; uncovered head.

Over-dressing: Too-thick clothing rather than layers; tight-fitting belt, clothing or shoes that restrict circulation; waterproof clothing that restricts evaporation.

Low activity level: Standing or sitting still, driving.

Contact with cold objects: These take the heat out of the body.

Being tired, hungry or thirsty: These keep the body from replacing lost heat.



Medical conditions: Especially those affecting circulation, such as diabetes, an underactive thyroid, heart disease, history of frostbite.

Medications: Some medications such as tranquilizers and beta-blockers cause drowsiness or decrease vasoconstriction.

Alcohol, caffeine, nicotine: Alcohol impairs judgement and reduces shivering. Caffeine increases urine production and blood circulation; both lead to a loss of body heat. Nicotine decreases blood flow to the extremities and raises the risk of cold injury.

Control measures to prevent cold-related injuries

1. Keep Track of the Temperature and Air Movement and Link to an Action Program

Indoors: Readings of temperature and air movement should be taken in all cold work areas at the start, middle, and end of each shift, at least every four hours.

Outdoors: The weather report can be used.

Wind Chill Chart: Where there is air movement from wind, ventilation or travel in an open vehicle like a forklift, the wind chill index should be used to evaluate the hazard, rather than the air temperature. The wind chill index takes into account the wind blowing the heat away from the body. If you know the temperature and speed of air movement, the wind chill can be looked up in **Table 1**, page 7.

2. Raise the Temperature The first line of defense against cold is to warm things up. A refrigerated room can be kept at the maximum allowable temperature. Outdoor work can be postponed to a warmer day, using weather forecasts for planning. Warm air jets, radiant heaters, and contact warm plates can be provided for spot heating. Infrared radiant heaters warm people and objects but not the air and therefore may be cost-effective in warehouses, loading docks, and other large, unheated indoor spaces.

3. Use Warming Shelters Heated tents, cabins, break rooms, etc. should be available to workers. The colder the temperature and the higher the wind speed, the more often special warm-up breaks should be taken in these shelters. Breaks should be

KEROSENE HEATER WARNING

Kerosene heaters present a number of serious hazards -- fire or explosion, burns, carbon monoxide poisoning, and other toxic gases.

Never use a kerosene heater in a small, tightly closed room.

at least 20 minutes to allow for re-warming. The onset of heavy shivering, frostnip or minor frostbite, the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the warming shelter. The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended the work/ warm up schedules in **Table 2**, page 7. For example, at -20 to -24 degrees Fahrenheit (°F) with a wind speed of five miles per hour (mph) [440 feet per minute (fpm)], the ACGIH recommends two warm up breaks in a 4-hour period, with a maximum work period of 75 minutes. Note that the table also gives several ACGIH recommendations on when non-emergency work should cease -- for example, below -35 °F with a 10-mph (880 fpm) wind speed.

4. Control Effects of Air Movement An increase of just one mph (88 fpm) in wind speed can double the chance of cold injury. Wind can be blocked by wind shields. In refrigerated rooms, air speed can be minimized as much as possible by properly designed air distribution systems and should not exceed 2.3 mph (200 fpm). Special wind-protective clothing can be provided.

5. Stay Dry Heavy sweating will result in wet clothing. The work rate should be fast enough to keep warm, but not so fast as to cause heavy sweating. Clothing that has become wet either from sweating, rain, snow, or other water source should be changed. When entering a heated shelter, snow or frost on clothing should be brushed off before it melts, the outer layer of clothing should be removed and the remainder of the clothing loosened to permit sweat evaporation. Snow should be kept out of clothing, boots and gloves.

6. Wear Loose-fitting, Layered Protective Clothing *NOTE: Selection of cold weather protection should be done in compliance with OSHA and PEOSH standards on personal protective equipment (PPE). These are 1910.132 for general requirements, 1910.136 for foot protection, and 1910.138 for hand protection. A hazard assessment is a key requirement. There are separate PPE standards for construction, maritime, and agriculture. Resources on the PPE Standard are given at the end of this fact sheet.*

Three layers of body, hand, foot, and head protection should be used!

Protection should be loose-fitting with at least three layers so as to trap air and provide insulation. At the same time, it is important that protection be permeable to perspiration. Only if very light work is involved should the outer layer of body protection be waterproof. Desirable features in cold weather clothing include hand-warmer pockets, hoods, Velcro® adjustable cuffs, removable linings, and easy control of openings at neck, underarms, and wrists to regulate ventilation of interior space.

Inner wicking layer: An inner layer of protection made of a wicking material, such as cotton or polypropylene, will help to draw moisture away from the skin.



Middle insulating layer: Wool, down, fleece or other material with loft will hold the body's heat without adding weight. Protective clothing has improved with the introduction of synthetic fabrics



that are lighter, more insulating, and faster-drying than wool, for example, polyester fleece like Polartec.®

Outer layer for wind and water protection: Water-repellent outer fabrics will let air pass through them and can be changed as they become too wet. There are now waterproof fabrics that are also breathable, for example, Gore-Tex.® This layer may also need to be resistant to oil, fire, chemicals, or abrasion.

Hand protection: Protection of the hands is important not only to prevent injury but also to maintain dexterity and prevent accidents. Layer with glove liners, gloves, then mittens. For jobs requiring dexterity, there are fingerless gloves with attached mittens that can be temporarily folded back. The ACGIH recommends gloves if the air temperature falls below 60.8 °F for sedentary, 39.2 °F for light, and 19.4 °F for moderate work. If fine work is to be performed with bare hands for more than 10-20 minutes, special provisions such as warm air jets, radiant heaters, or contact warm plates should be made. Below 0 °F, the ACGIH recommends mittens which protect better than gloves. Machine controls and tools for use in cold conditions should be designed so they can be handled without removing the mittens. Metal handles should be covered by thermal insulating material at temperatures below 30.2 °F. Warning signs should be placed on cold surfaces below 20 °F.



Foot protection: The feet and toes are highly susceptible to cold injury. Layer with sock liners, woolen or polyester socks, then waterproof insulated boots. Military vapor-barrier boots and Native Alaskan-inspired mukluk boots are models of good boots. Removable felt liners should be used in boots and removed daily for complete drying. Socks should be changed if damp. Boots may need to have a steel-toe if crushing hazards are present. Tight-fitting shoes should be avoided because they restrict blood circulation and don't allow air to be trapped in socks for insulation.



Head and face protection: Hats, hoods, and masks not only prevent frostbite to the cheeks, ears and nose but also conserve heat loss from the head. Forty percent of heat loss is through the head. Removing headgear is an important way to decrease body temperature when overheated.



7. Have a Change of Clothing for an Emergency In case of wetting or excessive sweating, a complete change of clothing, shoes, hat, gloves, etc., should be available.

8. Eat and Drink Well Workers can prepare for work in the cold by eating a high calorie diet to maintain a larger reserve of stored energy. Dehydration or the loss of body fluids can be a problem

in the cold. Warm, sweet drinks, and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee, tea, cola, and alcohol should be limited.



9. Use a Buddy System The ACGIH recommends that below 10.4 °F workers should be under constant protective observation by a co-worker or supervisor. New employees should not be required to work full-time in the cold during the first days on the job until they become accustomed to the working conditions and required protective clothing.

10. Prepare for Vehicle Breakdowns Workers who must travel in cold weather should be supplied with extra warm clothing, gloves, and blankets, as well as normal vehicle emergency supplies.

11. Worker Education Workers exposed to cold should receive initial and annual training regarding the health effects of cold exposure, proper rewarming procedures, recognition and first aid for frostbite and hypothermia, required protective clothing, proper use of warming shelters, the buddy system, vehicle breakdown procedures, and proper eating and drinking habits for working in the cold. *NOTE: The PPE Standard requires that employers certify in writing that training on PPE use, care, and limitations has been provided and that employees understand what they have been taught.*

12. Medical Checkups Workers should be checked by a physician to assure that they are not suffering from diseases or taking medications which interfere with normal body temperature regulation or reduce tolerance for cold environments.

13. Proper Medical Treatment *Treatment of cold-related health problems in a medical facility can make the difference between full recovery and lifelong problems.* **Treatment for frostbite** involves rapid rewarming of the affected parts in 104-108 °F water and oral and topical therapy to limit inflammation. **Treatment for hypothermia** involves whole body re-warming from the inside out, *not immersion or exercise*. Because internal organs, including the heart, are cold, people suffering from hypothermia are at increased risk of heart attacks. Helpful measures (until transport to a medical facility) include moving the worker to a warm, dry location, warm liquids, removing wet clothing, adding layers of dry clothing, placing the victim in a pre-warmed sleeping bag, preferably with a warm person, and heat packs in the armpits, neck, chest, and groin. *Severe hypothermia can mimic death. Victims should receive medical care even if they show no signs of life.*



Resources on Cold Safety

Weather Reports and Forecasts

- Local newspapers, TV and radio stations
- **National Weather Service**
  www.nws.noaa.gov
- **The Weather Channel**
  www.weather.com

Educational Materials

- **Protecting Workers in Cold Environments**, OSHA Fact Sheet, 12/22/98, free, *www.osha.gov/OshDoc/Fact_data/FSNO98-55.html* or call OSHA Publications, (202) 693-1888
- **Cold Weather Safety Guide**, CCOHS booklet, $10.00, Canadian Center for Occupational Safety and Health
  1-800-668-4284 or (905) 570-8094
  e-mail: custserv@cchos.ca
- **Learn2 Avoid Frostbite,** on-line tutorial for the lay person
  www.learn2.com

Articles and Reviews

- **Cold Environments and Cold Work**
  Homer, I; Granberg, P; Dahlstrom, G
  Encyclopedia of Occupational Health and Safety, Fourth Edition, 1998, 42.29-42.44
- **Cold Exposure Injuries: Prevention and Treatment**
  Fritz, RL; Perrin, DH
  Clin Sports Med, 1989, Jan; 8(1):11-28
- **Frostbite: Review and Current Concepts**
  Reamy, BV
  J Am Board Fam Pract, 1998, Jan-Feb; 11(1):34-40
- **Work in the Cold. Review of Methods for Assessment of Cold Exposure**
  Holmer, I
  Int Arch Occup Envir Health, 1993; 65(3):147-55

Exposure Limits

- **Thermal Stress, Cold Stress**, 1999 TLVs® and BEIs®, pages 159-167, ACGIH, (513) 742-2020, $19.50
  e-mail: customerservice@acgih.org
  www.acgih.org

Cold Weather Clothing, Shoes, Gloves

- Yellow Pages under "Safety Equipment and Clothing"
- Camping and Outdoor Stores, Department Stores
- Thomas Register, directory of vendors available in many libraries and on-line at: *www.thomasregister.com*
- On-line Buyer's Guides for Health and Safety equipment:
  www.ohsonline.com
  www.ohinteractive.com

OSHA/PEOSH Personal Protective Equipment Standard

- **Personal Protective Equipment**, OSHA Publication 3077, 1998, free, call OSHA Publications, (202) 693-1888
- **Assessing the Need for Personal Protective Equipment: A Guide for Small Business Employers**, OSHA Publication 3152, $4.25, call U.S. Gov't Printing Office, (202) 512-1800
  www.gpo.gov/
- **Assessing the Need for Personal Protective Equipment**, April 1999, OSHA Office of Training and Education. A set of training materials that includes a slide presentation and various checklists to help employers. May be borrowed from OSHA Area Offices, OSHA consultation, or purchased from NTIS, 5285 Port Royal Rd., Springfield, VA 22161
  1-800-553-NTIS or (703) 605-6000
  e-mail: orders@fedworld.gov
  www.ntis.gov
  Order AVA20431KKOO, $140.00

Table 1
Wind Chill Index

Wind speed (mph)	Actual Thermometer Reading in Degrees Fahrenheit (°F)								
	50	40	30	20	10	0	-10	-20	-30
	Equivalent Chill Temperature (°F)								
0	50	40	30	20	10	0	-10	-20	-30
5	48	37	27	16	6	-5	-15	-26	-36
10	40	28	16	4	-9	-24	-33	-46	-58
15	36	22	9	-5	-18	-32	-45	-58	-72
20	32	18	4	-10	-25	-39	-53	-67	-82
25	30	16	0	-15	-29	-44	-59	-74	-88
30	28	13	-2	-18	-33	-48	-63	-79	-94
35	27	11	-4	-20	-35	-51	-67	-82	-98
40	26	10	-6	-21	-37	-53	-69	-85	-100
over 40 - little added effect	Little danger for properly clothed person if less than one hour exposure with dry skin.				Danger. Exposed flesh may freeze within one minute.			Great danger. Exposed flesh may freeze within 30 seconds.	

Immersion foot may occur at any point on this table.

Table 2
Work/warm-up Schedule for 4-hour Shift Working in the Cold

Air Temp.	No wind		5 mph wind		10 mph wind		15 mph wind		20 mph wind	
Degrees Fahrenheit (°F)	max. work period	# of breaks	max. work period	# of breaks	max. work period	# of breaks	max. work period	# of breaks	max. work period	# of breaks
-15 to 19 °F	(normal breaks) 1		(normal breaks) 1		75 min.	2	55 min.	3	40 min.	4
-20 to -24 °F	(normal breaks) 1		75 min.	2	55 min.	3	40 min.	4	30 min.	5
-25 to -29 °F	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease	
-30 to -34 °F	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease			
-35 to -39 °F	40 min.	4	30 min.	5	Non-emergency work should cease					
-40 to -44 °F	30 min.	5	Non-emergency work should cease							
-45°F and below	Non-emergency work should cease									

Table applies only if workers are wearing dry clothing and doing moderate to heavy work activity. For light to moderate work activity, move down one line to decrease maximum work period and increase the number of breaks.

Source: Thermal Stress, Cold Stress, 1999 TLVs® and BEIs,® pages 159-167, ACGIH, Cincinnati, OH

Attachment 7

ROBERT WOOD JOHNSON UNIVERSITY HOSPITAL

Bee Stings

The danger of bee stings

The two greatest risks from most insect stings are allergic reaction (which occasionally could be fatal in some individuals) and infection (more common and less serious).

Bees, wasps, yellow jackets, and hornets belong to a class of insects called Hymenoptera. Most insect stings cause only minor discomfort. Stings can occur anywhere on the body and can be painful and frightening. Over 95 percent of stings are from honey bees or yellow jackets. Fire ants, usually found in southern states, can sting multiple times, and the sites are more likely to become infected.

What are the symptoms of an insect sting?

The following are the most common symptoms of insect stings. However, each individual may experience symptoms differently. Symptoms may include:

- Local skin reactions at the site or surrounding the sting, including the following:
  - Pain
  - Swelling
  - Redness
  - Itching
  - Warmth
  - Small amounts of bleeding or drainage
  - Hives
- Generalized symptoms that indicate a more serious and possibly life-threatening allergic reaction, including the following:
  - Coughing
  - Tickling in the throat
  - Tightness in the throat or chest
  - Breathing problems or wheezing
  - Nausea or vomiting
  - Dizziness or fainting
  - Sweating
  - Anxiety
  - Itching and rash elsewhere on the body, remote from the site of the sting

Treatment for stings

Specific treatment for stings will be determined by your doctor. Large, local reactions usually do not lead to generalized reactions. However, they can be life-threatening if the sting occurs in the mouth, nose, or throat area. This is due to swelling that can close off the airway.

Treatment for local skin reactions may include the following:

- Calm the individual and let him/her know that you can help.
- Remove the stinger by gently scraping across the site with a blunt-edged object, such as a credit card or dull knife. Do not try to pull it out, as this may release more venom.
- Wash the area well with soap and water.
- Apply a cold or ice pack wrapped in a cloth to help reduce swelling and pain (10 minutes on and

10 minutes off for 30 to 60 minutes).

- If the sting occurs on an arm or leg, elevate the limb to help reduce swelling.
- To help reduce the itching, consider the following:
    - Apply a paste of baking soda and water and leave it on for 15 to 20 minutes.
    - Apply a paste of nonseasoned meat tenderizer and water and leave it on for 15 to 20 minutes.
    - Apply a wet tea bag and leave it on for 15 to 20 minutes.
    - Use an over-the-counter product made to use on insect stings.
    - Apply an antihistamine or corticosteroid cream or calamine lotion.
    - Give acetaminophen for pain.
    - Give an over-the-counter antihistamine, if approved by your doctor.
    - Observe the individual closely for the next hour for any signs of allergic reaction that would warrant emergency medical treatment.

Call 911 or your local emergency medical service (EMS) and seek emergency care immediately if the individual is stung in the mouth, nose, or throat area, or for any signs of a systemic or generalized reaction.

Emergency medical treatment may include the following:

- Intravenous (IV) antihistamines
- Epinephrine
- Corticosteroids or other medications
- Lab tests
- Breathing support

Prevention of insect stings

Some general guidelines to help reduce the possibility of insect stings while outdoors include the following:

- Avoid perfumes, hairsprays, and other scented products.
- Avoid brightly colored clothing.
- Do not go outside barefoot.
- Spray clothing with the appropriate repellent.
- Avoid locations where hives and nests are present. Have the nests removed by professionals.
- Teach your child that if an insect comes near to stay calm and walk away slowly.

Some additional preventive measures for persons who have a known or suspected allergy to stings include the following:

- Carry a bee sting kit (such as Epi-Pen) at all times and know how to use it. These products are available by prescription.
- Make sure your child wears long-sleeve shirts and long pants when playing outdoors.
- See an allergist for allergy testing and treatment.

Click here to view the Online Resources of Non-Traumatic Emergencies

Ticks and Lyme Disease (LD)

The danger of tick bites

While most tick bites are harmless, several species can cause life-threatening diseases. Two of these well-known diseases are Rocky Mountain Spotted Fever and Lyme disease. Ticks can also transmit tularemia (a plague-like disease in rodents that can be transmitted to man), relapsing fever, and ehrlichiosis (an abrupt illness consisting of fever, rash, nausea, vomiting, and weight loss).

What is Lyme disease?

Lyme disease (LD) is a multi-stage, multi-system bacterial infection caused by the spirochete Borrelia burgdorferi, a spiral shaped bacterium that is most commonly transmitted by a tick bite. The disease takes its name from Lyme, Connecticut, where the illness was first identified in the United States in 1975.

According to the Centers for Disease Control and Prevention (CDC), Lyme disease continues to be a rapidly emerging infectious disease, and is the leading cause of all insect-borne illness in the US. According to the CDC, LD cases more than doubled during the surveillance period of 1992 to 2006. In 2008, there were nearly 23,000 confirmed cases and nearly 7,000 probable cases of LD.

What types of ticks transmit LD?

- Ixodes scapularis (northeastern, mid-Atlantic, and north-central U.S., black-legged deer tick)
- Ixodes pacificus (Pacific coastal U.S., Western black-legged tick)

Ticks prefer to live in wooded areas, low-growing grasslands, and yards. Depending on the location, anywhere from less than 1 percent to more than 50 percent of the ticks are infected with spirochetes.

Although Lyme disease is a year-round problem, April through October is considered tick season. Cases of Lyme disease have been reported in nearly all states in the U.S. and in large areas in Europe and Asia.

What are the symptoms of Lyme disease?

The list of possible symptoms is long, and symptoms can affect every part of the body. The following are the most common symptoms of Lyme disease. However, each individual may experience symptoms differently:

The primary symptom is a red rash that:

- Can appear several days after infection, or not at all.
- Can last up to several weeks.
- Can be very small or very large (up to 12 inches across) and may resemble a "bulls-eye."
- Can mimic, such skin problems as hives, eczema, sunburn, poison ivy, flea bites.
- Can itch or feel hot, or may not be felt at all.
- Can disappear and return several weeks later.

Several days or weeks after a bite from an infected tick, a patient usually experiences flu-like symptoms such as the following:

- Headache
- Stiff neck
- Aches and pains in muscles and joints
- Low-grade fever and chills

- Fatigue
- Poor appetite
- Swollen glands

After several months, arthritis-like symptoms may develop, including painful and swollen joints.

Other possible symptoms may include the following:

- Neurological symptoms
- Heart problems
- Skin disorders
- Eye problems
- Hepatitis
- Severe fatigue
- Limb weakness
- Poor motor coordination

Some people may develop post-Lyme disease syndrome (PLDS), a condition also known as chronic Lyme disease, characterized by persistent musculoskeletal and peripheral nerve pain, fatigue, and memory impairment.

How is Lyme disease diagnosed?

Lyme disease is difficult to diagnose because symptoms are not consistent and may imitate other conditions. The primary symptom is a rash, but it may not be present in up to 20 percent of cases.

Diagnosis for Lyme disease is a clinical one and must be made by a physician experienced in recognizing LD. Diagnosis is usually based on symptoms and a history of a tick bite. Testing is generally done to eliminate other conditions and may be supported through blood and laboratory tests, although these tests are not absolutely reliable for diagnosing LD.

Research is underway to develop and improve methods for diagnosing LD.

The symptoms of Lyme disease may resemble other medical conditions or problems. Always consult your doctor for a diagnosis.

What is the treatment for Lyme disease?

Specific treatment for Lyme disease will be determined by your doctor based on:

- Your age, overall health, and medical history
- Extent of the symptoms
- Your tolerance for specific medications, procedures, or therapies
- Expectations for the course of the condition
- Your opinion or preference

Lyme disease in the earliest stage is usually treated with antibiotics for three weeks.

Treatment will also be considered based on these and other factors:

- If you are bitten by a tick that tests positive for spirochetes.
- If you are bitten by a tick and have any of the symptoms.
- If you are bitten by a tick and are pregnant.
- If you are bitten by a tick and live in an endemic, high-risk area.

Relapse and incomplete treatment responses occur. Complications of untreated early-stage disease include: joint disease, neurologic disease, carditis, and frequent hospitalizations to manage the disease. Some of these complications result in chronic, debilitating conditions.

How can LD be prevented?

Humans do not develop immunity to LD and reinfection is possible. In 1998, the US Food and Drug Administration (FDA) had approved a new vaccine against Lyme disease called LYMErix. The vaccine was not 100 percent effective, however, and the FDA still recommended using other preventive

measures. In 2002, the manufacturer of LYMErix announced that the vaccine would no longer be available commercially.

Some general guidelines for preventing LD include the following:

- Dress appropriately by wearing:
  - Light-colored clothing
  - Long-sleeved shirts
  - Socks and closed-toe shoes
  - Long pants with legs tucked into socks
- Frequently check for ticks on:
  - All parts of the body that bend: behind the knees, between fingers and toes, and underarms.
  - Other areas where ticks are commonly found: belly button, in and behind the ears, neck, hairline, and top of the head.
  - Areas of pressure points, including:
    - Where underwear elastic touches the skin.
    - Where bands from pants or skirts touch the skin.
    - Anywhere else where clothing presses on the skin.
- Visually check all other areas of the body, and run fingers gently over skin.
- Shower after all outdoor activities are over for the day.
- Consider using repellents:
  - Products that contain DEET are tick repellents, but do not kill the tick and are not 100 percent effective in discouraging a tick from feeding on you.
  - Products that contain permethrin are known to kill ticks; however, they should not be sprayed on the skin but on clothing.
- Check pets and children for ticks.

What should you do if you find a tick?

- Do not touch the tick with your bare hand.
- Use a pair of tweezers to remove the tick. Grab the tick firmly by its mouth or head as close to your skin as possible.
- Pull up slowly and steadily without twisting until it lets go. Do not squeeze the tick, use petroleum jelly, solvents, knives, or a lit match to kill the tick.
- Save the tick and place it in a plastic container or bag so it can be tested for disease, if necessary.
- Thoroughly wash the bite area with soap and water and apply an antiseptic lotion or cream.
- Call your doctor to find out about follow-up care and testing of the tick for spirochetes (organisms that may be carried by the tick).

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OSHA FactSheet

Protect Yourself! Workers may be exposed to

Brown Recluse Spider

The brown recluse belongs to a group of spiders commonly known as violin spiders or fiddlebacks. The characteristic fiddle-shaped pattern is located on the top of the leg attachment region (cephalothorax). Because they are secluded and withdrawn, as their name implies, the brown recluse avoids open spaces. Brown recluse spiders are dangerous and they can bite and inject toxic venom.

Identification

- Body size: 1/4 to 3/4 inch (6.4-19.1mm)
- Color: Golden brown
- A dark violin/fiddle shape (see top photo) is located on the top of the leg attachment region (cephalothorax) with the neck of the violin/fiddle pointing backward toward the abdomen.
- Unlike most spiders that have 8 eyes, the brown recluse has 6 eyes. The eyes, arranged in pairs – one pair in front and a pair on either side – can be readily seen under low magnification.

Habitat

The Brown Recluse Spider builds small retreat webs behind objects of any type.

Symptoms

- The severity of the bite may vary. Symptoms may vary from none to very severe.
- The bite generally becomes reddened within several hours.



Photo: R. Bessin, University of Kentucky



Photo: creatures.ifas.ufl.edu

- There is often a systemic reaction within 24-36 hours characterized by restlessness, fever, chills, nausea, weakness and joint pain.
- Tissue at the site of the bite and the surrounding area dies and eventually sheds.

Protection

- Wear a long-sleeved shirt, hat, gloves, and boots when handling stored boxes, firewood, lumber and rocks, etc.
- Inspect and shake out clothing and shoes before getting dressed.
- Use insect repellants, such as DEET or Picaridin, on clothing and footwear.

Treatment

- Clean the bite area with soap and water.
- Apply ice to the bite area to slow absorption of the venom.
- Elevate and immobilize the bitten extremity.
- Capture the spider, if at all possible, for identification purposes.
- Seek medical attention.

This is one in a series of informational fact sheets highlighting OSHA programs, policies or standards. It does not impose any new compliance requirements. For a comprehensive list of compliance requirements of OSHA standards or regulations, refer to Title 29 of the Code of Federal Regulations. This information will be made available to sensory impaired individuals upon request. The voice phone is (202) 693-1999; teletypewriter (TTY) number: (877) 889-5627.

For more complete information:

OSHA Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov

(800) 321-OSHA

DSG 10/2005

OSHA FactSheet

Protect Yourself! Workers may be exposed to

Black Widow Spider

The black widow belongs to a group of spiders commonly known as cobweb spiders. The characteristic hourglass is located on the underside of the abdomen. Female black widows are dangerous and can bite and inject toxic venom.

Identification

- The female black widow is normally shiny black, with a red hourglass marking (see photo) on the underside of the abdomen.
- The abdominal marking may range in color from yellowish orange to red and its shape may range from an hourglass to a dot.
- The body of an adult black widow female is about 1/2 inch long.



Photo: Extension Entomology, Texas A&M University



Photo: University of Missouri Extension

Habitat

The black widow is commonly found in the following places:

- Outdoors - woodpiles, rubble piles, under stones, in hollow stumps, and in rodent burrows, privies, sheds and garages.
- Indoors - undisturbed, cluttered areas in basements and crawl spaces.

Symptons

- The bite of the black widow may be painful or it may go unnoticed.
- The skin may display one or two bite marks with local swelling. Pain usually progresses from the bite site and eventually to the abdomen and back.
- Severe cramping or rigidity may occur in the abdominal muscles.
- Symptoms may include nausea, profuse perspiration, tremors, labored breathing, restlessness, increased blood pressure and fever.
- The pain from the bite will usually persist for the first 8-12 hours.
- Symptoms may continue for several days.

Protection

- Wear a long-sleeved shirt, hat, gloves, and boots when handling boxes, firewood, lumber, and rocks, etc.
- Inspect and shake out clothing and shoes before getting dressed.
- Use insect repellants, such as DEET or Picaridin, on clothing and footwear.

Treatment

- Clean the bite area with soap and water.
- Apply ice to the bite area to slow absorption of the venom.
- Elevate and immobilize the extremity.
- Capture the spider, if at all possible, for identification purposes.
- Seek medical attention immediately.
- If you have a heart condition or other heart problem, you may need hospitalization.

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DSG 10/2005

Wildlife Damage Management Fact Sheet Series

Snakes

Kristi L. Sullivan and Paul D. Curtis
Cornell Cooperative Extension, Wildlife Damage Management Program

Seventeen species of snakes, which occupy a variety of different habitats, can be found in New York State (Table 1). Eight of these species—the water snake, brown snake, redbelly snake, eastern garter snake, ribbon snake, ringneck snake, smooth green snake, and milk snake—occur statewide. Of these, the garter snake is the most common and the species most likely to be encountered near residences. Others, like the eastern worm snake or eastern massasauga, are rare and occur in isolated patches. The eastern hognose snake and the eastern worm snake are species of special concern in New York State, the timber rattlesnake is threatened, and the eastern massasauga and the queen snake are endangered. Of the 17 species of snakes, three—the northern copperhead, eastern massasauga, and timber rattlesnake—are venomous. The other species are nonvenomous. Snakes do not actually cause damage, but an occasional snake that enters a home or other building may be considered an unwelcome visitor. All snakes native to New York State play an important ecological role, both as predators and as prey for other species.

General Biology

Snakes are specialized animals with elongated bodies and no legs. They have no ears, externally or internally, and no eyelids, although they do have a protective window over the eye. A snake's organs are elongated. They have a long, forked tongue that helps them smell. Gaseous particles from odors are picked up by the tongue and inserted into a two-holed organ, called the Jacobson's Organ, at the roof of the mouth.

The two halves of a snake's jaw are not fused together but are loosely connected by a ligament, allowing it to swallow food much larger than its head. Snakes are poikilotherms (temperature varies with outside environment) and are not very active. Therefore, one meal may last them several weeks. Because snakes are poikilotherms they hibernate during cold winter months during which they consume no food. Some snakes, like the milk snake, lay eggs in loose soil, hollow trees, or piles of sawdust. Others, like the garter snake, give birth to live young.

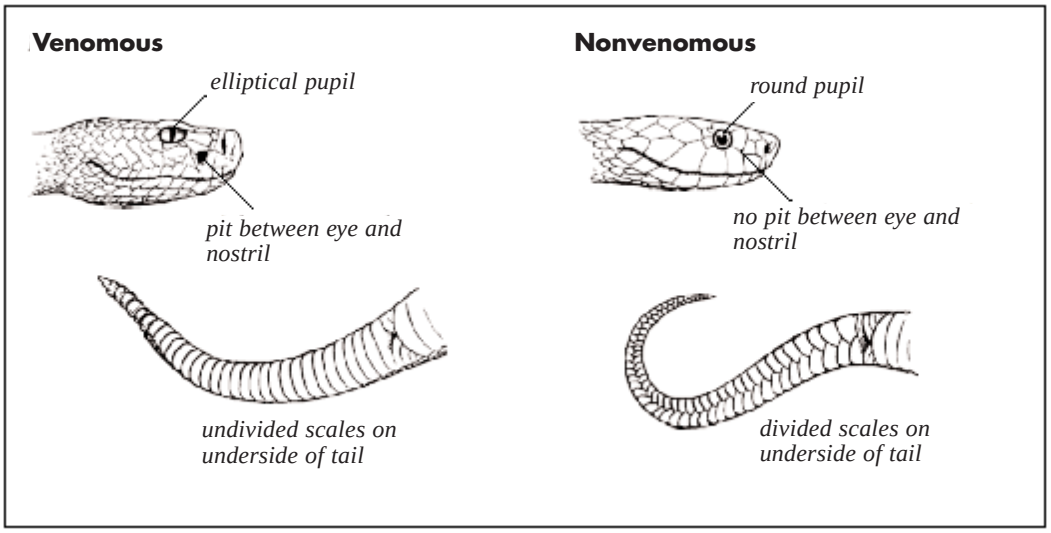


Figure 1. Distinctions between venomous and nonvenomous snakes

Snakes are very faithful to specific den and nesting sites in their home range, which they may share with snakes of the same or different species. Snakes also may use the same nesting sites year after year. Because they are very tied to the sites they use and may occur in large numbers in those places, they are very vulnerable to habitat destruction and persecution.

Habitat and Food Habits

Snakes live in a variety of different habitats. Some, like the eastern worm snake, live underground, rarely venturing onto the surface except on warm, humid nights. Others, such as the green snake, live in grassy openings. The water snake and ribbon snake make their homes in wetlands and near other bodies of water. Most snakes, however, prefer sunny areas where rock piles, logs, and other debris provide cool, shaded hiding places. Around the home snakes are attracted to stacks of firewood, old lumber piles, junk piles, rock walls, old wells and foundations, flower beds with heavy mulch, gardens, shrubbery growing against foundations, banks of streams and ponds, unmowed lawns, abandoned lots and fields, basements, and barn lofts (especially where rodents are abundant).

The most common species that people encounter in and around the home in New York are the garter snake, milk snake, and water snake. Garter snakes use a wide variety of habitats, from woodlands to marshes to fields. These snakes are variable in color and pattern. The basic color is dark brown or green with three yellowish stripes down the sides and back. They may reach lengths of two feet but are typically smaller. Garter snakes feed on earthworms, amphibians, carrion, insects, small birds, slugs, fish, crayfish, and other snakes.

The milk snake is frequently encountered in barns or other areas where its food—rodents and other snakes—may be present. The milk snake is boldly patterned (brown or reddish blotches on a light gray to tan body) above with a distinctive black and white checkered underside. The milk snake may vibrate its tail when annoyed.

The water snake is common in aquatic and semiaquatic habitats such as rivers, brooks, wet meadows, ponds, and swamps. It prefers areas with branches or logs overhanging the water or boulders near dams and bridges. As an adult, it is a stout animal typically dark brown to black with lighter-colored bands and splotches along its length. Although not venomous, the water snake is an aggressive species that will not hesitate to bite. These snakes often will sun on boat docks to the consternation of many beach-front property owners.

In addition to the snake species most commonly found around homes, several others may be encountered. The northern brown, redbelly, ringneck, and green snakes are all small, slender species that are well described by their names. These species feed on insects, spiders, earthworms, slugs, and amphibians.

The northern brown snake is brown to grayish in color with a broad light stripe bordered by dark spots down its back.

The northern redbelly snake is typically brown, bronze, or slate gray on its back, with an underside of red, orange, or occasionally yellow.

The ringneck is slate gray, black, or brown with smooth scales that give it a satin appearance. It is distinguished by a complete yellow band around its neck. The ringneck feeds primarily on salamanders but will also eat earthworms, insects, and an occasional fish.

Beautiful and light green in color, the smooth green snake is unmistakable and striking in appearance. This small, docile species feeds on crickets, grasshoppers, caterpillars, beetles, spiders, centipedes, and millipedes.

The eastern ribbon snake is slender and striped and resembles the garter snake but has a much longer tail, accounting for one-third or more of its total body length. It has three bold yellow stripes that run along its reddish-brown back. The ribbon snake prefers to feed on amphibians but will also eat fish and insects.

A fascinating creature, the eastern hognose snake has a thick body and an upturned nose. It has a yellow, gray, brown, olive, or black background color, with a pattern of large rectangular spots down the middle of the back that alternate with dark spots on the side. Hognose snakes put on a defensive display when frightened, spreading the skin around their necks like a cobra, hissing and lunging. Nevertheless, they almost never bite. Hognose snakes prefer to feed on toads, though they will also take frogs, salamanders, small mammals, birds, and invertebrates.

The northern black racer is a large black snake with smooth scales, a white or gray throat, and a dark belly from its throat back. Black racers feed on a variety of prey, including other snakes and the young of their own species.

Though usually smaller, the black rat snake can reach a length of up to eight feet. Black with a white or yellow chin and throat, it differs from the black racer in that its belly is a mixture of white and black. Black rat snakes feed on small mammals, birds, and bird eggs and are adept climbers.

The copperhead is a copper-colored, thick-bodied venomous snake. It has dark yellowish or light brown bands that alternate with darker bands that form an hourglass pattern along the length of the snake. Though often confused with other nonvenomous snakes, the copperhead has the distinctive characteristics of venomous snakes including a broad, triangular shaped head and vertical pupils. Copperheads eat small mammals such as mice and voles, small birds, amphibians, insects, and other snakes.

The timber rattlesnake is a large, thick-bodied snake with a rattle at the tip of its tail. The rattlesnake has two different color phases, yellow to brown (yellow phase) or gray to black (black phase). The rattlesnake's primary foods are mammals, including mice, shrews, chipmunks, squirrels, and rabbits.

Description of Damage

Snakes are attracted to cool, damp, dark areas associated with buildings, particularly if the structure is home to rodents or insects. Snakes may enter houses through torn screens, open basement windows, or cracks in foundation walls or floors. They may also be found in barns, sheds, or other outbuildings. Snakes may bite if threatened or handled. Many species will excrete a foul-smelling musk if handled.

Nonvenomous snakes



Black rat snake



Common garter snake



Eastern hognose snake



Eastern milk snake



Eastern ribbon snake



Northern black racer



Northern brown snake



Northern ringneck snake



Northern water snake



Red-bellied snake

Venomous snakes



Northern copperhead



Timber rattlesnake

Table 1. Snakes of New York

Common Name	Habitat	Distribution and Abundance	Disposition
Black rat snake *(Elaphe o. obsoleta)*	Woodlands, thickets, field edges, farmlands	Scattered pockets in upstate New York	Large size makes it intimidating
Common garter snake *(Thamnophis sirtalis)*	Almost all damp environments	Throughout New York	Most are docile
Eastern hognose snake *(Heterodon platirhinos)*	Sandy soils, wetlands, and occasionally on rocky slopes	Coastal plains of New York and Hudson River Valley	Usually docile but can put on an aggressive display
Eastern massasauga *(Sistrurus c. catenatus)*	Marshy areas or bogs in western New York	Two small, isolated populations in Onondaga and Genesee Counties	Defensive
Eastern milk snake *(Lampropeltis t. triangulum)*	Variety of habitats with brushy or woody cover	Throughout New York	Docile
Eastern ribbon snake *(Thamnophis sauritus)*	Stream edges, swampy areas, wet meadows, ponds, bogs, and ditches	Throughout New York	Docile
Eastern worm snake *(Carphophis a. amoemus)*	Sandy areas, dry to moist forests, weedy pastures	Coastal plains of New York and north to Albany County	Docile
Northern black racer *(Coluber c. constrictor)*	Wooded areas, fields, roadsides, swamps, clearings	Southern New York, Long Island	Most are docile but large size may be intimidating
Northern brown snake *(Storeria d. dekayi)*	Almost every habitat type	Throughout New York	Docile
Northern copperhead *(Agkistrodon contortrix mokasen)*	Forested rocky ridges, wooded swamps, near pond or stream edges	Patches in the lower Hudson Valley	Defensive
Northern redbelly snake *(Storeria o. occipitomaculata)*	Moist woods, hillsides, upland meadows	Throughout New York	Docile
Northern ringneck snake *(Diadophis punctatus edwardsii)*	Moist, shady woodlands	Throughout New York	Docile
Northern water snake *(Nerodia s. sipedon)*	Aquatic and semi-aquatic	Throughout New York	Aggressive
Queen snake *(Regina septemvittata)*	Lowlands by streams and small rivers with rocky or sandy bottoms	Small pockets in western New York	Most are docile
Shorthead garter snake *(Thamnophis brachystoma)*	Fields, meadows	Southern tier counties	Most are docile
Smooth green snake *(Liochlorophis vernalis)*	Grassy fields, mountain meadows, marshes	Throughout New York	Docile
Timber rattlesnake *(Crotalus horridus)*	Steep hillsides, rocky ledges, streamsides	Lower Hudson Valley, parts of western New York and the southern Adirondacks	Defensive

Laws and Regulations

In New York, snakes are unprotected unless threatened (timber rattlesnake) or endangered (eastern massausauga and queen snake).

Preventing Damage

Repellents

One snake repellent, Snake-Away, is registered for use in New York but only against rattlesnakes and checkered garter snakes (not present in the state); it has been shown to be ineffective against other species. The active ingredients of this repellent are sulfur and naphthalene.

Exclusion

All openings 1/4 inch in diameter or larger should be sealed to exclude snakes. Snakes may enter buildings at the corners of doors and windows as well as around water pipes and electrical service entrances. Holes in foundations should be sealed with mortar to exclude snakes. Holes in wooden buildings can be sealed with fine mesh hardware cloth (1/8 inch) or sheet metal.

Trapping

Snakes can be captured using a funnel trap and drift fences constructed of 1/4- or 1/2-inch mesh hardware cloth. The drift fences guide the snakes into the funnel end of the trap. The drift fence should be 2 feet high and 25 feet long. Posts should be located on the outside of the fence.

A funnel trap can be made by rolling a 3-x-4-foot piece of 1/4-inch hardware cloth into a cylinder about 1 foot in diameter and 4 feet long. An entrance funnel can be made similarly and fitted into one end of the cylinder. The other end of the cylinder should be closed with hardware cloth. Attach the drift fence to the open end of the funnel. Snakes often seek a dark place to hide, so covering the cylinder will make it more attractive to them.

Inside homes or buildings, if a snake is visible it may be captured by scooping it into a large garbage can, covering it with the lid, and carrying it outside. All of New York's nonvenomous snakes have very short teeth and can be handled safely with heavy leather gloves. If the snake cannot be located you may attract it to an accessible location by placing piles of damp towels or burlap bags along a wall. Cover each pile with a dry burlap bag or towel to slow evaporation. Snakes are attracted to these damp, cool piles. After the bags or towels have been out for a couple of weeks, use a large scoop shovel to pick up the pile, put it into a large garbage can, and take it outdoors during the middle of the day when snakes are likely to be inside or underneath the pile.

It is always best for the individual snake to leave it alone and in its normal home range. If the snake must be removed, however, be certain to relocate it to an area of suitable habitat.

Cultural Practices

The most effective way of deterring snakes from frequenting areas around the home and garden is to reduce the amount of food and cover available to them in those areas. Mow closely around homes and outbuildings, store firewood away from residences, and eliminate junk piles and piles of rocks. In addition, reducing layers of mulch around shrubs and flowerbeds will discourage small animals that serve as food for snakes. Flower and shrub beds serve as convenient cover for the snakes to hide and should not be planted around the foundation if you want to minimize snake encounters.

Safety Concerns

The best way to avoid being bitten by a snake, venomous or otherwise, is to keep your distance. Most snakebites occur when snakes are handled or cornered. To avoid being bitten by a snake when hiking, always look before putting your hands or feet down as you climb over rocks and logs and always wear sturdy shoes or boots.

If you are bitten, the first step is to determine if the snake is a venomous species. New York's venonous snakes leave one or two puncture marks. Our nonvenomous snakes will leave a faint U-shaped mark caused by their numerous tiny teeth. It is always a good idea to become familiar with the venomous snakes in your area, including the outdoor places you visit. Few areas of New York, however, harbor venomous snakes. There are several ways to differentiate between venomous and nonvenomous snakes. Venomous snakes belong to the pit viper family and are so-named because they have a "pit," or opening, in the side of the head between the eye and nostril (Figure 1). Venomous snakes also have elliptical-shaped eyes as opposed to the round eyes of nonvenomous snakes. In addition, venomous snakes have undivided scales on the underside of the tail whereas the scales on the underside of the nonvenomous snake's tail are divided (Figure 1).

If bitten by a venomous snake, you should remain calm and seek immediate medical assistance. Commercial snakebite kits, which suggest making lacerations in the area of the bite and applying suction and tourniquets, are not recommended. Snakebites by venomous species found in New York occur rarely and are seldom fatal among healthy adults.

References

Byford, J. 1994. "Nonpoisonous Snakes". In *Prevention and Control of Wildlife Damage*. S. Hygnstrom, R. Timm, and G. Larson, eds. Lincoln: University of Nebraska Cooperative Extension.

Conant, R., and J. T. Collins. 1991. *A Field Guide to Reptiles and Amphibians: Eastern and General North America.* 3rd ed. Boston: Houghton Mifflin.

Harding, J. H. 1997. *Amphibians and Reptiles of the Great Lakes Region.* Ann Arbor: University of Michigan Press.

Johnson, G. 1994. *Snakes of New York.* A public service brochure of the SUNY College of Environmental Science and Forestry. Syracuse, N.Y.: SUNY-ESF.

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Attachment 8

ROBERT WOOD JOHNSON UNIVERSITY HOSPITAL

Poison Ivy / Poison Oak

What is poison ivy/poison oak?

There are three native American plants that collectively may be called poison ivy:

- Poison ivy
- Poison oak
- Poison sumac

Did You Know?

Scratching poison ivy blisters will not spread the rash. In addition, the poison ivy rash is not contagious - only urushiol (oil found in the sap of poison ivy) can cause a reaction.

These plants can cause an allergic reaction in nearly 85 percent of the population. To be allergic to poison ivy, you must first be "sensitized" to the oils. This means that next time there is contact with the plant, a rash may occur.

What causes an allergic reaction?

The resin in the plants contains an oily substance called urushiol. Urushiol is easily transferred from the plants to other objects, including toys, garments, tools, and animals. This chemical can remain active for a year or longer. It is important to know that the oils can also be transferred from clothing, pets, and can be present in the smoke from a burning plant.

What are the symptoms of poison ivy/poison oak?

The following are the most common symptoms of poison ivy. However, each individual may experience symptoms differently. Symptoms may include:

- A contact dermatitis rash characterized by bumps and blisters that itch
- Swelling in the area of contact sometimes occurs
- Blisters that eventually break open, ooze, and then crust over

The symptoms of poison ivy may resemble other skin conditions. Always consult your physician for a diagnosis.

Treatment for poison ivy/poison oak:

Specific treatment for poison ivy/poison oak will be determined by your physician based on:

- Your age, overall health, and medical history
- Extent of the condition
- Your tolerance for specific medications, procedures, or therapies
- Expectations for the course of the condition
- Your opinion or preference

Making sure you avoid the poisonous plants is the best treatment. It is important to teach your family members what the plants look like and not to touch them.

If contact with the plants has already occurred, you should remove the oils from the skin as soon as possible by cleansing with an ordinary soap. Repeat the cleaning with the soap three times. There are also alcohol-based wipes that help remove the oils. Wash all clothes and shoes also, because the oils can remain on these.

If the blisters and rash are on the face, near the genitals, or all over the body, your physician should be notified. You should also call your doctor if the rash covers a large area of your body, you can't sleep, or you have large blisters. Swelling is a sign of a serious reaction and you should contact your physician

right away, especially if the swelling is on your face or makes an eye close. If you have a serious reaction, you need to see a doctor right away. After a medical history and physical examination, your physician may prescribe a steroid cream, oral steroids, or steroid injections to help with the swelling and itching, depending on the severity of the rash.

Is poison ivy/poison oak contagious?

Poison ivy/poison oak cannot be spread from person to person by touching the blisters, or from the fluid inside the blisters. It can be spread, however, if the oils remain on the skin, clothes, or shoes. This is why washing your hands, clothes, and shoes as soon as possible is very important.

Preventing poison ivy/poison oak:

- Teach all family members to recognize the plants.
- Make sure you wear long pants and long sleeves when poison ivy or poison oak are in the vicinity.
- Wash all clothes and shoes immediately after you have been outside.
- Make sure you do not touch a pet that might have been in contact with a poisonous plant.
- Wash your hands thoroughly.

Click here to view the Online Resources of Dermatology

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UF UNIVERSITY of FLORIDA
IFAS Extension

ENH886

Identification of Poison Ivy, Poison Oak, Poison Sumac, and Poisonwood[1]

Sydney Park Brown and Patricia Grace[2]

Introduction

Florida parks and woodlands are favorite places for many people who enjoy outdoor activities. Unfortunately, the native plants poison ivy, poison oak, poison sumac, and poisonwood can make these outings a miserable experience (Figure 1). All four contain urushiol, a plant oil that can cause a severe skin rash (dermatitis) when any part of the plant is contacted. Allergic reaction can occur directly by touching the plant or indirectly by coming into contact with the oil on animals, tools, clothes, shoes, or other items. Even the smoke from burning plants contains oil particles that can be inhaled and cause lung irritation.

Individuals vary in their susceptibility to these plants. Some people are not sensitive but may become sensitive after repeated exposure. Symptoms appear within 8–48 hours and can last for weeks. Itching and burning of the skin may be followed by a rash, redness, swelling, and watery blisters. The rash, which can last 2–5 weeks, is not contagious and will not spread. Systemic complications can occur if the blisters become infected.

Over-the-counter skin creams containing the active ingredient bentoquatam (for example, Ivy Block®) absorb the urushiol oil and can prevent or lessen a reaction if applied before contact. If exposed to the urushiol oil in one of these plants, immediately cleanse exposed skin, tools, shoes, or other items with plenty of warm, soapy water and then rinse thoroughly with plain, cool water. Clothes should be washed thoroughly and separately from other laundry. Minor rashes can be cared for at home with over-the-counter treatments that contain zinc acetate, hydrocortisone, or zinc oxide; oatmeal baths; a paste of baking soda; or oral antihistamines. Severe or infected rashes may need professional medical treatment.



Figure 1. Poison ivy, poison oak, poison sumac, and poisonwood
Credits: (*Source:* Cook 2012; Larry Korhnak, UF/IFAS)

1. This document is ENH886, one of a series of the Environmental Horticulture Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date April 2003. Revised March 2012. Visit the EDIS website at http://edis.ifas.ufl.edu.

2. Sydney Park Brown, associate professor and consumer horticulture Extension specialist, Environmental Horticulture Department, Gulf Coast Research and Education Center, Wimauma, FL 33598; Patricia Grace, former Extension horticulture agent, Putnam County; Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

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Interaction with these plants is largely preventable. This publication helps individuals learn to identify these plants in order to avoid contact with them. Children should be taught to recognize these plants, particularly poison ivy, as it is by far the most common. Keep in mind that poison ivy, poison oak, and poison sumac are deciduous, making identification difficult in winter. Nevertheless, the sap from leafless stems and roots is still problematic. Other poison ivy relatives that grow in Florida and may also cause allergic reactions include mango (*Mangifera indica*) (http://edis.ifas.ufl.edu/mg216), cashew (*Anacardium occidentale*) (http://edis.ifas.ufl.edu/hs377), and the highly invasive Brazilian pepper-tree (*Schinus terebinthifolius*) (http://edis.ifas.ufl.edu/aa219).

Poison Ivy (*Toxicodendron radicans*)

Poison ivy grows in shady or sunny locations throughout Florida. It can be a woody shrub up to 6 feet tall or a vine up to 150 feet tall that climbs high on trees, walls, and fences or trails along the ground (Figure 2). All parts of



Figure 2. Poison ivy leaves (consisting of three leaflets) and flowers
Credits: UF/IFAS Center for Aquatic and Invasive Plants

poison ivy, including the hairy-looking aerial roots, contain urushiol at all times of the year, even when bare of leaves and fruit in winter. Plants are frequently abundant along old fence rows and the edges of paths and roadways. Leaf forms are variable among plants and even among leaves on the same plant; however, the leaves always consist of three leaflets. The old saying "Leaflets three, let it be" is a reminder of this consistent leaf characteristic. Leaflets can be 2–6 inches long and may be toothed or have smooth edges. The stem attaching the terminal leaflet is longer than stems attaching the other two. Leaves emerge with a shiny reddish tinge in the spring and turn a dull green as they age, eventually turning shades of red or purple (Figure 3) in the fall before dropping.



Figure 3. Poison ivy vine showing single leaf (in circle) and fall red color
Credits: Dan Culbert, UF/IFAS

Flowers and fruit are always in clusters on slender stems that originate in the leaf axils, or angles, between the leaves and woody twigs. The berrylike fruits are round and grooved with a white, waxy coating. They are attractive to birds. The leaves and fruit are an important food source for deer (Figure 4).



Figure 4. Poison ivy mature fruits
Credits: (*Source:* Cook 2012)

A common poison ivy look-alike is the native Virginia creeper (*Parthenocissus quinquefolia*) (Figure 5). This trailing or climbing vine can be distinguished from poison ivy rather easily by its five divided palmate leaflets. Other distinguishing features include blue-black berries and

tendrils that end in tiny sticky pads that attach to trees and other surfaces. In winter, the leaves of Virginia creeper turn red and drop from the plant (Figure 6). For more information, see http://edis.ifas.ufl.edu/fp454.



Figure 5. Virginia creeper
Credits: Larry Korhnak, UF/IFAS



Figure 6. Virginia creeper showing vining habit and winter color
Credits: Sydney Park Brown, UF/IFAS

Poison Oak (*Toxicodendron pubescens*)

Poison oak, also known as Atlantic poison oak, oakleaf ivy, or oakleaf poison ivy, is a low-growing, upright shrub that is about 3 feet tall. It is found in dry, sunny locations and does not tolerate heavy shade. Poison oak is confirmed in North and Central Florida, from Levy and Marion Counties northward.

Like poison ivy, a single poison oak leaf consists of three leaflets. The stem attaching the terminal leaflet is longer than the stems attaching the other two. One distinguishing feature of poison oak is its lobed leaves, which give it the appearance of an oak leaf. The middle leaflet usually is lobed alike on both margins, and the two lateral leaflets are often irregularly lobed (Figure 7). Leaf size varies considerably, even on the same plant, but leaves are generally about 6 inches long. Another distinguishing feature is that the leaf stems and leaflets have a coating of fine hair.



Figure 7. Poison oak lobed leaves and immature green fruit
Credits: Larry Korhnak, UF/IFAS

Leaflets emerge with a reddish tinge in the spring, turn green, and then assume varying shades of yellow and red in the fall before dropping. As with poison ivy, the flowers and fruit arise from the leaf axils in clusters. The small flowers are white, and the ripe fruit is round, light tan, waxy, and grooved (Figure 8).



Figure 8. Poison oak mature fruit
Credits: (*Source:* Cook 2012)

Poison Sumac (*Toxicodendron vernix*)

More allergenic than poison ivy and poison oak is poison sumac, a deciduous woody shrub or small tree that grows 5–20 feet tall and has a sparse, open form (Figure 9). It inhabits swamps and other wet areas, pine woods, and shady hardwood forests. In Florida, poison sumac has been confirmed in the north and central regions, as far south as Polk County.



Figure 9. Poison sumac
Credits: (*Source:* Cook 2012)

Poison sumac leaves consist of 7–13 leaflets arranged in pairs with a single leaflet at the end of the midrib. Distinctive features include reddish stems and petioles (Figure 10). Leaflets are elongated, oval, and have smooth margins. They are 2–4 inches long, 1–2 inches wide, and have a smooth, velvety texture. In early spring, the leaves emerge bright



Figure 10. Poison sumac leaflets, reddish stems, and immature green fruit
Credits: Larry Korhnak, UF/IFAS

orange. Later, they become dark green and glossy on the upper leaf surface and pale green on the underside. In the early fall, leaves turn a brilliant red-orange or russet shade. The small, yellowish-green flowers are borne in clusters on slender stems arising from the leaf axils. Flowers mature into ivory-white to gray fruits resembling those of poison oak or poison ivy, but they are usually less compact and hang in loose clusters of up to 10–12 inches in length (Figure 11).



Figure 11. Poison sumac mature fruit in winter
Credits: (*Source:* Cook 2012)

Winged sumac (*Rhus copallinum)* has a similar appearance but is a nonallergenic relative that grows throughout Florida. It can be distinguished from poison sumac most readily by its 9–23 leaflets, clusters of red berries, and the winged rachis between the leaflets (Figure 12).



Figure 12. Winged sumac
Credits: Larry Korhnak, UF/IFAS

Poisonwood (*Metopium toxiferum*)

Poisonwood is an evergreen shrub or tree that grows 25–35 feet tall in hammocks, pinelands, and sandy areas near saltwater. It is particularly abundant in the Florida Keys. As of this writing, poisonwood's range has only been confirmed in five counties in South Florida: Martin, Palm Beach, Broward, Miami-Dade, and Monroe. The tree has a spreading, rounded form with a short trunk and arching limbs with drooping branches. The bark varies in color from reddish brown to gray, depending on the habitat, and has oily patches of sap on the surface; older trees have scaly bark (Figure 13). Each leaf is comprised of three to



Figure 13. Poisonwood bark variations
Credits: Kim Gabel, UF/IFAS

seven oval leaflets, although five leaflets are typical. Leaves are glossy and dark green above and paler underneath. The smooth edges are thick and curl under slightly. Irregular blotches of resin dot the surface of many of the leaflets (Figure 14). The fruit is ½ inch long, oval, yellow to orange in color, and hangs in loose clusters (Figure 15).



Figure 14. Poisonwood leaves with dots of resin
Credits: Kim Gabel, UF/IFAS



Figure 15. Poisonwood fruit
Credits: Larry Korhnak, UF/IFAS

The poisonwood fruit is an important food source for the threatened white crown pigeon.

Do not walk where poisonwood is known to grow during a rainstorm. Rainwater dripping off the poisonwood leaves contains urushiol, which causes contact dermatitis.

Acknowledgements

The author wishes to thank Mary Derrick, horticulture program assistant, for her help with the research and editing of this publication, and Dan Culbert, Okeechobee County Extension agent, as well as Kim Gabel, Monroe County Extension agent, for their reviews and contributions.

References

Cook, W. 2012. "Trees, Shrubs, and Woody Vines of North Carolina." Accessed February 2012. http://www.duke.edu/~cwcook/trees/.

Additional Resources

Centers for Disease Control and Prevention. 2012. "Poisonous Plants." Accessed March 2012. http://www.cdc.gov/niosh/topics/plants/

Hossler, E. W. 2010. "Botanical Briefs: Poisonwood (*Metopium toxiferum*)." *Cutis* 85(4) 178–179.

Institute for Systemic Botany. 2012. "Atlas of Florida Vascular Plants." Accessed February 2012. http://florida.plantatlas.usf.edu/.

Mayo Clinic Online. 2012. "Poison Ivy Rash." Accessed March 2012. http://www.mayoclinic.com/health/poison-ivy/DS00774.

MedLine Plus. 2012. "Poison Ivy – Oak – Sumac Rash." Accessed February 2012. http://www.nlm.nih.gov/medlineplus/ency/article/00y0027.htm.

Nellis, D. W. 1997. *Poisononus Plants and Animals of Florida and the Caribbean*. Sarasota, FL: Pineapple Press.

UF/IFAS (University of Florida Institute of Food and Agricultural Sciences). 2012. "Forest Trees and Companion Plants." Accessed March 2012. http://www.sfrc.ufl.edu/4h/Trees_Plants/trees_plants.html.

Attachment 9

SAFETY DATA SHEET

Creation Date 28-Apr-2009 **Revision Date** 25-Apr-2019 **Revision Number** 7

1. Identification

Product Name **Acetone**

Cat No. : **AC177170000; AC177170010; AC177170025; AC177170050; AC177170100; AC177170250**

CAS-No 67-64-1
Synonyms 2-Propanone

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, spleen, Blood.	

Label Elements

Signal Word
Danger

Hazard Statements
Highly flammable liquid and vapor
Causes serious eye irritation

May cause drowsiness or dizziness
May cause damage to organs through prolonged or repeated exposure



Precautionary Statements
Prevention
Wash face, hands and any exposed skin thoroughly after handling
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Wear protective gloves/protective clothing/eye protection/face protection
Keep cool
Response
Get medical attention/advice if you feel unwell
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician if you feel unwell
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Storage
Store in a well-ventilated place. Keep container tightly closed
Store locked up
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Repeated exposure may cause skin dryness or cracking

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Acetone	67-64-1	>95

4. First-aid measures

General Advice If symptoms persist, call a physician.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.

Inhalation Move to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur.

Ingestion Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects None reasonably foreseeable. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting: May cause pulmonary edema: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.

Unsuitable Extinguishing Media Water may be ineffective

Flash Point -20 °C / -4 °F

Method - Closed cup

Autoignition Temperature 465 °C / 869 °F

Explosion Limits

Upper 12.8 vol %

Lower 2.5 vol %

Oxidizing Properties Not oxidising

Sensitivity to Mechanical Impact No information available

Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical

Flammable. Risk of ignition. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO_2) Formaldehyde Methanol

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	3	0	N/A

6. Accidental release measures

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition. Take precautionary measures against static discharges.

Environmental Precautions Should not be released into the environment.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling Do not get in eyes, on skin, or on clothing. Wear personal protective equipment. Ensure adequate ventilation. Avoid ingestion and inhalation. Keep away from open flames, hot

surfaces and sources of ignition. Use only non-sparking tools. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. Take precautionary measures against static discharges.

Storage Flammables area. Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Acetone	TWA: 250 ppm STEL: 500 ppm	(Vacated) TWA: 750 ppm (Vacated) TWA: 1800 mg/m³ (Vacated) STEL: 2400 mg/m³ (Vacated) STEL: 1000 ppm TWA: 1000 ppm TWA: 2400 mg/m³	IDLH: 2500 ppm TWA: 250 ppm TWA: 590 mg/m³	TWA: 500 ppm STEL: 750 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location. Use explosion-proof electrical/ventilating/lighting/equipment.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	sweet
Odor Threshold	19.8 ppm
pH	7
Melting Point/Range	-95 °C / -139 °F
Boiling Point/Range	56 °C / 132.8 °F
Flash Point	-20 °C / -4 °F
Method -	Closed cup
Evaporation Rate	5.6 (Butyl Acetate = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	12.8 vol %
Lower	2.5 vol %
Vapor Pressure	247 mbar @ 20 °C

Vapor Density	2.0
Specific Gravity	0.790
Solubility	Soluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	465 °C / 869 °F
Decomposition Temperature	> 4°C
Viscosity	0.32 mPa.s @ 20 °C
Molecular Formula	C3 H6 O
Molecular Weight	58.08
Refractive index	1.358 - 1.359

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Heat, flames and sparks. Incompatible products. Keep away from open flames, hot surfaces and sources of ignition.

Incompatible Materials Strong oxidizing agents, Strong reducing agents, Strong bases, Peroxides, Halogenated compounds, Alkali metals, Amines

Hazardous Decomposition Products Carbon monoxide (CO), Carbon dioxide (CO_2), Formaldehyde, Methanol

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Acetone	5800 mg/kg (Rat)	> 15800 mg/kg (rabbit) > 7400 mg/kg (rat)	76 mg/l, 4 h, (rat)

Toxicologically Synergistic Products Carbon tetrachloride; Chloroform; Trichloroethylene; Bromodichloromethane; Dibromochloromethane; N-nitrosodimethylamine; 1,1,2-Trichloroethane; Styrene; Acetonitrile, 2,5-Hexanedione; Ethanol; 1,2-Dichlorobenzene

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Irritating to eyes and skin

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Acetone	67-64-1	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Central nervous system (CNS)

STOT - repeated exposure Kidney Liver spleen Blood

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting: May cause pulmonary edema: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Acetone	NOEC = 430 mg/l (algae; 96 h)	Oncorhynchus mykiss: LC50 = 5540 mg/l 96h Alburnus alburnus: LC50 = 11000 mg/l 96h Leuciscus idus: LC50 = 11300 mg/L/48h Salmo gairdneri: LC50 = 6100 mg/L/24h	EC50 = 14500 mg/L/15 min	EC50 = 8800 mg/L/48h EC50 = 12700 mg/L/48h EC50 = 12600 mg/L/48h

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility.

Component	log Pow
Acetone	-0.24

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Acetone - 67-64-1	U002	-

14. Transport information

DOT

UN-No UN1090
Proper Shipping Name ACETONE
Hazard Class 3
Packing Group II

TDG

UN-No UN1090
Proper Shipping Name ACETONE
Hazard Class 3
Packing Group II

IATA

UN-No UN1090
Proper Shipping Name ACETONE
Hazard Class 3
Packing Group II

IMDG/IMO

UN-No UN1090

Proper Shipping Name	ACETONE
Hazard Class	3
Packing Group	II

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
Acetone	67-64-1	X	ACTIVE	-

Legend:
TSCA - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDSL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
Acetone	67-64-1	X	-	200-662-2	X	X	X	X	KE-29367

U.S. Federal Regulations

SARA 313 Not applicable

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act) Not applicable

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Acetone	5000 lb	-

California Proposition 65 This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Acetone	X	X	X	-	X

U.S. Department of Transportation

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade	Serious risk, Grade 3

16. Other information

Prepared By	Regulatory Affairs Thermo Fisher Scientific Email: EMSDS.RA@thermofisher.com
Creation Date	28-Apr-2009
Revision Date	25-Apr-2019
Print Date	25-Apr-2019
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

Acetylene

Section 1. Identification

GHS product identifier : Acetylene

Chemical name : acetylene

Other means of identification : Ethyne; Ethine; Narcylen; C2H2; Acetylen; UN 1001; Vinylene

Product type : Gas.

Product use : Synthetic/Analytical chemistry.

Synonym : Ethyne; Ethine; Narcylen; C2H2; Acetylen; UN 1001; Vinylene

SDS # : 001001

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Compressed gas

GHS label elements

Hazard pictograms :



Signal word : Danger

Hazard statements : Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Fusible plugs in top, bottom, or valve melt at 98°C to 107°C (208°F to 224°F). Do not discharge at pressures above 15psig (103kpa). Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Approach suspected leak area with caution.

Prevention : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Response : Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Protect from sunlight. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : acetylene

Other means of identification : Ethyne; Ethine; Narcylen; C2H2; Acetylen; UN 1001; Vinylene

Product code : 001001

CAS number/other identifiers

CAS number : 74-86-2

Ingredient name	%	CAS number
acetylene	100	74-86-2

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Section 4. First aid measures

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Use only non-sparking tools. Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
acetylene	**NIOSH REL (United States, 10/2016).** CEIL: 2662 mg/m³ CEIL: 2500 ppm **ACGIH TLV (United States, 3/2017). Oxygen Depletion [Asphyxiant].** **California PEL for Chemical Contaminants (*Table AC-1*) (United States). Oxygen Depletion [Asphyxiant].**

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Section 8. Exposure controls/personal protection

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas.

Color : Colorless.

Odor : Mild. Ethereal.

Odor threshold : Not available.

pH : Not available.

Melting point : -81°C (-113.8°F)

Boiling point : Not available.

Critical temperature : 35.25°C (95.5°F)

Flash point : Closed cup: -18.15°C (-0.67°F)

Evaporation rate : Not available.

Flammability (solid, gas) : Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and oxidizing materials.
Highly flammable in the presence of the following materials or conditions: heat.

Lower and upper explosive (flammable) limits : Lower: 2.5%
Upper: 100%

Vapor pressure : 635 (psig)

Vapor density : 0.907 (Air = 1)

Specific Volume (ft ^{3}/lb) : 14.7058

Gas Density (lb/ft ^{3}) : 0.0691

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : 1.2 g/l

Partition coefficient: n-octanol/water : 0.37

Auto-ignition temperature : 305°C (581°F)

Section 9. Physical and chemical properties

Decomposition temperature : Not available.

Viscosity : Not applicable.

Flow time (ISO 2431) : Not available.

Molecular weight : 26.04 g/mole

Aerosol product

Heat of combustion : -48257522 J/kg

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials : Oxidizers

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Section 11. Toxicological information

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Section 12. Ecological information

Product/ingredient name	$LogP_{ow}$	BCF	Potential
acetylene	0.37	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1001	UN1001	UN1001	UN1001	UN1001
UN proper shipping name	ACETYLENE, DISSOLVED	ACETYLENE, DISSOLVED	ACETYLENE, DISSOLVED	ACETYLENE, DISSOLVED	ACETYLENE, DISSOLVED
Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

DOT Classification : **Limited quantity** Yes.
Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: 15 kg.

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).

Explosive Limit and Limited Quantity Index
0

Passenger Carrying Ship Index
75

Passenger Carrying Road or Rail Index
Forbidden

Section 14. Transport information

Special provisions
38

IATA : **Quantity limitation** Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: 15 kg.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

Clean Air Act (CAA) 112 regulated flammable substances: acetylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

State regulations

Massachusetts : This material is listed.

New York : This material is not listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Section 15. Regulatory information

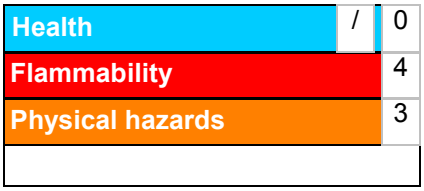
Not listed.

Inventory list

Australia	:	This material is listed or exempted.
Canada	:	This material is listed or exempted.
China	:	This material is listed or exempted.
Europe	:	This material is listed or exempted.
Japan	:	**Japan inventory (ENCS)**: This material is listed or exempted. **Japan inventory (ISHL)**: Not determined.
Malaysia	:	Not determined.
New Zealand	:	This material is listed or exempted.
Philippines	:	This material is listed or exempted.
Republic of Korea	:	This material is listed or exempted.
Taiwan	:	This material is listed or exempted.
Thailand	:	Not determined.
Turkey	:	This material is listed or exempted.
United States	:	This material is listed or exempted.
Viet Nam	:	Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)



Note: The instability hazard rating for acetylene, dissolved (stabilized acetylene) is 2.

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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE GASES - Category 1 GASES UNDER PRESSURE - Compressed gas	Expert judgment According to package

Section 16. Other information

History

Date of printing	:	1/18/2018
Date of issue/Date of revision	:	1/18/2018
Date of previous issue	:	10/10/2017
Version	:	1.01
Key to abbreviations	:	ATE = Acute Toxicity Estimate BCF = Bioconcentration Factor GHS = Globally Harmonized System of Classification and Labelling of Chemicals IATA = International Air Transport Association IBC = Intermediate Bulk Container IMDG = International Maritime Dangerous Goods LogPow = logarithm of the octanol/water partition coefficient MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution) UN = United Nations
References	:	Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

1. IDENTIFICATION

Product Identifier	Diesel Fuel
Synonyms:	Diesel Fuel, Motor Vehicle Diesel Fuel, Dyed Diesel, * DieselOne®, * DieselOne® w/Platinum Plus DFX, Low Sulfur Diesel (LSD), Ultra Low Sulfur Diesel (ULSD)
Intended use of the product:	Fuel
Contact:	Global Companies LLC Water Mill Center 800 South St. Waltham, MA 02454-9161 www.globalp.com
Contact Information:	EMERGENCY TELEPHONE NUMBER (24 hrs): CHEMTREC (800) 424-9300 COMPANY CONTACT (business hours): 800-542-0778

2. HAZARD IDENTIFICATION

According to OSHA 29 CFR 1910.1200 HCS

Classification of the Substance or Mixture

Classification (GHS-US):

Flam. Liquid	Category 3	H226
Skin Corrosion/Irritation	Category 2	H315
Aspiration Hazard	Category 1	H304
STOT SE	Category 3	H336
Carcinogenicity	Category 2	H350
Aquatic Chronic	Category 2	H411
Serious Eye Damage/ Irritation	Category 2B	H319

Labeling Elements



Signal Word (GHS-US):	**Danger**
Hazard Statements (GHS-US):	H226 – Flammable liquid and vapor. H315 – Causes Skin irritation. H304 – May be fatal if swallowed and enters airways. H336 – May cause drowsiness or dizziness. H350 – May cause cancer. H411 – Toxic to aquatic life with long lasting effects. H319 – May cause eye damage/irritation.
Precautionary Statements (GHS-US):	P210 - Keep away from heat/sparks/open flames/hot surfaces. - No smoking. P233 - Keep container tightly closed. P240 – Ground/bond container and receiving equipment.

P241 – Use explosion-proof electrical/ventilating/lighting equipment pursuant to applicable electrical code.
P242 – Use only non-sparking tools.
P243 – Take precautionary measures against static discharge.
P261 – Avoid breathing dust/fume/gas/mist/vapors/spray.
P264 – Wash skin thoroughly after handling.
P271 – Use only outdoors or in a well-ventilated area.
P273 – Avoid release to the environment.
P280 - Wear protective gloves/protective clothing/eye protection/face protection.
P303+361+353 - If on skin (or hair): Take off immediately all contaminated clothing. Rinse with water/shower.
P308+311 - If exposed or concerned: Get medical advice/attention.
P301+310 - If swallowed: Immediately call a poison center/doctor/…
P331 - Do NOT induce vomiting.
P370+P378 – In case of fire use firefighting foam or other appropriate media for Class B fires to extinguish.
P403+235 - Store in a well-ventilated place. Keep cool.
P405 - Store locked up.
P501 – Dispose of contents/container in accordance with local/regional/national/international regulation.

Other information:

NFPA 704
Health: 1
Fire: 2
Reactivity: 0



3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Composition Information
Mixture

Name	Product Identifier (CAS#)	% (w/w)	Classification
Diesel Fuel	68476-34-6	100	Flam Liq. 3, H226; Skin Irrit. 2, H315; Aspiration 1, H304; STOT SE 3, H336; Carc.2. H350; Aquatic chronic 2, H411
Naphthalene	91-20-3	<0.1	Carc. 2, H351; Acute Tox. 4, H302; Aquatic Acute 1, H400; Aquatic Chronic 1, H410

Additional Formulation Information:
Diesel Fuel consists of C9+ hydrocarbons resulting from distillation of crude oil.

Low Sulfur Diesel Fuel typically contains less than 500 ppm of sulfur

Ultra Low Sulfur Diesel Fuel typically contains less than 15 ppm of sulfur

4. FIRST AID MEASURES

Route	Measures
Inhalation	Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

Route	Measures
Ingestion	Aspiration Hazard: DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Ingestion may cause gastrointestinal disturbances including irritation, nausea, vomiting, and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory failure, and death.
Eye Contact	In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention. In case of contact lenses, remove immediately.
Skin Contact	Remove contaminated clothing and shoes. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops. Thermal burns require immediate medical attention depending on the severity and of the area of the body burned.

Most Important Symptoms
Contact with eyes and face may cause irritation. Long-term exposure may cause dermatitis (itching, irritation, pain and swelling).

Inhalation may cause irritation and significant or long term exposure could cause respiratory insufficiency and pulmonary edema.

Ingestion may cause aspiration, gastrointestinal disturbance, and CNS effects.

Immediate Medical Attention and Special Treatment
For contact with skin or eyes, immediately wash or flush contaminated eyes with gently flowing water. If possible, irrigate each eye continuously with 0.9% saline (NS). If ingested, rinse mouth. Do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs).

If inhaled, administer oxygen or establish a patent airway if breathing is labored. Suction if necessary. Monitor closely, anticipate seizures. Consider orotracheal or nostracheal intubation of airway control if patient is unconscious or is in severe respiratory distress.

Discard any clothing or shoes contaminated as they may be flammable.

5. FIRE-FIGHTING MEASURES

Extinguishing Media
Foam, carbon dioxide, dry chemical are most suitable

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, C02, water spray, firefighting foam, or Halon. Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other firefighting equipment.

LARGE FIRES: Foam, carbon dioxide, dry chemical. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

Specific Hazards / Products of Combustion
Moderate fire hazard when exposed to heat or flame with a very low flash point. Product is flammable and easily ignited when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

Combustion may produce smoke, carbon monoxide and other products of incomplete combustion.

Special Precautions and Protective Equipment for Firefighters
Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied firefighting foam.

Fighting Equipment/Instructions
Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH- approved pressure-demand self-contained breathing apparatus with full face piece and protective clothing.

Refer to Section 9 for fire properties of this chemical including flash point, auto ignition temperature, and explosive limits.

6. ACCIDENTAL RELEASE MEASURES

ACTIVATE FACILITY SPCC, SPILL CONTINGENCY or EMERGENCY PLAN.

Personal Precautions
Due to high vapor density, flammable / toxic vapors may be present in low lying areas, dikes, pits, drains, or trenches. Vapors may accumulate in low lying areas and reach ignitable concentrations. Ventilate the area. Use of non-sparking tools and intrinsically safe equipment is recommended. Potential for flammable atmosphere should be monitored using a combustible gas indicator positioned downwind of the spill area. Refer to Sections 2 and 7 for further hazard warnings and handling instructions.

Use appropriate personal protective equipment to prevent eye/skin contact and absorption. Use NIOSH approved respiratory protection, if warranted, to prevent exposures above permissible limits. Refer to Section 8. Contaminated clothing should not be near sources of ignition.

Emergency Measures
As an immediate precautionary measure, isolate spill or leak area for at least 50 meters (150 feet) in all directions. Consider wind direction. Secure all ignition sources (flame, spark, hot work, hot metal, etc.) from area. Evaluate the direction of product travel, diking sewers, etc. to confirm spill areas. Do not touch or walk-through spilled material. For large spills, isolate initial action distance downwind 1,000 ft. (300 m).

Environmental Precautions
Stop the spill to prevent environmental release if it can be done safely. Product is toxic to aquatic life. Take action to isolate environmental receptors including drains, storm sewers and natural water bodies. Keep on impervious surface if at all possible. Use water sparingly to prevent product from spreading. Foam and absorbents may be used to reduce / prevent airborne release.

Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Follow federal, state or local requirements for reporting environmental release where necessary. Refer to Section 15 for further information.

Containment and Clean-Up Methods
Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of firefighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with dry earth, sand or other non-combustible, inert oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container with clean, non-sparking tools for reclamation or disposal. Response and cleanup crews must be properly trained and must utilize proper protective equipment. Refer to Section 8 for appropriate protective equipment.

7. HANDLING AND STORAGE

USE ONLY AS A FUEL.
DO NOT SIPHON BY MOUTH.

Handling Precautions
Handle as a flammable liquid. Keep away from heat, sparks, and open flame. No smoking. Electrical equipment should be approved for classified area. Bond and ground containers during product transfer pursuant to NFPA 70 and API RP 2003 to reduce the possibility of static-initiated fire or explosion. Follow precautions to prevent static initiated fire.

Use good personal hygiene practices. Use only with protective equipment specified in Section 8. Avoid repeated and/or prolonged skin exposure. Use only outdoors or in well ventilated areas. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this

product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves. Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API RP 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents."

Storage

Large quantities of diesel fuel are stored in tanks or portable containers at an ambient storage temperature. Separate from incompatible chemicals (Refer to Section 10) by distance or secondary containment. Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers that are clearly labeled. Label all secondary containers that this material is transferred into with the chemical name and associated hazard(s). Empty product containers or vessels may contain flammable vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Storage tanks should have a venting system. If stored in small containers, the area should be well ventilated, away from ignition sources and protected from potential damage or vehicular traffic. Post “No Smoking” signs in product storage areas. This storage area should comply with NFPA 30 “Flammable and Combustible Liquid Code” or applicable building code. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 “Cleaning Mobile Tanks in Flammable and Combustible Liquid Service” and API RP 2015 “Safe Entry and Cleaning of Petroleum Storage Tanks”.

Incompatibles

Keep away from strong oxidizers, ignition sources and heat.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational Exposure Limits

Component	CAS #	List	Value
Diesel Fuel	68476-34-6	ACGIH TLV-TWA	100 mg/m3*
Naphthalene	91-20-3	ACGIH TLV-TWA OSHA PEL ACGIH STEL	10 ppm 10 ppm 15 ppm

*Critical effects; Skin; A3; CNS impairment.

Engineering Controls

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces. Intrinsically safe equipment and non-sparking tools shall be used in circumstances where concentrations may exceed lower flammable limits. Grounding and bonding shall be used to prevent accumulation and discharge of static electricity. Emergency shower and eyewash should be provided in proximity to handling areas in the event of exposure to decontaminate.

Personal Protective Equipment

Exposure	Equipment
Eye / Face	Wear appropriate chemical protective glasses or goggles or face shields to prevent skin and eye contact especially caused from splashing.
Skin	Wear appropriate personal protective clothing to prevent skin contact. Gloves constructed of nitrile, neoprene or PVC are recommended when handling this material. Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure.

Exposure	Equipment
Respiratory	A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, ANSI Z88.2-1992, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection and limitations. Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.
Thermal	Product is stored at ambient temperature. No thermal protection is required except for emergency operations involving actual or potential for fire. Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

9. PHYSICAL AND CHEMICAL PROPERTIES

Property	Value	
Appearance	Clear or straw-colored liquid. May be dyed red for distribution.	
Odor	Mild characteristic petroleum distillate odor.	
Odor Threshold	<1 ppm	
pH	Not available	
Melting Point	-22 to -0.4 ˚F (-30 to -18 ˚C)	
Boiling Point Range	320 to 690 ˚F (160 to 366 ˚C)	
Flash Point	> 125.6 ˚F (52 ˚C) PMCC	
Evaporation Rate	Slow, varies with conditions	
Flammability	Flammable liquid (OSHA defined)	
Flammable Limits	0.6 % - 6.5%	
Vapor Pressure	0.009 psia @ 70 ˚F	
Vapor Density	> 1	(air=1)
Specific Gravity	0.83-0.86 @ 60 ˚F (16 ˚C)	(water=1)
Solubility	Insoluble in water; miscible with other petroleum solvents.	
Partition Coefficient (N-octanol/water)	Log Kow range of 3.3 to >.6.0	
Autoignition Temperature	494 ˚F (257 ˚C)	
Decomposition Temperature	When heated it emits acrid smoke and irritating vapors.	
Viscosity	<3 cSt	
Percent Volatiles	100	

10. STABILITY AND REACTIVITY

Stability
This is a stable material that is flammable liquid (OSHA/GHS hazard category 3). Stable during transport.

Reactivity
Material is not self-reacting. Flammable concentrations may be present in air. Compound can react with oxidizing materials.

Possibility of Hazardous Reactions
Hazardous polymerization will not occur.

Incompatibility
Keep away from strong oxidizers such as nitric and sulfuric acids.

Conditions to Avoid
Avoid high temperatures, open flames, sparks, static electricity, welding, smoking and other ignition sources.

Hazardous Decomposition Products
Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

11. TOXICOLOGICAL INFORMATION

Acute Toxicity:
Acute Toxicity (Inhalation LC50)
Diesel Fuel (68476-34-6)
LC50 Inhalation Rat >6 mg/l/4h

Acute Toxicity (Dermal LD50)
Diesel Fuel (68476-34-6)
LD50 Dermal Rabbit >5000 mg/kg

Acute Toxicity (Oral LD50)
Diesel Fuel (68476-34-6)
LD50 Oral Rabbit >5000 mg/kg

Skin Corrosion/Irritation: Prolonged and repeated contact may cause skin irritation leading to dermatitis. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

Serious Eye Damage/Irritation: Causes serious eye irritation.

Respiratory or Skin Sensitization: Not classified

Germ Cell Mutagenicity: Not classified

Teratogenicity: Not available

Carcinogenicity: OSHA: NO, IARC: Group 3, NTP: NO, ACGIH: NOIC:A3, NIOSH: NO

IARC: Group 3 – Not classifiable as to their carcinogenicity to humans ACGIH: A3 – Confirmed animal carcinogen with unknown relevance to humans

Studies have shown that similar products produce skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation.

IARC classifies whole diesel fuel exhaust particulates (byproduct of combustion of this material) carcinogenic to humans (Group 1) and NIOSH regards diesel fuel exhaust particulate as a potential occupational carcinogen.

Reproductive Toxicity: Not classified

Specific Target Organ Toxicity (Repeated Exposure): Not classified

Specific Target Organ Toxicity (Single Exposure): Inhalation exposure may cause drowsiness or dizziness by inhalation exposure.

Aspiration Hazard: The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Potential Health Effects: Vapor irritating to skin, eyes, nose, and throat. Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

WARNING: The burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of

combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

12. ECOLOGICAL INFORMATION

Toxicity:
This material is expected to be toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment.

Data for Component: Diesel Fuel (68476-34-6)

Material is toxic to aquatic organisms based on an acute basis (LC50/EC50 >1 but ≤ 10 mg/L in the most sensitive species tested).

Material is a long-term aquatic hazard based on a chronic basis (LC50/EC50 >1 but ≤ 10 mg/L in the most sensitive species tested).

Persistence and Degradation: This material is not expected to be readily biodegradable.

Bioaccumulative Potential: Not available

Mobility in Soil: Not available

Other Adverse Effects: None known

Other Information: Avoid release to the environment.

13. DISPOSAL CONSIDERATIONS

Consult federal, state and local waste regulations to determine appropriate disposal options. May be considered a hazardous waste if disposed. Direct solid waste (landfill) or incineration at a solid waste facility is not permissible. Do not discharge to sanitary or storm sewer. Personnel handling waste containers should follow precautions provided in this document.

Shipping containers must be DOT authorized packages. Follow licensure and regulations for transport of hazardous material and hazardous waste as applicable.

14. TRANSPORT INFORMATION

US DOT

UN Identification Number	NA 1993
Proper Shipping Name	Diesel fuel
Hazard Class and Packing Group	3, PGIII
Shipping Label	Flammable liquid
Placard / Bulk Package	Flammable liquid, 1993
Emergency Response Guidebook Guide Number	128

This product may be re-classified as a “Combustible Liquid” meeting the definition in 49 CFR 173.120 unless transported by vessel or aircraft.
Specific placard requirements must be met for shipments of this product as a Combustible Liquid by rail (See 49 CFR 172.332).
Non-bulk packages (<= 119 gal) of Combustible Liquids in package sizes less than the product reportable quantity are not regulated as hazardous materials if the material does not meet any other hazard class.

IATA Information

UN Identification Number	UN 1202
Proper Shipping Name	Diesel fuel
Hazard Class and Packing Group	3, PGIII
ICAO Label	3
Packing Instructions Cargo	310
Max Quantity Per Package Cargo	220L
Packing Instructions Passenger	309Y
Max Quantity per Package Passenger	60L

ICAO

UN Identification Number	UN 1202
Shipping Name / Description	Diesel fuel
Hazard Class and Packing Group	3, PG III
IMDG Label	3

IMDG

UN Identification Number	UN 1202
Shipping Name / Description	Diesel fuel
Hazard Class and Packing Group	3, PGIII
IMDG Label	3
EmS Number	F-E-S-E
Marine Pollutant	Yes

15. REGULATORY INFORMATION

U.S. Federal, State, and Local Regulatory Information
Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other federal, state, or local regulations; consult those regulations applicable to your facility/operation.

OSHA Hazard Communication Standard
This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning And Community Right-to-Know Act of 1986) Sections 311 and 312

Immediate (Acute) Health Hazard	Yes
Delayed (Chronic) Health Hazard	Yes
Fire Hazard	Yes
Reactive Hazard	No
Sudden Release of Pressure Hazard	No

Clean Water Act (Oil Spills)
Any spill or release of this product to “navigable waters” (Essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA Section 103 and SARA Section 304 (Release to the Environment)
The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts this material. This product does not contain any chemicals subject to the reporting requirements of CERCLA Section 103 or SARA 304.

SARA Section 313- Supplier Notification
This product does not contain any chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372.

EPA Notification (Oil Spills)
If the there is a discharge of more than 1,000-gallons of oil into or upon navigable waters of the United States, or if it is the second spill event of 42 gallons or more of oil into water within a twelve (12) month period, a written report must be submitted to the Regional Administrator of the EPA within sixty days of the event.

Pennsylvania Right to Know Hazardous Substance list:
The following product components are cited in the Pennsylvania Special Hazardous Substance List, and are present at levels which require reporting.

Component	CAS	Amount
Diesel Fuel	68476-34-6	100%

New Jersey Right to Know Hazardous Substance list:
The following product components are cited in the New Jersey Right to Know Hazardous Substance List, and are present at levels which require reporting.

Component	CAS	Amount
Diesel Fuel	68476-34-6	100%

California Proposition 65 WARNING: This product contains chemicals known to the State of California to cause Cancer or Reproductive Toxicity.

Component	CAS	Amount
Naphthalene	91-20-3	<0.1%

U.S. Toxic Substances Control Act
All components of this product are on the TSCA Inventory or are exempt from TSCA Inventory requirements under 40 CFR 720.30.

CEPA - Domestic Substances List (DSL)
All substances contained in this product are listed on the Canadian Domestic Substances List (DSL) or are not required to be listed.

Canadian Regulatory Information (WHMIS)
Class B3 – Combustible Liquid
Class D2A – Materials causing other toxic effects. (Very Toxic)

16. OTHER INFORMATION

Version	5
Issue Date	June 26, 2019
Prior Issue Date	May 20, 2016

Description of Revisions
Update viscosity information in Section 9. Update transportation information in Section 14 to clarify US DOT re-classification option as a Combustible Liquid.

Abbreviations

˚F	Degrees Fahrenheit (temperature)
<	Less than
=	Equal to
>	Greater than
AP	Approximately
C	Centigrade (temperature)
kg	Kilogram
L	Liter
mg	Milligrams
mL	Milliliter
mm^2	Square millimeters
mmHg	Millimeters of mercury (pressure)
N/A	Not applicable
N/D	Not determined
ppm	Parts per million
sec	Second
ug	Micrograms

Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
AL	Action Level
ANSI	American National Standards Institute
API	American Petroleum Institute
CAS	Chemical Abstract Service
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation
EC50	Ecological concentration 50%
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guideline
GHS	Global Harmonized System

HMIS	Hazardous Materials Information System
IARC	International Agency for Research On Cancer
IATA	International Air Transport Association
IMDG	International Maritime Dangerous Goods
Koc	Soil Organic Carbon
LC50	Lethal concentration 50%
LD50	Lethal dose 50%
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act Reauthorization Act of 1986 Title III
REL	Recommended Exposure Limit (NIOSH)
RVP	Reid Vapor Pressure
SARA	Superfund Amendments and
SCBA	Self Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
UN	United Nations
UNECE	United Nations Economic Commission for Europe
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Canadian Workplace Hazardous Materials Information System

Disclaimer of Expressed and Implied Warranties

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

** End of Safety Data Sheet **

1. IDENTIFICATION

Product Identifier: No. 2 Fuel Oil

Synonyms: No. 2 Heating Oil, #2 Fuel Oil, Heating Oil Plus™, Low Sulfur Heating Oil (LSHO), Ultra Low Sulfur Heating Oil (ULSHO)

Intended use of the product: Fuel

Contact:
Global Companies LLC
Water Mill Center
800 South St.
Waltham, MA 02454-9161
www.globalp.com

Contact Information: EMERGENCY TELEPHONE NUMBER (24 hrs.): CHEMTREC (800) 424-9300
COMPANY CONTACT (business hours): 800-542-0778

2. HAZARD IDENTIFICATION

According to OSHA 29 CFR 1910.1200 HCS

Classification of the Substance or Mixture

Classification (GHS-US):

Flam. Liquid	Category 3	H226
Skin Corrosion/Irritation	Category 2	H315
Aspiration Hazard	Category 1	H304
Acute toxicity – Inhalation	Category 4	H332
STOT SE	Category 3	H336
Carcinogenicity	Category 2	H350
Aquatic Chronic	Category 2	H411
Eye damage/Irritation	Category 2	H319

Labeling Elements



Signal Word (GHS-US): **Danger**

Hazard Statements (GHS-US):
H226 – Flammable liquid and vapor.
H315 – Causes Skin irritation.
H304 – May be fatal if swallowed and enters airways.
H332—Harmful if inhaled.
H336 – May cause drowsiness or dizziness.
H350 – May cause cancer.
H411 – Toxic to aquatic life with long lasting effects.
H319 – May cause eye damage/irritation.

Precautionary Statements (GHS-US):
P210 - Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P233 - Keep container tightly closed.
P240 – Ground/bond container and receiving equipment.
P241 – Use explosion-proof electrical/ventilating/lighting equipment pursuant to applicable electrical code.

P242 – Use only non-sparking tools.
P243 – Take precautionary measures against static discharge.
P261 – Avoid breathing dust/fume/gas/mist/vapors/spray.
P264 – Wash skin thoroughly after handling.
P271 – Use only outdoors or in a well-ventilated area.
P273 – Avoid release to the environment.
P280 - Wear protective gloves/protective clothing/eye protection/face protection.
P303+361+353 - If on skin (or hair): Take off immediately all contaminated clothing. Rinse with water/shower.
P308+311 - If exposed or concerned: Get medical advice/attention.
P301+310 - If swallowed: Immediately call a poison center/doctor/…
P331 - Do NOT induce vomiting.
P370+P378 – In case of fire use firefighting foam or other appropriate media for Class B fires to extinguish.
P403+235 - Store in a well-ventilated place. Keep cool.
P405 - Store locked up.
P501 – Dispose of contents/container in accordance with local/regional/national/international regulation.

Other information:

NFPA 704
Health: 1
Fire: 2
Reactivity: 0



3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Composition Information
Mixture

Name	Product Identifier (CAS#)	% (w/w)	Classification
No. 2 Fuel Oil	68476-30-2	95-100	Flam Liq. 3, H226; Skin Irrit. 2, H315; Aspiration 1, H304; STOT SE 3, H336; Carc.2. H350; Aquatic chronic 2, H411
Methyl Esters	N/A	0-5	N/A
Naphthalene	91-20-3	< 0.1	Carc. 2, H351; Acute Tox. 4, H302; Aquatic Acute 1, H400; Aquatic Chronic 1, H411

Additional Formulation Information:
No. 2 Fuel Oil consists of C9+ hydrocarbons resulting from distillation of crude oil.

Low Sulfur Heating Oil typically contains less than 500 ppm of sulfur

Ultra Low Sulfur Heating Oil typically contains less than 15 ppm of sulfur

4. FIRST AID MEASURES

Route	Measures
Inhalation	Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.
Ingestion	Aspiration Hazard: DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Ingestion may cause gastrointestinal disturbances including irritation, nausea, vomiting, and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory failure, and death.
Eye Contact	In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention. In case of contact lenses, remove immediately.
Skin Contact	Remove contaminated clothing and shoes. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops. Thermal burns require immediate medical attention depending on the severity and of the area of the body burned.

Most Important Symptoms
Contact with eyes and face may cause irritation. Long-term exposure may cause dermatitis (itching, irritation, pain and swelling).

Inhalation may cause irritation and significant or long term exposure could cause respiratory insufficiency and pulmonary edema.

Ingestion may cause aspiration, gastrointestinal disturbance, and CNS effects.

Immediate Medical Attention and Special Treatment
For contact with skin or eyes, immediately wash or flush contaminated eyes with gently flowing water. If possible, irrigate each eye continuously with 0.9% saline (NS). If ingested, rinse mouth. Do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs).

If inhaled, administer oxygen or establish a patent airway if breathing is labored. Suction if necessary. Monitor closely, anticipate seizures. Consider orotracheal or nostracheal intubation of airway control if patient is unconscious or is in severe respiratory distress.

Discard any clothing or shoes contaminated as they may be flammable.

5. FIRE-FIGHTING MEASURES

Extinguishing Media
Foam, carbon dioxide, dry chemical are most suitable

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, C02, water spray, firefighting foam, or Halon. Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other firefighting equipment.

LARGE FIRES: Foam, carbon dioxide, dry chemical. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

Specific Hazards / Products of Combustion
Moderate fire hazard when exposed to heat or flame with a very low flash point. Product is flammable and easily ignited when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

Combustion may produce smoke, carbon monoxide and other products of incomplete combustion.

Special Precautions and Protective Equipment for Firefighters
Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water.

For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied firefighting foam.

Fighting Equipment/Instructions
Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH- approved pressure-demand self-contained breathing apparatus with full face piece and protective clothing.

Refer to Section 9 for fire properties of this chemical including flash point, auto ignition temperature, and explosive limits.

6. ACCIDENTAL RELEASE MEASURES

ACTIVATE FACILITY SPCC, SPILL CONTINGENCY or EMERGENCY PLAN.

Personal Precautions
Due to high vapor density, flammable / toxic vapors may be present in low lying areas, dikes, pits, drains, or trenches. Vapors may accumulate in low lying areas and reach ignitable concentrations. Ventilate the area. Use of non-sparking tools and intrinsically safe equipment is recommended. Potential for flammable atmosphere should be monitored using a combustible gas indicator positioned downwind of the spill area. Refer to Sections 2 and 7 for further hazard warnings and handling instructions.

Use appropriate personal protective equipment to prevent eye/skin contact and absorption. Use NIOSH approved respiratory protection, if warranted, to prevent exposures above permissible limits. Refer to Section 8. Contaminated clothing should not be near sources of ignition.

Emergency Measures
As an immediate precautionary measure, isolate spill or leak area for at least 50 meters (150 feet) in all directions. Consider wind direction. Secure all ignition sources (flame, spark, hot work, hot metal, etc.) from area. Evaluate the direction of product travel, diking sewers, etc. to confirm spill areas. Do not touch or walk-through spilled material. For large spills, isolate initial action distance downwind 1,000 ft. (300 m).

Environmental Precautions
Stop the spill to prevent environmental release if it can be done safely. Product is toxic to aquatic life. Take action to isolate environmental receptors including drains, storm sewers and natural water bodies. Keep on impervious surface if at all possible. Use water sparingly to prevent product from spreading. Foam and absorbents may be used to reduce / prevent airborne release.

Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Follow federal, state or local requirements for reporting environmental release where necessary. Refer to Section 15 for further information.

Containment and Clean-Up Methods
Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of firefighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with dry earth, sand or other non-combustible, inert oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container with clean, non-sparking tools for reclamation or disposal. Response and cleanup crews must be properly trained and must utilize proper protective equipment. Refer to Section 8 for appropriate protective equipment.

7. HANDLING AND STORAGE

USE ONLY AS A FUEL.
DO NOT SIPHON BY MOUTH.

Handling Precautions
Handle as a flammable liquid. Keep away from heat, sparks, and open flame. No smoking. Electrical equipment should be approved for classified area. Bond and ground containers during product transfer pursuant to NFPA 70 and API RP 2003 to reduce the possibility of static-initiated fire or explosion. Follow precautions to prevent static initiated fire.

Use good personal hygiene practices. Use only with protective equipment specified in Section 8. Avoid repeated and/or prolonged skin exposure. Use only outdoors or in well ventilated areas. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves. Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API RP 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents."

Storage

Large quantities of fuel oil are stored in tanks or portable containers at an ambient storage temperature. Separate from incompatible chemicals (Refer to Section 10) by distance or secondary containment. Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers that are clearly labeled. Label all secondary containers that this material is transferred into with the chemical name and associated hazard(s). Empty product containers or vessels may contain flammable vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Storage tanks should have a venting system. If stored in small containers, the area should be well ventilated, away from ignition sources and protected from potential damage or vehicular traffic. Post “No Smoking” signs in product storage areas. This storage area should comply with NFPA 30 “Flammable and Combustible Liquid Code” or applicable building code. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 “Cleaning Mobile Tanks in Flammable and Combustible Liquid Service” and API RP 2015 “Safe Entry and Cleaning of Petroleum Storage Tanks”.

Incompatibles

Keep away from strong oxidizers, ignition sources and heat.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational Exposure Limits

Component	CAS #	List	Value
No. 2 Fuel Oil	68476-30-2	ACGIH TLV-TWA	100 mg/m3*
Naphthalene	91-20-3	ACGIH TLV-TWA OSHA PEL ACGIH STEL	10 ppm 10 ppm 15 ppm

*Critical effects; Skin; A3; CNS impairment.

Engineering Controls

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces. Intrinsically safe equipment and non-sparking tools shall be used in circumstances where concentrations may exceed lower flammable limits. Grounding and bonding shall be used to prevent accumulation and discharge of static electricity. Emergency shower and eyewash should be provided in proximity to handling areas in the event of exposure to decontaminate.

Personal Protective Equipment

Exposure	Equipment
Eye / Face	Wear appropriate chemical protective glasses or goggles or face shields to prevent skin and eye contact especially caused from splashing.
Skin	Wear appropriate personal protective clothing to prevent skin contact. Gloves constructed of nitrile, neoprene or PVC are recommended when handling this material. Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure.

Exposure	Equipment
Respiratory	A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, ANSI Z88.2-1992, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection and limitations. Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.
Thermal	Product is stored at ambient temperature. No thermal protection is required except for emergency operations involving actual or potential for fire. Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

9. PHYSICAL AND CHEMICAL PROPERTIES

Property	Value	
Appearance	Clear or straw-colored liquid dyed red for distribution	
Odor	Mild petroleum distillate odor.	
Odor Threshold	<1 ppm	
pH	Not available	
Melting Point	-15 ˚F (-26 ˚C)	
Boiling Point Range	320 to 690 ˚F (160 to 366 ˚C)	
Flash Point	>125.6 ˚F (52 ˚C) PMCC	
Evaporation Rate	Slow, varies with conditions	
Flammability	Flammable liquid	
Flammable Limits	0.6 % - 7.5%	
Vapor Pressure	0.009 psia @ 70 ˚F	
Vapor Density	>1	(air=1)
Specific Gravity	0.81-0.88 @ 60 ˚F (16 ˚C)	(water=1)
Solubility	Insoluble in water; miscible with other petroleum solvents.	
Partition Coefficient (N-octanol/water)	Log Kow range of 3.3 to >.6.0	
Autoignition Temperature	494 ˚F (257 ˚C)	
Decomposition Temperature	When heated it emits acrid smoke and irritating vapors.	
Viscosity	<3 cSt	
Percent Volatiles	95-100	

10. STABILITY AND REACTIVITY

Stability
This is a stable material that is flammable liquid (OSHA/GHS hazard category 3). Stable during transport.

Reactivity
Material is not self-reacting. Flammable concentrations may be present in air. Compound can react with oxidizing materials.

Possibility of Hazardous Reactions
Hazardous polymerization will not occur.

Incompatibility
Keep away from strong oxidizers such as nitric and sulfuric acids.

Conditions to Avoid
Avoid high temperatures, open flames, sparks, static electricity, welding, smoking and other ignition sources.

Hazardous Decomposition Products
Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

11. TOXICOLOGICAL INFORMATION

Acute Toxicity:
Acute Toxicity (Inhalation LC50)

No. 2 Fuel Oil (68476-30-2)
LC50 Inhalation Rat >4.6 mg/l/4h

Acute Toxicity (Dermal LD50)

No. 2 Fuel Oil (68476-30-2)
LD50 Dermal Rabbit >2000 mg/kg

Acute Toxicity (Oral LD50)

No. 2 Fuel Oil (68476-30-2)
LD50 Oral Rat >12000 mg/kg

Acute Toxicity (Oral LD50)

Methyl Esters
LD50 Oral Rat >14400 mg/kg

Skin Corrosion/Irritation: Prolonged and repeated contact may cause skin irritation leading to dermatitis. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

Serious Eye Damage/Irritation: Causes serious eye irritation.

Respiratory or Skin Sensitization: Not classified

Germ Cell Mutagenicity: Not classified

Teratogenicity: Not available

Carcinogenicity: OSHA: NO, IARC: Group 3, NTP: NO, ACGIH: NOIC:A3, NIOSH: NO

IARC: Group 3 – Not classifiable as to their carcinogenicity to humans ACGIH: A3 – Confirmed animal carcinogen with unknown relevance to humans

Studies have shown that similar products produce skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation.

This product is similar to Diesel Fuel. IARC classifies whole diesel fuel exhaust particulates (byproduct of combustion of this material) carcinogenic to humans (Group 1) and NIOSH regards diesel fuel exhaust particulate as a potential occupational carcinogen.

Reproductive Toxicity: Not classified

Specific Target Organ Toxicity (Repeated Exposure): Not classified

Specific Target Organ Toxicity (Single Exposure): Inhalation exposure may cause drowsiness or dizziness by inhalation exposure.

Aspiration Hazard: The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Potential Health Effects: Vapor irritating to skin, eyes, nose, and throat. Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

WARNING: The burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

12. ECOLOGICAL INFORMATION

Toxicity
This material is expected to be toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment.

Data for Component: No. 2 Fuel Oil (68476-30-2)

Material is toxic to aquatic organisms based on an acute basis (LC50/EC50 >1 but ≤ 10 mg/L in the most sensitive species tested).

Material is a long-term aquatic hazard based on a chronic basis (LC50/EC50 >1 but ≤ 10 mg/L in the most sensitive species tested).

Persistence and Degradation: This material is not expected to be readily biodegradable.

Bioaccumulative Potential: Not available

Mobility in Soil: Not available

Other Adverse Effects: None known

Other Information: Avoid release to the environment.

13. DISPOSAL CONSIDERATIONS

Consult federal, state and local waste regulations to determine appropriate disposal options. May be considered a hazardous waste if disposed. Direct solid waste (landfill) or incineration at a solid waste facility is not permissible. Do not discharge to sanitary or storm sewer. Personnel handling waste containers should follow precautions provided in this document.

Shipping containers must be DOT authorized packages. Follow licensure and regulations for transport of hazardous material and hazardous waste as applicable.

14. TRANSPORT INFORMATION

US DOT

UN Identification Number	NA 1993
Proper Shipping Name	Fuel oil (No. 2)
Hazard Class and Packing Group	3, PGIII
Shipping Label	Flammable liquid
Placard / Bulk Package	Flammable liquid, 1993
Emergency Response Guidebook Guide Number	128

This product may be re-classified as a “Combustible Liquid” meeting the definition in 49 CFR 173.120 unless transported by vessel or aircraft.
Specific placard requirements must be met for shipments of this product as a Combustible Liquid by rail (See 49 CFR 172.332).
Non-bulk packages (<= 119 gal) of Combustible Liquids in package sizes less than the product reportable quantity are not regulated as hazardous materials if the material does not meet any other hazard class.

IATA Information

UN Identification Number	UN 1202
Proper Shipping Name	Fuel oil (No. 2)
Hazard Class and Packing Group	3, PGIII

ICAO Label	3
Packing Instructions Cargo	355
Max Quantity Per Package Cargo	220L
Packing Instructions Passenger	344Y
Max Quantity per Package Passenger	60L

ICAO

UN Identification Number	UN 1202
Shipping Name / Description	Fuel oil (No. 2)
Hazard Class and Packing Group	3, PG III
IMDG Label	3

IMDG

UN Identification Number	UN 1202
Shipping Name / Description	Heating Oil, Light
Hazard Class and Packing Group	3, PGIII
IMDG Label	3
EmS Number	N/A
Marine Pollutant	Yes

15. REGULATORY INFORMATION

U.S. Federal, State, and Local Regulatory Information
Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other federal, state, or local regulations; consult those regulations applicable to your facility/operation.

OSHA Hazard Communication Standard
This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning And Community Right-to-Know Act of 1986) Sections 311 and 312

Immediate (Acute) Health Hazard	Yes
Delayed (Chronic) Health Hazard	Yes
Fire Hazard	Yes
Reactive Hazard	No
Sudden Release of Pressure Hazard	No

Clean Water Act (Oil Spills)
Any spill or release of this product to “navigable waters” (Essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA Section 103 and SARA Section 304 (Release to the Environment)
The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts this material. This product does not contain any chemicals subject to the reporting requirements of CERCLA Section 103 or SARA 304.

SARA Section 313- Supplier Notification
This product does not contain any chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372.

EPA Notification (Oil Spills)
If the there is a discharge of more than 1,000-gallons of oil into or upon navigable waters of the United States, or if it is the second spill event of 42 gallons or more of oil into water within a twelve (12) month period, a written report must be submitted to the Regional Administrator of the EPA within sixty days of the event.

Pennsylvania Right to Know Hazardous Substance list:
The following product components are cited in the Pennsylvania Special Hazardous Substance List, and are present at levels which require reporting.

Component	CAS	Amount
No. 2 Fuel Oil	68476-30-2	100%

New Jersey Right to Know Hazardous Substance list:
The following product components are cited in the New Jersey Right to Know Hazardous Substance List, and are present at levels which require reporting.

Component	CAS	Amount
No. 2Fuel Oil	68476-30-2	100%

California Proposition 65 WARNING: This product contains chemicals known to the State of California to cause Cancer or Reproductive Toxicity.

Component	CAS	Amount
Naphthalene	91-20-3	<0.1%

U.S. Toxic Substances Control Act
All components of this product are on the TSCA Inventory or are exempt from TSCA Inventory requirements under 40 CFR 720.30.

CEPA - Domestic Substances List (DSL)
All substances contained in this product are listed on the Canadian Domestic Substances List (DSL) or are not required to be listed.

Canadian Regulatory Information (WHMIS)
Class B3 – Combustible Liquid
Class D2A – Materials causing other toxic effects. (Very Toxic)

16. OTHER INFORMATION

Version	5
Issue Date	June 26, 2019
Prior Issue Date	May 20, 2016

Description of Revisions
Update viscosity information in Section 9. Update transportation information in Section 14 to clarify US DOT re-classification option as a Combustible Liquid.

Abbreviations

˚F	Degrees Fahrenheit (temperature)
<	Less than
=	Equal to
>	Greater than
AP	Approximately
C	Centigrade (temperature)
kg	Kilogram
L	Liter
mg	Milligrams
mL	Milliliter
mm^2	Square millimeters
mmHg	Millimeters of mercury (pressure)
N/A	Not applicable
N/D	Not determined
ppm	Parts per million
sec	Second
ug	Micrograms

Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
AL	Action Level
ANSI	American National Standards Institute
API	American Petroleum Institute
CAS	Chemical Abstract Service
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation
EC50	Ecological concentration 50%
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guideline
GHS	Global Harmonized System
HMIS	Hazardous Materials Information System
IARC	International Agency for Research On Cancer
IATA	International Air Transport Association
IMDG	International Maritime Dangerous Goods
Koc	Soil Organic Carbon
LC50	Lethal concentration 50%
LD50	Lethal dose 50%
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act Reauthorization Act of 1986 Title III
REL	Recommended Exposure Limit (NIOSH)
RVP	Reid Vapor Pressure
SARA	Superfund Amendments and
SCBA	Self Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
UN	United Nations
UNECE	United Nations Economic Commission for Europe
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Canadian Workplace Hazardous Materials Information System

Disclaimer of Expressed and Implied Warranties

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

** End of Safety Data Sheet **

SAFETY DATA SHEET

1. Identification

Product identifier **UNLEADED GASOLINE**

Other means of identification

SDS number 002-GHS

Synonyms Regular/Premium/Midgrade - Unleaded Gasoline, RFG - Reformulated Unleaded Gasoline, Conventional Unleaded Gasoline, Oxygenated Unleaded Gasoline, Non-Oxygenated Unleaded Gasoline, CARB (California Air Resource Board) Unleaded Gasoline, RBOB - Reformulated Blendstock for Oxygenate Blending, CBOB - Conventional Blendstock for Oxygenate Blending, Petrol, Motor Fuel.
See section 16 for complete information.

Recommended use Motor Fuel
Motor fuels.

Recommended restrictions None known.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer/Supplier Valero Marketing & Supply Company and Affiliates
One Valero Way
San Antonio, TX 78269-6000

General Assistance 210-345-4593

E-Mail CorpHSE@valero.com

Contact Person Industrial Hygienist

Emergency Telephone 24 Hour Emergency 866-565-5220
1-800-424-9300 (CHEMTREC USA)

2. Hazard(s) identification

Physical hazards	Flammable liquids	Category 1
Health hazards	Skin corrosion/irritation	Category 2
	Germ cell mutagenicity	Category 1B
	Carcinogenicity	Category 1B
	Reproductive toxicity	Category 2
	Specific target organ toxicity, single exposure	Category 3 narcotic effects
	Specific target organ toxicity, repeated exposure	Category 2
	Aspiration hazard	Category 1
Environmental hazards	Hazardous to the aquatic environment, long-term hazard	Category 2

OSHA defined hazards Not classified.

Label elements



Signal word Danger

Hazard statement Extremely flammable liquid and vapor. Causes skin irritation. May cause genetic defects. May cause cancer. Suspected of damaging fertility or the unborn child. May cause drowsiness or dizziness. May cause damage to organs (blood, liver, kidney) through prolonged or repeated exposure. May be fatal if swallowed and enters airways. Toxic to aquatic life with long lasting effects.

Precautionary statement

Prevention	Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting// equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Do not breathe gas/mist/vapors/spray. Wash thoroughly after handling. Wear protective gloves/protective clothing/eye protection/face protection. Use only outdoors or in a well-ventilated area. Avoid release to the environment.
Response	If exposed or concerned: Get medical advice/attention. If inhaled: Remove person to fresh air and keep comfortable for breathing. If swallowed: Immediately call a poison center/doctor. Do NOT induce vomiting. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. If skin irritation occurs: Get medical advice/attention. In case of fire: Use alcohol-resistant foam, carbon dioxide, dry powder or water fog for extinction. Collect spillage.
Storage	Store locked up. Store in a well-ventilated place. Keep container tightly closed. Keep cool.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazard(s) not otherwise classified (HNOC)	None known.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Gasoline	86290-81-5	80-100
Toluene	108-88-3	0-30
Hexane (Other Isomers)	96-14-0	5-25
Xylene (o, m, p isomers)	1330-20-7	0-25
Octane (All isomers)	111-65-9	0-18.5
Ethanol	64-17-5	0-10
1,2,4, Trimethylbenzene	95-63-6	0-6
n-Heptane	142-82-5	1-5
Pentane	109-66-0	1-5
Cumene	98-82-8	0-5
Ethylbenzene	100-41-4	0-5
Benzene	71-43-2	0-4.9
n-Hexane	110-54-3	0-3
Cyclohexane	110-82-7	0-3

4. First-aid measures

Inhalation	Move to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Get medical attention.
Skin contact	Remove contaminated clothing and shoes. Wash off immediately with soap and plenty of water. Get medical attention if irritation develops or persists. Wash clothing separately before reuse. Destroy or thoroughly clean contaminated shoes. If high pressure injection under the skin occurs, always seek medical attention.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention.
Ingestion	Rinse mouth thoroughly. Do not induce vomiting without advice from poison control center. Do not give mouth-to-mouth resuscitation. If vomiting occurs, keep head low so that stomach content does not get into the lungs. Never give anything by mouth to a victim who is unconscious or is having convulsions. Get medical attention immediately.
Most important symptoms/effects, acute and delayed	Irritation of nose and throat. Irritation of eyes and mucous membranes. Skin irritation. Unconsciousness. Corneal damage. Narcosis. Cyanosis (blue tissue condition, nails, lips, and/or skin). Decrease in motor functions. Behavioral changes. Edema. Liver enlargement. Jaundice. Conjunctivitis. Proteinuria. Defatting of the skin. Rash.

Indication of immediate medical attention and special treatment needed	In case of shortness of breath, give oxygen. Keep victim warm. Keep victim under observation. Symptoms may be delayed.
General information	If exposed or concerned: get medical attention/advice. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance. Wash contaminated clothing before re-use.

5. Fire-fighting measures

Suitable extinguishing media	Water spray. Water fog. Foam. Dry chemical powder. Carbon dioxide (CO2).
Unsuitable extinguishing media	Do not use a solid water stream as it may scatter and spread fire.
Specific hazards arising from the chemical	Vapor may cause flash fire. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge.
Special protective equipment and precautions for firefighters	Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask.
Fire-fighting equipment/instructions	Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask. Withdraw immediately in case of rising sound from venting safety devices or any discoloration of tanks due to fire. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Move containers from fire area if you can do it without risk. In the event of fire, cool tanks with water spray. Cool containers exposed to flames with water until well after the fire is out. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Vapors may form explosive air mixtures even at room temperature. Prevent buildup of vapors or gases to explosive concentrations. Some of these materials, if spilled, may evaporate leaving a flammable residue. Water runoff can cause environmental damage. Use compatible foam to minimize vapor generation as needed.
Specific methods	Use water spray to cool unopened containers.
General fire hazards	Extremely flammable liquid and vapor. Containers may explode when heated.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Local authorities should be advised if significant spills cannot be contained. Keep upwind. Keep out of low areas. Ventilate closed spaces before entering. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. See Section 8 of the SDS for Personal Protective Equipment.
Methods and materials for containment and cleaning up	Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Stop leak if you can do so without risk. This material is a water pollutant and should be prevented from contaminating soil or from entering sewage and drainage systems and bodies of water. Dike the spilled material, where this is possible. Prevent entry into waterways, sewers, basements or confined areas. Use non-sparking tools and explosion-proof equipment. Small Spills: Absorb spill with vermiculite or other inert material, then place in a container for chemical waste. Clean surface thoroughly to remove residual contamination. This material and its container must be disposed of as hazardous waste. Large Spills: Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Prevent product from entering drains. Do not allow material to contaminate ground water system. Should not be released into the environment.
Environmental precautions	Gasoline may contain oxygenated blend products (Ethanol, etc.) that are soluble in water and therefore precautions should be taken to protect surface and groundwater sources from contamination. If facility or operation has an "oil or hazardous substance contingency plan", activate its procedures. Stay upwind and away from spill. Wear appropriate protective equipment including respiratory protection as conditions warrant. Do not enter or stay in area unless monitoring indicates that it is safe to do so. Isolate hazard area and restrict entry to emergency crew. Extremely flammable. Review Firefighting Measures, Section 5, before proceeding with clean up. Keep all sources of ignition (flames, smoking, flares, etc.) and hot surfaces away from release. Contain spill in smallest possible area. Recover as much product as possible (e.g. by vacuuming). Stop leak if it can be done without risk. Use water spray to disperse vapors. Use compatible foam to minimize vapor generation as needed. Spilled material may be absorbed by an appropriate absorbent, and then handled in accordance with environmental regulations. Prevent spilled material from entering sewers, storm drains, other unauthorized treatment or drainage systems and natural waterways. Contact fire authorities and appropriate federal, state and local agencies. If spill of any amount is made into or upon navigable waters, the contiguous zone, or adjoining shorelines, contact the National Response Center at 1-800-424-8802.

7. Handling and storage

Precautions for safe handling

Eliminate sources of ignition. Avoid spark promoters. Ground/bond container and equipment. These alone may be insufficient to remove static electricity.
Wear personal protective equipment. Do not breathe dust/fume/gas/mist/vapors/spray. Avoid contact with eyes, skin, and clothing. Do not taste or swallow. Avoid prolonged exposure. Use only with adequate ventilation. Wash thoroughly after handling. The product is extremely flammable, and explosive vapor/air mixtures may be formed even at normal room temperatures. DO NOT handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Use non-sparking tools and explosion-proof equipment. When using, do not eat, drink or smoke. Avoid release to the environment.

Conditions for safe storage, including any incompatibilities

Flammable liquid storage. Do not handle or store near an open flame, heat or other sources of ignition. This material can accumulate static charge which may cause spark and become an ignition source. The pressure in sealed containers can increase under the influence of heat. Keep container tightly closed in a cool, well-ventilated place. Keep away from food, drink and animal feedingstuffs. Keep out of the reach of children.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Components	Type	Value
Benzene (CAS 71-43-2)	STEL	5 ppm
	TWA	1 ppm

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value
Cumene (CAS 98-82-8)	PEL	245 mg/m3
		50 ppm
Cyclohexane (CAS 110-82-7)	PEL	1050 mg/m3
		300 ppm
Ethanol (CAS 64-17-5)	PEL	1900 mg/m3
		1000 ppm
Ethylbenzene (CAS 100-41-4)	PEL	435 mg/m3
		100 ppm
n-Heptane (CAS 142-82-5)	PEL	2000 mg/m3
		500 ppm
n-Hexane (CAS 110-54-3)	PEL	1800 mg/m3
		500 ppm
Octane (All isomers) (CAS 111-65-9)	PEL	2350 mg/m3
		500 ppm
Pentane (CAS 109-66-0)	PEL	2950 mg/m3
		1000 ppm
Xylene (o, m, p isomers) (CAS 1330-20-7)	PEL	435 mg/m3
		100 ppm

US. OSHA Table Z-2 (29 CFR 1910.1000)

Components	Type	Value
Benzene (CAS 71-43-2)	Ceiling	25 ppm
	TWA	10 ppm
Toluene (CAS 108-88-3)	Ceiling	300 ppm
	TWA	200 ppm

US. ACGIH Threshold Limit Values

Components	Type	Value
1,2,4, Trimethylbenzene (CAS 95-63-6)	TWA	25 ppm
Benzene (CAS 71-43-2)	STEL	2.5 ppm

US. ACGIH Threshold Limit Values

Components	Type	Value
	TWA	0.5 ppm
Cumene (CAS 98-82-8)	TWA	50 ppm
Cyclohexane (CAS 110-82-7)	TWA	100 ppm
Ethanol (CAS 64-17-5)	STEL	1000 ppm
Ethylbenzene (CAS 100-41-4)	TWA	20 ppm
Gasoline (CAS 86290-81-5)	STEL	500 ppm
	TWA	300 ppm
Hexane (Other Isomers) (CAS 96-14-0)	STEL	1000 ppm
	TWA	500 ppm
n-Heptane (CAS 142-82-5)	STEL	500 ppm
	TWA	400 ppm
n-Hexane (CAS 110-54-3)	TWA	50 ppm
Octane (All isomers) (CAS 111-65-9)	TWA	300 ppm
Pentane (CAS 109-66-0)	TWA	600 ppm
Toluene (CAS 108-88-3)	TWA	20 ppm
Xylene (o, m, p isomers) (CAS 1330-20-7)	STEL	150 ppm
	TWA	100 ppm

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value
1,2,4, Trimethylbenzene (CAS 95-63-6)	TWA	125 mg/m3
		25 ppm
Benzene (CAS 71-43-2)	STEL	1 ppm
	TWA	0.1 ppm
Cumene (CAS 98-82-8)	TWA	245 mg/m3
		50 ppm
Cyclohexane (CAS 110-82-7)	TWA	1050 mg/m3
		300 ppm
Ethanol (CAS 64-17-5)	TWA	1900 mg/m3
		1000 ppm
Ethylbenzene (CAS 100-41-4)	STEL	545 mg/m3
		125 ppm
	TWA	435 mg/m3
		100 ppm
Hexane (Other Isomers) (CAS 96-14-0)	Ceiling	1800 mg/m3
		510 ppm
	TWA	350 mg/m3
		100 ppm
n-Heptane (CAS 142-82-5)	Ceiling	1800 mg/m3
		440 ppm
	TWA	350 mg/m3
		85 ppm
n-Hexane (CAS 110-54-3)	TWA	180 mg/m3
		50 ppm
Octane (All isomers) (CAS 111-65-9)	Ceiling	1800 mg/m3
		385 ppm
	TWA	350 mg/m3
		75 ppm
Pentane (CAS 109-66-0)	Ceiling	1800 mg/m3

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Components	Type	Value
		610 ppm
	TWA	350 mg/m3
		120 ppm
Toluene (CAS 108-88-3)	STEL	560 mg/m3
		150 ppm
	TWA	375 mg/m3
		100 ppm
Xylene (o, m, p isomers) (CAS 1330-20-7)	STEL	655 mg/m3
		150 ppm
	TWA	435 mg/m3
		100 ppm

Biological limit values

ACGIH Biological Exposure Indices

Components	Value	Determinant	Specimen	Sampling Time
Benzene (CAS 71-43-2)	25 µg/g	S-Phenylmercapturic acid	Creatinine in urine	*
Ethylbenzene (CAS 100-41-4)	0.7 g/g	Sum of mandelic acid and phenylglyoxylic acid	Creatinine in urine	*
n-Hexane (CAS 110-54-3)	0.4 mg/l	2,5-Hexanedi - on, without hydrolysis		*
	0.4 mg/l	2,5-Hexanedion, without hydrolysis	Urine	*
Toluene (CAS 108-88-3)	0.3 mg/g	o-Cresol, with hydrolysis	Creatinine in urine	*
	0.03 mg/l	Toluene	Urine	*
	0.02 mg/l	Toluene	Blood	*
Xylene (o, m, p isomers) (CAS 1330-20-7)	1.5 g/g	Methylhippuric acids	Creatinine in urine	*

* - For sampling details, please see the source document.

Exposure guidelines

US - California OELs: Skin designation

Benzene (CAS 71-43-2)	Can be absorbed through the skin.
Cumene (CAS 98-82-8)	Can be absorbed through the skin.
n-Hexane (CAS 110-54-3)	Can be absorbed through the skin.
Toluene (CAS 108-88-3)	Can be absorbed through the skin.

US - Minnesota Haz Subs: Skin designation applies

Cumene (CAS 98-82-8)	Skin designation applies.
Toluene (CAS 108-88-3)	Skin designation applies.

US - Tennesse OELs: Skin designation

Cumene (CAS 98-82-8)	Can be absorbed through the skin.

US ACGIH Threshold Limit Values: Skin designation

Benzene (CAS 71-43-2)	Can be absorbed through the skin.
n-Hexane (CAS 110-54-3)	Can be absorbed through the skin.

US. NIOSH: Pocket Guide to Chemical Hazards

Cumene (CAS 98-82-8)	Can be absorbed through the skin.

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Cumene (CAS 98-82-8)	Can be absorbed through the skin.

Appropriate engineering controls Provide adequate general and local exhaust ventilation. Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Use explosion-proof equipment.

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear safety glasses. If splash potential exists, wear full face shield or chemical goggles.
Skin protection	
Hand protection	Avoid exposure - obtain special instructions before use. Wear protective gloves. Be aware that the liquid may penetrate the gloves. Frequent change is advisable. Suitable gloves can be recommended by the glove supplier.
Other	Wear chemical-resistant, impervious gloves. Full body suit and boots are recommended when handling large volumes or in emergency situations. Flame retardant protective clothing is recommended.
Respiratory protection	Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. If workplace exposure limits for product or components are exceeded, NIOSH approved equipment should be worn. Proper respirator selection should be determined by adequately trained personnel, based on the contaminants, the degree of potential exposure and published respiratory protection factors. This equipment should be available for nonroutine and emergency use.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Consult supervisor for special handling instructions. Avoid contact with eyes. Avoid contact with skin. Keep away from food and drink. Wash hands before breaks and immediately after handling the product. Provide eyewash station and safety shower. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance	Light straw to red clear liquid with characteristic strong odor of gasoline.
Physical state	Liquid.
Form	Liquid.
Color	Light straw to red clear.
Odor	Characteristic Gasoline Odor (Strong).
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	44.01 °F (6.67 °C) May start to solidify at this temperature. This is based on data for the following ingredient: Cyclohexane. Weighted average: -91.9 deg C (-133.4 deg F)
Initial boiling point and boiling range	80.06 - 440.06 °F (26.7 - 226.7 °C)
Flash point	-40.0 °F (-40.0 °C) (closed cup)
Evaporation rate	10 - 11 BuAc
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	1.3 %
Flammability limit - upper (%)	7.1 %
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	60.8 - 101.3 kPa (20°C)
Vapor density	3 - 4 (Air=1)
Relative density	Not available.
Solubility(ies)	
Solubility (water)	Very slightly soluble.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	> 500 °F (> 260 °C)
Decomposition temperature	Not available.
Viscosity	Not available.

Other information

Flash point class	Flammable IA
VOC (Weight %)	100 %

10. Stability and reactivity

Reactivity	None known.
Chemical stability	Stable under normal temperature conditions and recommended use.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Heat, flames and sparks. Ignition sources. Contact with incompatible materials. Do not pressurize, cut, weld, braze, solder, drill, grind or expose empty containers to heat, flame, sparks, static electricity, or other sources of ignition; they may explode and cause injury or death.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Ingestion	Swallowing or vomiting of the liquid may result in aspiration into the lungs.
Inhalation	In high concentrations, mists/vapors may irritate throat and respiratory system and cause coughing. May cause drowsiness or dizziness.
Skin contact	Causes skin irritation. Prolonged contact may cause dryness of the skin.
Eye contact	May cause eye irritation.
Symptoms related to the physical, chemical and toxicological characteristics	Irritation of nose and throat. Irritation of eyes and mucous membranes. Skin irritation. Unconsciousness. Corneal damage. Narcosis. Cyanosis (blue tissue condition, nails, lips, and/or skin). Decrease in motor functions. Behavioral changes. Edema. Liver enlargement. Jaundice. Conjunctivitis. Proteinuria. Defatting of the skin. Rash.

Information on toxicological effects

Acute toxicity Based on available data, the classification criteria are not met.

Components	Species	Test Results
1,2,4, Trimethylbenzene (CAS 95-63-6)		
Acute		
Dermal		
LD50	Rabbit	> 3160 mg/kg
Inhalation		
LC50	Rat	> 2000 mg/l, 48 Hours
Oral		
LD50	Rat	6 g/kg
Benzene (CAS 71-43-2)		
Acute		
Oral		
LD50	Rat	3306 mg/kg
Cumene (CAS 98-82-8)		
Acute		
Inhalation		
LC50	Mouse	2000 mg/l, 7 Hours
	Rat	8000 mg/l, 4 Hours
Oral		
LD50	Rat	1400 mg/kg
Cyclohexane (CAS 110-82-7)		
Acute		
Oral		
LD50	Rat	12705 mg/kg

Components	Species	Test Results
Ethanol (CAS 64-17-5)		
Acute		
Inhalation		
LC50	Rat	30000 mg/m3
Ethylbenzene (CAS 100-41-4)		
Acute		
Dermal		
LD50	Rabbit	> 5000 mg/kg
Oral		
LD50	Rat	5.46 g/kg
n-Heptane (CAS 142-82-5)		
Acute		
Inhalation		
LC50	Rat	103 mg/l, 4 Hours
n-Hexane (CAS 110-54-3)		
Acute		
Oral		
LD50	Rat	28710 mg/kg
Octane (All isomers) (CAS 111-65-9)		
Acute		
Inhalation		
LC50	Rat	118 mg/l, 4 Hours
Pentane (CAS 109-66-0)		
Acute		
Inhalation		
LC50	Rat	364 mg/l, 4 Hours
Toluene (CAS 108-88-3)		
Acute		
Dermal		
LD50	Rabbit	14.1 ml/kg
Inhalation		
LC50	Rat	8000 mg/l, 4 Hours
Oral		
LD50	Rat	2.6 g/kg
Xylene (o, m, p isomers) (CAS 1330-20-7)		
Acute		
Oral		
LD50	Rat	4300 mg/kg

Skin corrosion/irritation Causes skin irritation.

Serious eye damage/eye irritation Based on available data, the classification criteria are not met.

Respiratory or skin sensitization

Respiratory sensitization Based on available data, the classification criteria are not met.

Skin sensitization Based on available data, the classification criteria are not met.
This substance may have a potential for sensitization which may provoke an allergic reaction among sensitive individuals.

Germ cell mutagenicity May cause genetic defects.
In in-vitro experiments, neither benzene, toluene nor xylene changed the number of sister-chromatid exchanges (SCEs) or the number of chromosomal aberrations in human lymphocytes. However, toluene and xylene caused a significant cell growth inhibition which was not observed with benzene in the same concentrations. In in-vivo experiments, toluene changed the number of sister-chromatid exchanges (SCEs) in human lymphocytes. Toluene may cause heritable genetic damage.

Carcinogenicity May cause cancer.

IARC Monographs. Overall Evaluation of Carcinogenicity

Benzene (CAS 71-43-2)	1 Carcinogenic to humans.
Cumene (CAS 98-82-8)	2B Possibly carcinogenic to humans.
Ethylbenzene (CAS 100-41-4)	2B Possibly carcinogenic to humans.
Gasoline (CAS 86290-81-5)	2B Possibly carcinogenic to humans.
Toluene (CAS 108-88-3)	3 Not classifiable as to carcinogenicity to humans.
Xylene (o, m, p isomers) (CAS 1330-20-7)	3 Not classifiable as to carcinogenicity to humans.

NTP Report on Carcinogens

Benzene (CAS 71-43-2)	Known To Be Human Carcinogen.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Benzene (CAS 71-43-2)	Cancer

Reproductive toxicity Suspected of damaging fertility or the unborn child.
Benzene, xylene and toluene have demonstrated animal effects of reproductive toxicity. Animal studies of benzene have shown testicular effects, alterations in reproductive cycles, chromosomal aberrations and embryo/fetotoxicity. Ethanol has demonstrated human effects of reproductive toxicity. Can cause adverse reproductive effects - such as birth defects, miscarriages, or infertility. Avoid exposure to women during early pregnancy. Avoid contact during pregnancy/while nursing.

Specific target organ toxicity - single exposure May cause drowsiness or dizziness.

Specific target organ toxicity - repeated exposure May cause damage to the following organs through prolonged or repeated exposure: Blood. Kidneys. Liver.

Aspiration hazard May be fatal if swallowed and enters airways.

Chronic effects Repeated exposure of laboratory animals to high concentrations of gasoline vapors has caused kidney damage and cancer in rats and cancer in mice. Gasoline was evaluated for genetic activity in assays using microbial cells, cultured mammalian cells and rat bone marrow cells. The results were all negative so gasoline was considered nonmutagenic under these conditions. Overexposure to this product or its components has been suggested as a cause of liver abnormalities in laboratory animals and humans. Lifetime studies by the American Petroleum Institute have shown that kidney damage and kidney cancer can occur in male rats after prolonged inhalation exposures at elevated concentrations of total gasoline. Kidneys of mice and female rats were unaffected. The U.S. EPA Risk Assessment Forum has concluded that the male rat kidney tumor results are not relevant for humans. Total gasoline exposure also produced liver tumors in female mice only. The implication of these data for humans has not been determined.

Further information Symptoms may be delayed.

12. Ecological information

Ecotoxicity Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Components		Species	Test Results
1,2,4, Trimethylbenzene (CAS 95-63-6)			
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	7.19 - 8.28 mg/l, 96 hours
Benzene (CAS 71-43-2)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	8.76 - 15.6 mg/l, 48 hours
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	7.2 - 11.7 mg/l, 96 hours
Cumene (CAS 98-82-8)			
Aquatic			
Crustacea	EC50	Brine shrimp (Artemia sp.)	3.55 - 11.29 mg/l, 48 hours
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	2.7 mg/l, 96 hours
Cyclohexane (CAS 110-82-7)			
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	3.961 - 5.181 mg/l, 96 hours
		Striped bass (Morone saxatilis)	8.3 mg/l, 96 hours

Components		Species	Test Results
Ethanol (CAS 64-17-5)			
Aquatic			
Algae	EC50	Freshwater algae	275 mg/l, 72 Hours
		Marine water algae	1970 mg/l
Fish	LC50	Fathead minnow (Pimephales promelas)	> 100 mg/l, 96 hours
		Freshwater fish	11200 mg/l, 96 Hours
Invertebrate	EC50	Freshwater invertebrate	5012 mg/l, 48 Hours
		Marine water invertebrate	857 mg/l, 48 Hours
Ethylbenzene (CAS 100-41-4)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	1 - 4 mg/l, 48 hours
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	4 mg/l, 96 hours
n-Heptane (CAS 142-82-5)			
Aquatic			
Fish	LC50	Western mosquitofish (Gambusia affinis)	4924 mg/l, 96 hours
n-Hexane (CAS 110-54-3)			
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	2.101 - 2.981 mg/l, 96 hours
Toluene (CAS 108-88-3)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	5.46 - 9.83 mg/l, 48 hours
Fish	LC50	Pink salmon (Oncorhynchus gorbuscha)	6.86 - 8.48 mg/l, 96 hours
Xylene (o, m, p isomers) (CAS 1330-20-7)			
Aquatic			
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	8 mg/l, 96 Hours

Persistence and degradability Not available.

Bioaccumulative potential Not available.

Partition coefficient n-octanol / water (log Kow)

Benzene (CAS 71-43-2)	2.13
Cumene (CAS 98-82-8)	3.66
Cyclohexane (CAS 110-82-7)	3.44
Ethanol (CAS 64-17-5)	-0.31
Ethylbenzene (CAS 100-41-4)	3.15
Hexane (Other Isomers) (CAS 96-14-0)	3.6
Octane (All isomers) (CAS 111-65-9)	5.18
Pentane (CAS 109-66-0)	3.39
Toluene (CAS 108-88-3)	2.73
Xylene (o, m, p isomers) (CAS 1330-20-7)	3.2
n-Heptane (CAS 142-82-5)	4.66
n-Hexane (CAS 110-54-3)	3.9

Mobility in soil Not available.

Other adverse effects Not available.

13. Disposal considerations

Disposal instructions Dispose in accordance with all applicable regulations. This material and its container must be disposed of as hazardous waste. Dispose of this material and its container to hazardous or special waste collection point. Incinerate the material under controlled conditions in an approved incinerator. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container.

Hazardous waste code D001: Waste Flammable material with a flash point <140 °F
D018: Waste Benzene

US RCRA Hazardous Waste U List: Reference

Benzene (CAS 71-43-2)	U019
Cumene (CAS 98-82-8)	U055
Cyclohexane (CAS 110-82-7)	U056
Toluene (CAS 108-88-3)	U220
Xylene (o, m, p isomers) (CAS 1330-20-7)	U239

Waste from residues / unused products Dispose of in accordance with local regulations.

Contaminated packaging Offer rinsed packaging material to local recycling facilities.

14. Transport information

DOT

UN number	UN1203
UN proper shipping name	Gasoline
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	II
Environmental hazards	
Marine pollutant	Yes
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	139, B33, B101, T8
Packaging exceptions	150
Packaging non bulk	202
Packaging bulk	242

IATA

UN number	UN1203
UN proper shipping name	Gasoline
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Label(s)	3
Packing group	II
Environmental hazards	Yes
ERG Code	3H
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number	UN1203
UN proper shipping name	Gasoline
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Label(s)	3
Packing group	II
Environmental hazards	
Marine pollutant	Yes
EmS	F-E, S-E
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable. However, this product is a liquid and if transported in bulk covered under MARPOL 73/78, Annex I.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
All components are on the U.S. EPA TSCA Inventory List.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Benzene (CAS 71-43-2)	Cancer

Central nervous system
Blood
Aspiration
Skin
Eye
Respiratory tract irritation
Flammability

CERCLA Hazardous Substance List (40 CFR 302.4)

Benzene (CAS 71-43-2)	LISTED
Cumene (CAS 98-82-8)	LISTED
Cyclohexane (CAS 110-82-7)	LISTED
Ethanol (CAS 64-17-5)	LISTED
Ethylbenzene (CAS 100-41-4)	LISTED
Gasoline (CAS 86290-81-5)	LISTED
Hexane (Other Isomers) (CAS 96-14-0)	LISTED
n-Heptane (CAS 142-82-5)	LISTED
n-Hexane (CAS 110-54-3)	LISTED
Octane (All isomers) (CAS 111-65-9)	LISTED
Pentane (CAS 109-66-0)	LISTED
Toluene (CAS 108-88-3)	LISTED
Xylene (o, m, p isomers) (CAS 1330-20-7)	LISTED

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories
Immediate Hazard - No
Delayed Hazard - No
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Toluene	108-88-3	0-30
Xylene (o, m, p isomers)	1330-20-7	0-25
1,2,4, Trimethylbenzene	95-63-6	0-6
Cumene	98-82-8	0-5
Ethylbenzene	100-41-4	0-5
Benzene	71-43-2	0-4.9
n-Hexane	110-54-3	0-3
Cyclohexane	110-82-7	0-3

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Benzene (CAS 71-43-2)
Cumene (CAS 98-82-8)
Ethylbenzene (CAS 100-41-4)
n-Hexane (CAS 110-54-3)
Toluene (CAS 108-88-3)
Xylene (o, m, p isomers) (CAS 1330-20-7)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Pentane (CAS 109-66-0)

Safe Drinking Water Act (SDWA) Not regulated.

Drug Enforcement Administration (DEA). List 2, Essential Chemicals (21 CFR 1310.02(b) and 1310.04(f)(2) and Chemical Code Number

Toluene (CAS 108-88-3) 6594

Drug Enforcement Administration (DEA). List 1 & 2 Exempt Chemical Mixtures (21 CFR 1310.12(c))

Toluene (CAS 108-88-3) 35 % weight/volumn

DEA Exempt Chemical Mixtures Code Number

Toluene (CAS 108-88-3) 594

US state regulations

WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

US. Massachusetts RTK - Substance List

1,2,4, Trimethylbenzene (CAS 95-63-6)
Benzene (CAS 71-43-2)
Cumene (CAS 98-82-8)
Cyclohexane (CAS 110-82-7)
Ethanol (CAS 64-17-5)
Ethylbenzene (CAS 100-41-4)
Hexane (Other Isomers) (CAS 96-14-0)
n-Heptane (CAS 142-82-5)
n-Hexane (CAS 110-54-3)
Octane (All isomers) (CAS 111-65-9)
Pentane (CAS 109-66-0)
Toluene (CAS 108-88-3)
Xylene (o, m, p isomers) (CAS 1330-20-7)

US. New Jersey Worker and Community Right-to-Know Act

1,2,4, Trimethylbenzene (CAS 95-63-6)
Benzene (CAS 71-43-2)
Cumene (CAS 98-82-8)
Cyclohexane (CAS 110-82-7)
Ethanol (CAS 64-17-5)
Ethylbenzene (CAS 100-41-4)
n-Heptane (CAS 142-82-5)
n-Hexane (CAS 110-54-3)
Octane (All isomers) (CAS 111-65-9)
Pentane (CAS 109-66-0)
Toluene (CAS 108-88-3)
Xylene (o, m, p isomers) (CAS 1330-20-7)

US. Pennsylvania Worker and Community Right-to-Know Law

1,2,4, Trimethylbenzene (CAS 95-63-6)
Benzene (CAS 71-43-2)
Cumene (CAS 98-82-8)
Cyclohexane (CAS 110-82-7)
Ethanol (CAS 64-17-5)
Ethylbenzene (CAS 100-41-4)
Gasoline (CAS 86290-81-5)
Hexane (Other Isomers) (CAS 96-14-0)
n-Heptane (CAS 142-82-5)
n-Hexane (CAS 110-54-3)
Octane (All isomers) (CAS 111-65-9)
Pentane (CAS 109-66-0)
Toluene (CAS 108-88-3)
Xylene (o, m, p isomers) (CAS 1330-20-7)

US. Rhode Island RTK

1,2,4, Trimethylbenzene (CAS 95-63-6)
Benzene (CAS 71-43-2)
Cumene (CAS 98-82-8)
Cyclohexane (CAS 110-82-7)
Ethylbenzene (CAS 100-41-4)
n-Hexane (CAS 110-54-3)
Pentane (CAS 109-66-0)
Toluene (CAS 108-88-3)
Xylene (o, m, p isomers) (CAS 1330-20-7)

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Benzene (CAS 71-43-2)
Cumene (CAS 98-82-8)
Ethylbenzene (CAS 100-41-4)
Toluene (CAS 108-88-3)

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

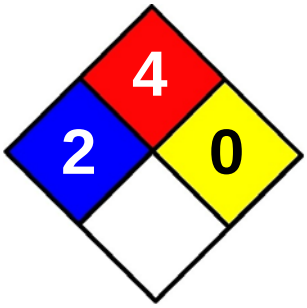
Issue date 13-May-2013

Revision date 23-May-2014

Version # 03

Further information HMIS® is a registered trade and service mark of the NPCA.

NFPA Ratings



References

ACGIH
EPA: AQUIRE database
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
HSDB® - Hazardous Substances Data Bank
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

Disclaimer

This material Safety Data Sheet (SDS) was prepared in accordance with 29 CFR 1910.1200 by Valero Marketing & Supply Co., ("VALERO"). VALERO does not assume any liability arising out of product use by others. The information, recommendations, and suggestions presented in this SDS are based upon test results and data believed to be reliable. The end user of the product has the responsibility for evaluating the adequacy of the data under the conditions of use, determining the safety, toxicity and suitability of the product under these conditions, and obtaining additional or clarifying information where uncertainty exists. No guarantee expressed or implied is made as to the effects of such use , the results to be obtained, or the safety and toxicity of the product in any specific application. Furthermore, the information herein is not represented as absolutely complete, since it is not practicable to provide all the scientific and study information in the format of this document, plus additional information may be necessary under exceptional conditions of use, or because of applicable laws or government regulations.

Hexanes, ACS

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 04/06/2015 Version: 1.0

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form	:	Mixture
Product name	:	Hexanes, ACS
CAS No	:	110-54-3
Product code	:	LC14920
Formula	:	C6H14
Other means of identification	:	"This reagent is generally a mixture of several isomers of hexane (C6H14), predominantly n-hexane, 2-methylpentane, and 3-methylpentane, plus methylcyclopentane (C6H12)."- Reagent Chemicals, 10th ed., ACS Committee on Analytical Reagents

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture	:	For laboratory and manufacturing use only.

1.3. Details of the supplier of the safety data sheet

LabChem Inc
Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court
Zelienople, PA 16063 - USA
T 412-826-5230 - F 724-473-0647
info@labchem.com - www.labchem.com

1.4. Emergency telephone number

Emergency number	:	CHEMTREC: 1-800-424-9300 or 011-703-527-3887

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification (GHS-US)

Flam. Liq. 2	H225
Acute Tox. 2 (Oral)	H300
Skin Irrit. 2	H315
Eye Irrit. 2A	H319
Repr. 2	H361
STOT SE 3	H336
STOT RE 1	H372
Asp. Tox. 1	H304
Aquatic Acute 2	H401
Aquatic Chronic 2	H411

Full text of H-phrases: see section 16

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :



GHS02 GHS06 GHS07 GHS08 GHS09

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) :
H225 - Highly flammable liquid and vapor
H300 - Fatal if swallowed
H304 - May be fatal if swallowed and enters airways
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H336 - May cause drowsiness or dizziness
H361 - Suspected of damaging fertility
H372 - Causes damage to organs (central nervous system) through prolonged or repeated exposure
H411 - Toxic to aquatic life with long lasting effects

Precautionary statements (GHS-US) :
P201 - Obtain special instructions before use
P202 - Do not handle until all safety precautions have been read and understood

P210 - Keep away from heat, sparks, open flames, hot surfaces. - No smoking
P233 - Keep container tightly closed
P240 - Ground/bond container and receiving equipment
P241 - Use explosion-proof electrical, ventilating, lighting equipment
P242 - Use only non-sparking tools
P243 - Take precautionary measures against static discharge
P260 - Do not breathe mist, vapors
P264 - Wash exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P271 - Use only outdoors or in a well-ventilated area
P273 - Avoid release to the environment
P280 - Wear protective gloves, protective clothing, eye protection, face protection
P301+P310 - IF SWALLOWED: Immediately call a POISON CENTER/doctor
P303+P361+P353 - IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P308+P313 - IF exposed or concerned: Get medical advice/attention
P312 - Call a POISON CENTER/doctor if you feel unwell
P330 - If swallowed, rinse mouth
P331 - If swallowed, do NOT induce vomiting
P332+P313 - If skin irritation occurs: Get medical advice/attention
P337+P313 - If eye irritation persists: Get medical advice/attention
P363 - Wash contaminated clothing before reuse
P370+P378 - In case of fire: Use alcohol resistant foam, extinguishing powder, sand to extinguish
P391 - Collect spillage
P403+P235 - Store in a well-ventilated place. Keep cool
P405 - Store locked up
P501 - Dispose of contents/container to comply with local, state and federal regulations

2.3. Other hazards

Other hazards not contributing to the classification : None under normal conditions.

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/information on ingredients

3.1. Substance

Not applicable

3.2. Mixture

Full text of H-phrases: see section 16

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Never give anything by mouth to an unconscious person. IF exposed or concerned: Get medical advice/attention.

First-aid measures after inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/physician if you feel unwell.

First-aid measures after skin contact : Rinse skin with water/shower. Remove/Take off immediately all contaminated clothing. Wash contaminated clothing before reuse. If skin irritation occurs: Get medical advice/attention.

First-aid measures after eye contact : Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

First-aid measures after ingestion : Rinse mouth. Do NOT induce vomiting. Fatal if swallowed. Immediately call a poison center or doctor/physician.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries : Suspected of damaging fertility. Causes damage to organs (nervous system) through prolonged or repeated exposure.

Symptoms/injuries after inhalation : May cause drowsiness or dizziness. Headache. Nausea. Vomiting.

Symptoms/injuries after skin contact : Causes skin irritation.

Symptoms/injuries after eye contact : Causes serious eye irritation.

Symptoms/injuries after ingestion	:	Fatal if swallowed. May be fatal if swallowed and enters airways. Risk of lung edema. Risk of aspiration pneumonia.
Chronic symptoms	:	Central nervous system depression.

4.3. Indication of any immediate medical attention and special treatment needed

Obtain medical assistance.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media	:	Foam. Dry powder. Carbon dioxide. Water fog. Sand.
Unsuitable extinguishing media	:	Do not use a heavy water stream.

5.2. Special hazards arising from the substance or mixture

Fire hazard	:	Highly flammable liquid and vapor.
Explosion hazard	:	May form flammable/explosive vapor-air mixture. Vapors are heavier than air and may travel considerable distance to an ignition source and flash back to source of vapors.

5.3. Advice for firefighters

Firefighting instructions	:	Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire. Prevent fire-fighting water from entering environment.
Protection during firefighting	:	Do not enter fire area without proper protective equipment, including respiratory protection. Complete protective clothing. Self-contained breathing apparatus.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures	:	Remove ignition sources. Use special care to avoid static electric charges. No naked lights. No smoking.

6.1.1. For non-emergency personnel

Protective equipment	:	Safety glasses. Protective clothing. Gloves.
Emergency procedures	:	Evacuate unnecessary personnel. Keep upwind. Do not breathe vapors. Ventilate spillage area.

6.1.2. For emergency responders

Protective equipment	:	Equip cleanup crew with proper protection. Avoid breathing dust/fume/gas/mist/vapors/spray.
Emergency procedures	:	Ventilate area.

6.2. Environmental precautions

Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters. Avoid release to the environment.

6.3. Methods and material for containment and cleaning up

For containment	:	Dam up the liquid spill. Dilute/disperse combustible gas/vapour with water curtain. Collect spillage.
Methods for cleaning up	:	Soak up spills with inert solids, such as clay or diatomaceous earth as soon as possible. Collect spillage. Store away from other materials.

6.4. Reference to other sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Additional hazards when processed	:	Handle empty containers with care because residual vapors are flammable.
Precautions for safe handling	:	Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Provide good ventilation in process area to prevent formation of vapor. No naked lights. No smoking. Use only non-sparking tools. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use only outdoors or in a well-ventilated area. Do not breathe mist, vapors.
Hygiene measures	:	Do not eat, drink or smoke when using this product. Wash exposed skin thoroughly after handling.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures	:	Proper grounding procedures to avoid static electricity should be followed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting/… equipment.
Storage conditions	:	Keep only in the original container in a cool, well ventilated place away from : Heat sources., Ignition sources, incompatible materials. Keep in fireproof place. Keep container tightly closed.

Incompatible products : Strong oxidizers.

Incompatible materials : Sources of ignition. Direct sunlight. Heat sources.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Hexanes, ACS (110-54-3)		
ACGIH	ACGIH TWA (mg/m³)	176 mg/m³ Skin
ACGIH	ACGIH TWA (ppm)	50 ppm
OSHA	OSHA PEL (TWA) (mg/m³)	1800 mg/m³
OSHA	OSHA PEL (TWA) (ppm)	500 ppm

8.2. Exposure controls

Appropriate engineering controls : Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Ensure good ventilation of the work station. Material should be handled in a laboratory hood whenever possible.

Personal protective equipment : Avoid all unnecessary exposure.

Hand protection : Wear protective gloves.

Eye protection : Chemical goggles or safety glasses.

Skin and body protection : Wear suitable protective clothing.

Respiratory protection : Where exposure through inhalation may occur from use, respiratory protection equipment is recommended. Wear respiratory protection.

Other information : Do not eat, drink or smoke during use.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Liquid

Appearance : Clear, colorless liquid.

Color : Colorless

Odor : gasoline-like

Odor threshold : Not available

pH : Not available

Melting point : -94 °C

Freezing point : No data available

Boiling point : 69 °C

Flash point : -21.7 °C

Relative evaporation rate (butyl acetate=1) : No data available

Flammability (solid, gas) : No data available

Explosion limits : 1.1 - 7.5 vol %

Explosive properties : No data available

Oxidizing properties : No data available

Vapor pressure : 20.13 kPa @ 25°C

Relative density : 0.66

Relative vapor density at 20 °C : 2.97

Specific gravity / density : 0.65 g/cm³

Molecular mass : 86.17 g/mol

Solubility : Water: 0.02 g/l

Log Pow : 3.9

Log Kow : No data available

Auto-ignition temperature : 225 °C

Decomposition temperature : No data available

Viscosity : No data available

Viscosity, kinematic : 0.4979 mm²/s

Viscosity, dynamic : 0.33 mPa.s

9.2. Other information

VOC content : 100 %

SECTION 10: Stability and reactivity

10.1. Reactivity

No additional information available

10.2. Chemical stability

Highly flammable liquid and vapor. May form flammable/explosive vapor-air mixture.

10.3. Possibility of hazardous reactions

Not established.

10.4. Conditions to avoid

Direct sunlight. Extremely high or low temperatures. Open flame.

10.5. Incompatible materials

Strong oxidizers.

10.6. Hazardous decomposition products

Carbon monoxide. Carbon dioxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Likely routes of exposure : Inhalation; Skin and eye contact

Acute toxicity : Oral: Fatal if swallowed.

Hexanes, ACS (110-54-3)	
LD50 oral rat	43.5 mg/kg
LC50 inhalation rat (mg/l)	< 48000 mg/l/4h
ATE US (oral)	43.500 mg/kg body weight

Skin corrosion/irritation : Causes skin irritation.
pH: Not available

Serious eye damage/irritation : Causes serious eye irritation.
pH: Not available

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Reproductive toxicity : Suspected of damaging fertility.

Specific target organ toxicity (single exposure) : May cause drowsiness or dizziness.

Specific target organ toxicity (repeated exposure) : Causes damage to organs (central nervous system) through prolonged or repeated exposure.

Aspiration hazard : May be fatal if swallowed and enters airways.

Potential Adverse human health effects and symptoms : Based on available data, the classification criteria are not met. Fatal if swallowed.

Symptoms/injuries after inhalation : May cause drowsiness or dizziness. Headache. Nausea. Vomiting.

Symptoms/injuries after skin contact : Causes skin irritation.

Symptoms/injuries after eye contact : Causes serious eye irritation.

Symptoms/injuries after ingestion : Fatal if swallowed. May be fatal if swallowed and enters airways. Risk of lung edema. Risk of aspiration pneumonia.

Chronic symptoms : Central nervous system depression.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - water : Toxic to aquatic life. Toxic to aquatic life with long lasting effects.

Hexanes, ACS (110-54-3)	
LC50 fish 1	2.101 - 2.981 mg/l 96 hr.

12.2. Persistence and degradability

Hexanes, ACS (110-54-3)	
Persistence and degradability	May cause long-term adverse effects in the environment.

12.3. Bioaccumulative potential

Hexanes, ACS (110-54-3)	
Log Pow	3.9
Bioaccumulative potential	Not established.

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Other information : Avoid release to the environment.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Dispose in a safe manner in accordance with local/national regulations. Dispose of contents/container to comply with local, state and federal regulations.

Additional information : Handle empty containers with care because residual vapors are flammable.

Ecology - waste materials : Avoid release to the environment. Hazardous waste due to toxicity.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Transport document description : UN1208 Hexanes, 3, II

UN-No.(DOT) : UN1208

Proper Shipping Name (DOT) : Hexanes

Transport hazard class(es) (DOT) : 3 - Class 3 - Flammable and combustible liquid 49 CFR 173.120

Hazard labels (DOT) : 3 - Flammable liquid



Packing group (DOT) : II - Medium Danger

Dangerous for the environment : Yes

Marine pollutant : Yes



DOT Packaging Non Bulk (49 CFR 173.xxx) : 202

DOT Packaging Bulk (49 CFR 173.xxx) : 242

DOT Special Provisions (49 CFR 172.102) : IB2 - Authorized IBCs: Metal (31A, 31B and 31N); Rigid plastics (31H1 and 31H2); Composite (31HZ1). Additional Requirement: Only liquids with a vapor pressure less than or equal to 110 kPa at 50 C (1.1 bar at 122 F), or 130 kPa at 55 C (1.3 bar at 131 F) are authorized.
T4 - 2.65 178.274(d)(2) Normal..... 178.275(d)(3)
TP1 - The maximum degree of filling must not exceed the degree of filling determined by the following: Degree of filling = 97 / 1 + a (tr - tf) Where: tr is the maximum mean bulk temperature during transport, and tf is the temperature in degrees celsius of the liquid during filling.

DOT Packaging Exceptions (49 CFR 173.xxx) : 150

DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27) : 5 L

DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75) : 60 L

DOT Vessel Stowage Location : E - The material may be stowed ''on deck'' or ''under deck'' on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers, or one passenger per each 3 m of overall vessel length, but is prohibited from carriage on passenger vessels in which the limiting number of passengers is exceeded.

Additional information

Other information : No supplementary information available.

ADR

No additional information available

Transport by sea

No additional information available

Air transport

No additional information available

SECTION 15: Regulatory information

15.1. US Federal regulations

Hexanes, ACS (110-54-3)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory Listed on United States SARA Section 313	
RQ (Reportable quantity, section 304 of EPA's List of Lists)	5000 lb
SARA Section 311/312 Hazard Classes	Fire hazard Immediate (acute) health hazard Delayed (chronic) health hazard

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

Chemical(s) subject to the reporting requirements of Section 313 or Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986 and 40 CFR Part 372.

Hexanes, ACS	CAS No 110-54-3	100%

15.2. International regulations

CANADA

Hexanes, ACS (110-54-3)
Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

No additional information available

Classification according to Regulation (EC) No. 1272/2008 [CLP]

No additional information available

Classification according to Directive 67/548/EEC [DSD] or 1999/45/EC [DPD]

Not classified

National regulations

No additional information available

15.3. US State regulations

California Proposition 65 - This product does not contain any substance known to the state of California to cause cancer and/or reproductive harm

SECTION 16: Other information

Other information : None.

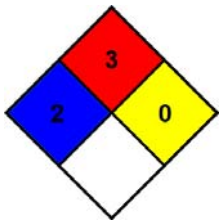
Full text of H-phrases: see section 16:

Acute Tox. 2 (Oral)	Acute toxicity (oral) Category 2
Aquatic Acute 2	Hazardous to the aquatic environment - Acute Hazard Category 2
Aquatic Chronic 2	Hazardous to the aquatic environment - Chronic Hazard Category 2
Asp. Tox. 1	Aspiration hazard Category 1
Eye Irrit. 2A	Serious eye damage/eye irritation Category 2A
Flam. Liq. 2	Flammable liquids Category 2
Repr. 2	Reproductive toxicity Category 2
Skin Irrit. 2	Skin corrosion/irritation Category 2
STOT RE 1	Specific target organ toxicity (repeated exposure) Category 1
STOT SE 3	Specific target organ toxicity (single exposure) Category 3
H225	Highly flammable liquid and vapor
H300	Fatal if swallowed
H304	May be fatal if swallowed and enters airways
H315	Causes skin irritation
H319	Causes serious eye irritation
H336	May cause drowsiness or dizziness
H361	Suspected of damaging fertility or the unborn child
H372	Causes damage to organs through prolonged or repeated exposure
H401	Toxic to aquatic life
H411	Toxic to aquatic life with long lasting effects

NFPA health hazard : 2 - Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical attention is given.

NFPA fire hazard : 3 - Liquids and solids that can be ignited under almost all ambient conditions.

NFPA reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health : 2 Moderate Hazard - Temporary or minor injury may occur

* - Chronic (long-term) health effects may result from repeated overexposure

Flammability : 3 Serious Hazard - Materials capable of ignition under almost all normal temperature conditions. Includes flammable liquids with flash points below 73 F and boiling points above 100 F. as well as liquids with flash points between 73 F and 100 F. (Classes IB & IC)

Physical : 0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.

Personal Protection : H

H - Splash goggles, Gloves, Synthetic apron, Vapor respirator

SDS US (GHS HazCom 2012)

Information in this SDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc assumes no liability resulting from the use of this SDS. The user must determine suitability of this information for his application.

SAFETY DATA SHEET

M34514 - ANSI - EN



HYDROCHLORIC ACID (HCl) (ALL GRADES)

SDS No.: M34514 **SDS Revision Date:** 21-Jan-2016

SECTION 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Company Identification:	Occidental Chemical Corporation 5005 LBJ Freeway P.O. Box 809050 Dallas, TX 75380-9050 1-800-752-5151
24 Hour Emergency Telephone Number:	1-800-733-3665 or 1-972-404-3228 (USA); CANUTEC (Canada): 1-613-996-6666; CHEMTREC (within USA and Canada): 1-800-424-9300; CHEMTREC (outside USA and Canada): +1 703-527-3887; CHEMTREC Contract No: CCN16186
To Request an SDS:	MSDS@oxy.com or 1-972-404-3245
Customer Service:	1-800-752-5151 or 1-972-404-3700
Product Identifier:	**HYDROCHLORIC ACID (HCl) (ALL GRADES)**
Trade Name:	Hydrochloric Acid (HCl) aqueous all grades
Synonyms:	Muriatic Acid, HCl Solution, Aqueous hydrogen chloride
Product Use:	Process chemical, Metal cleaning, Water purification, Petroleum Industry
Uses Advised Against:	None identified

SECTION 2. HAZARDS IDENTIFICATION

HYDROCHLORIC ACID (HCl) (ALL GRADES)

SDS No.: M34514 **SDS Revision Date:** 21-Jan-2016

OSHA REGULATORY STATUS: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

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EMERGENCY OVERVIEW:

Color: Colorless
Physical State: Liquid
Appearance: Clear
Odor: Irritating, Pungent, Sharp

Signal Word: **Danger**

MAJOR HEALTH HAZARDS: CORROSIVE. CAUSES SEVERE SKIN BURNS AND SERIOUS EYE DAMAGE. HARMFUL IF SWALLOWED. HARMFUL IF INHALED. CAUSES DAMAGE TO TEETH THROUGH PROLONGED OR REPEATED EXPOSURES.

PHYSICAL HAZARDS: Contact with metals may evolve flammable hydrogen gas. May spatter or generate heat when mixed with water.

PRECAUTIONARY STATEMENTS: Do not get in eyes, on skin, or on clothing. Wear gloves, protective clothing, eye, and face protection. Do not breathe mist, vapors, or spray. Use outdoors or in a well-ventilated area. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Keep separated from incompatible substances.

ADDITIONAL HAZARD INFORMATION: This material is corrosive. To treat contacted tissue, flush with water to dilute. There is no specific antidote.

****

GHS CLASSIFICATION:

GHS: CONTACT HAZARD - SKIN:	Category 1B - Causes severe skin burns and eye damage.
GHS: CONTACT HAZARD - EYE:	Category 1 - Causes serious eye damage
GHS: ACUTE TOXICITY - INHALATION:	Category 4 - Harmful if inhaled
GHS: ACUTE TOXICITY - ORAL:	Category 4 - Harmful if swallowed.
GHS: TARGET ORGAN TOXICITY (REPEATED EXPOSURE):	Category 1 - Causes damage to teeth through prolonged or repeated exposure
GHS: TARGET ORGAN TOXICITY (REPEATED EXPOSURE):	Category 1 - Causes damage to teeth through prolonged or repeated exposure
GHS: CARCINOGENICITY:	Not classified as a carcinogen per GHS criteria. This material is not classifiable as to its carcinogenicity to humans (Group 3 - IARC). ACGIH - A4 Carcinogen - Not classifiable as a human carcinogen.

HYDROCHLORIC ACID (HCl) (ALL GRADES)

UNKNOWN ACUTE TOXICITY: Not applicable. 100% of this product consists of ingredient(s) of known acute toxicity.

GHS SYMBOL: Corrosive, Health hazard, Exclamation mark



GHS SIGNAL WORD: **DANGER**

GHS HAZARD STATEMENTS:

GHS - Health Hazard Statement(s)
• Causes severe skin burns and eye damage
• Causes serious eye damage
• Harmful if swallowed
• Harmful if inhaled
• Causes damage to organs through prolonged or repeated exposure (teeth)

GHS - Precautionary Statement(s) - Prevention
• Wear protective gloves, protective clothing, eye, and face protection
• Do not breathe mist, vapors, or spray
• Wash thoroughly after handling
• Do not eat, drink or smoke when using this product
• Use only outdoors or in a well-ventilated area

GHS - Precautionary Statement(s) - Response
• IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
• IF ON SKIN (or hair): Remove/Take off Immediately all contaminated clothing. Rinse SKIN with water/shower
• IF SWALLOWED: Rinse mouth. Do NOT induce vomiting
• Immediately call a POISON CENTER or doctor/physician
• Wash contaminated clothing before reuse
• IF INHALED: Remove person to fresh air and keep comfortable for breathing
• Call a POISON CENTER or doctor/physician if you feel unwell
• Specific treatment (see First Aid information on product label and/or Section 4 of the SDS)

GHS - Precautionary Statement(s) - Storage
• Store locked up

GHS - Precautionary Statement(s) - Disposal
• Dispose of contents and container in accordance with applicable local, regional, national, and/or international regulations

Hazards Not Otherwise Classified (HNOC)
None identified

See Section 11: TOXICOLOGICAL INFORMATION

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms: Muriatic Acid, HCl Solution, Aqueous hydrogen chloride

Contains Hydrochloric Acid [Hydrogen Chloride]

Component	Percent [%]	CAS Number
Water	63 - 91	7732-18-5
Hydrochloric Acid [Hydrogen Chloride]	9-36	7647-01-0

SECTION 4. FIRST AID MEASURES

INHALATION: If inhaled and adverse effects occur, remove victim to fresh air and keep at rest in a position comfortable for breathing. Evaluate ABC's (is Airway constricted, is Breathing occurring, and is blood Circulating) and treat symptomatically. IF exposed or concerned: Get medical advice/attention. If you feel unwell, GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT: If on skin or hair, immediately flush contaminated areas with water. Immediately remove all contaminated clothing, jewelry, and shoes. Rinse skin with large amounts of water. Thoroughly clean and dry contaminated clothing and shoes before reuse. The specific treatment is dilution with water. There is no antidote. If you feel unwell, IMMEDIATELY CONTACT A POISON CENTER, PHYSICIAN/DOCTOR, OR GET MEDICAL ATTENTION.

EYE CONTACT: Immediately rinse eyes cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Continued irrigation may be necessary to ensure neutral pH. Water or saline may be used. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION: If swallowed: Rinse mouth. Do NOT induce vomiting. Give large amounts of water. If vomiting occurs spontaneously, keep airway clear. Give more water when vomiting stops. Never give anything by mouth to an unconscious or convulsive person. GET MEDICAL ATTENTION IMMEDIATELY.

Most Important Symptoms/Effects (Acute and Delayed) Hydrochloric acid may be corrosive to the eyes, skin, and mucus membranes. It may be corrosive to any tissue it comes in contact with. Depending on the concentration, duration, and nature of the exposure, it can cause serious burns and extensive tissue destruction.

Acute Symptoms/Effects: Listed below.
Inhalation (Breathing): Respiratory System Effects: Inhalation of this material may cause: irritation of the respiratory tract with sore throat, coughing, shortness of breath, hoarseness, laryngeal spasms, upper respiratory tract edema, inflammation and ulceration, hemorrhage, chest pain, and pulmonary edema. Measurements of distress include increased respiration rate and decreased tidal volume, decreased forced expiratory volume, increased airway resistance, and reduced vital capacity. You may observe sudden circulatory collapse, glottis or esophageal edema and death.

Skin: Skin Corrosion: Concentrated hydrochloric acid is corrosive to tissue, possibly causing redness, irritation, burns, ulceration, scarring, and possible necrosis (tissue death). Severe burns have been fatal. Sudden circulatory collapse can occur with shock if large areas of skin have been burned.
Eye: Serious Eye Damage. Exposure to eyes may cause irritation and burns to the eye lids, conjunctivitis, corneal edema, and corneal burn.
Ingestion (Swallowing): Gastrointestinal System Effects: Acute ingestion of concentrated hydrochloric acid may cause nausea, vomiting, abdominal pain, diarrhea, gastrointestinal bleeding, perforation, necrosis, scarring, acidosis, and sudden circulatory collapse. May be fatal if swallowed.

Delayed Symptoms/Effects:
- Respiratory System Effects: Chronic occupational exposure to hydrochloric acid has been reported to cause chronic bronchitis
- Skin: Repeated and prolonged skin contact may cause a chronic dermatitis
- Eye: Blindness, resulting from corneal burns, damage/loss of internal contents of eye, and perforation of globe
- Gastrointestinal Effects: Chronic occupational exposure has been reported to cause gastritis
- Teeth: Prolonged exposure to low concentrations may also cause dental discoloration and erosion

Interaction with Other Chemicals Which Enhance Toxicity: None known.

Medical Conditions Aggravated by Exposure: May aggravate preexisting conditions such as: eye disorders that decrease tear production or have reduced integrity of the eye; skin disorders that compromise the integrity of the skin; and respiratory conditions including asthma and other breathing disorders.

Protection of First-Aiders: Protect yourself by avoiding contact with this material. Avoid contact with skin and eyes. Do not breathe dust, fume, gas, mist, vapors, or spray. Do not ingest. Use personal protective equipment. Refer to Section 8 for specific personal protective equipment recommendations.

Notes to Physician: Treat as a corrosive substance. Do not attempt to neutralize pH with sodium bicarbonate. Treat via dilution. Water or milk may be used. There is no antidote. Severe burns have been fatal. Treatment is supportive care. Follow normal parameters for airway, breathing, and circulation.

SECTION 5. FIRE-FIGHTING MEASURES

Fire Hazard: Not combustible, but if involved in a fire decomposes to produce irritants and toxic gases.

Extinguishing Media: Use media appropriate for surrounding fire.

Fire Fighting: Keep unnecessary people away, isolate hazard area and deny entry. Wear NIOSH approved positive-pressure self-contained breathing apparatus operated in pressure demand mode. Move container from fire area if it can be done without risk. Cool non-leaking containers with water. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas.

Component	Immediately Dangerous to Life/ Health (IDLH)
Hydrochloric Acid [Hydrogen Chloride] 7647-01-0	50 ppm IDLH

Hazardous Combustion Products: Hydrogen chloride, Chlorine, Hydrogen gas

Sensitivity to Mechanical Impact:	Not sensitive.
Sensitivity to Static Discharge:	Not sensitive.
Lower Flammability Level (air):	Not flammable
Upper Flammability Level (air):	Not flammable
Flash point:	Not flammable
Auto-ignition Temperature:	Not determined

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal Precautions:
Remove all ignition sources. Keep unnecessary and unprotected persons away. Isolate hazard area and deny entry. Stop spill/leak if no risk involved. Consider evacuation of personnel located downwind if material is leaking. Do not get in eyes, on skin or on clothing. Do not breathe dust, fume, gas, mist, vapors, or spray. Do not ingest. Wear appropriate personal protective equipment recommended in Section 8, Exposure Controls / Personal Protection, of the SDS.

Methods and Materials for Containment and Cleaning Up:
Completely contain spilled materials with dikes, sandbags, etc. Shut off ventilation system if needed. Reuse or reprocess where possible. Neutralize with soda ash or dilute caustic soda. Collect with appropriate, noncombustible absorbent and place into suitable container. Liquid material may be removed with a properly rated vacuum truck.

Environmental Precautions:
Keep out of water supplies and sewers. This material is acidic and may lower the pH of the surface waters with low buffering capacity. Releases should be reported, if required, to appropriate agencies.

SECTION 7. HANDLING AND STORAGE

Precautions for Safe Handling:
Avoid breathing vapor or mist. Do not get in eyes, on skin, or on clothing. Wash thoroughly after handling. Wear personal protective equipment as described in Exposure Controls/Personal Protection (Section 8) of the MSDS. Use only equipment and hoses approved for this material. NEVER add water to this product. Always add product to large quantities of water. When mixing, slowly add to water to minimize heat generation and spattering. Water or caustic solutions should never be added directly to this product because of violent reaction and spattering.

Safe Storage Conditions:
Store and handle in accordance with all current regulations and standards. Store in rubber-lined steel, acid-resistant plastic or glass containers. Keep container tightly closed. Store in a cool, dry area. Store in a well-ventilated area. Keep away from heat, sparks and open flames. Keep separated from incompatible substances (see below or Section 10 of the Safety Data Sheet). Do not store in aluminum container or use aluminum fittings or transfer lines. Protect from physical damage. Dike and vent storage tanks.

Incompatibilities/ Materials to Avoid:
Alkalis, metals, oxidizing agents, Mercuric sulfate, Perchloric acid, Carbides of calcium, cesium, rubidium, Acetylides of cesium and rubidium, Phosphides of calcium and uranium, Lithium silicide

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Regulatory Exposure Limit(s): Listed below for the product components that have non-regulatory occupational exposure limits (OEL's).

Component	OSHA Final PEL TWA	OSHA Final PEL STEL	OSHA Final PELCeiling
Hydrochloric Acid [Hydrogen Chloride] 7647-01-0	-----	-----	5 ppm 7 mg/m^3

OEL: Occupational Exposure Limit; OSHA: United States Occupational Safety and Health Administration; PEL: Permissible Exposure Limit; TWA: Time Weighted Average; STEL: Short Term Exposure Limit

NON-REGULATORY EXPOSURE LIMIT(S): Listed below for the product components that have non-regulatory occupational exposure limits (OEL's).

Component	ACGIH TWA	ACGIH STEL	ACGIH Ceiling	OSHA TWA (Vacated)	OSHA STEL (Vacated)	OSHA Ceiling (Vacated)
Hydrochloric Acid [Hydrogen Chloride]	-----	-----	2 ppm	-----	-----	5 ppm 7 mg/m^3

- *The Non-Regulatory United States Occupational Safety and Health Administration (OSHA) limits, if shown, are the Vacated 1989 PEL's (vacated by 58 FR 35338, June 30, 1993).*

- The American Conference of Governmental Industrial Hygienists (ACGIH) is a voluntary organization of professional industrial hygiene personnel in government or educational institutions in the United States. The ACGIH develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLVs) for hundreds of chemicals, physical agents, and biological exposure indices.

Component	OXY REL 8 hr TWA	OXY REL STEL	OXY REL Ceiling
Hydrochloric Acid [Hydrogen Chloride] 7647-01-0 (9-36)			2 ppm

ENGINEERING CONTROLS: Use closed systems when possible. Provide local exhaust ventilation where vapor or mist may be generated. Ensure compliance with applicable exposure limits.

PERSONAL PROTECTIVE EQUIPMENT:

Eye Protection: Wear chemical safety goggles with a face-shield to protect against eye and skin contact when appropriate. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

Skin and Body Protection: Wear chemical resistant clothing and rubber boots when potential for contact with the material exists. Always place pants legs over boots.

Hand Protection: Wear appropriate chemical resistant gloves. Consult a glove supplier for assistance in selecting an appropriate chemical resistant glove.

Protective Material Types:
- Nitrile
- Neoprene
- Butyl rubber
- Polyvinyl chloride (PVC)
- Responder®
- Trellchem® HPS
- Tychem®

Respiratory Protection: Where vapor or mist concentration exceeds or is likely to exceed applicable exposure limits, a NIOSH approved respirator with acid gas cartridges (appropriate for hydrogen chloride) is required. When an air-purifying respirator is not adequate, for exposures above the IDLH or for spills and/or emergencies of unknown concentrations, a NIOSH approved self-contained breathing apparatus or airline respirator with a full-face piece and with an auxiliary self contained escape pack is required. A respiratory protection program that meets 29 CFR 1910.134 must be followed whenever workplace conditions warrant use of a respirator.

Component	Immediately Dangerous to Life/ Health (IDLH)
Hydrochloric Acid [Hydrogen Chloride] 7647-01-0	50 ppm IDLH

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Appearance:	Clear
Color:	Colorless
Odor:	Irritating, Pungent, Sharp
Odor Threshold [ppm]:	0.3 ppm (causes olfactory fatigue).
Molecular Weight:	36.46
Molecular Formula:	HCl
Boiling Point/Range:	140 - 221°F (60 - 105 °C)
Freezing Point/Range:	-29 to 5 °F (-34 to -15 °C).
Melting Point/Range:	Not applicable to liquids
Vapor Pressure:	14.6 - 80 mmHg @ 20 °C
Vapor Density (air=1):	1.3 @ 20 °C
Relative Density/Specific Gravity (water=1):	1.05 - 1.18
Density:	8.75 - 9.83 lbs/gal

Water Solubility:	100%
pH:	0.03647 wt% HCl solution (364 ppm) has a pH of 2
Volatility:	9 - 36% by volume
Evaporation Rate (ether=1):	< 1.00 (butyl acetate = 1)
Partition Coefficient (n-octanol/water):	No data available
Flash point:	Not flammable
Flammability (solid, gas):	Not flammable
Lower Flammability Level (air):	Not flammable
Upper Flammability Level (air):	Not flammable
Auto-ignition Temperature:	Not determined
Viscosity:	No data available

SECTION 10. STABILITY AND REACTIVITY

Reactivity: Hydrochloric acid reacts vigorously with alkalis and with many organic materials. Reacts with strong oxidizing materials causing the release of chlorine.

Chemical Stability: Stable at normal temperatures and pressures.

Possibility of Hazardous Reactions:
Avoid heat, flames, sparks and other sources of ignition. Mixing with water may cause splattering and release of large amounts of heat. Will react with some metals forming flammable hydrogen gas. Hydrogen chloride may react with cyanide, forming lethal concentrations of hydrocyanic acid. Avoid contact with incompatible materials.

Conditions to Avoid: (e.g., static discharge, shock, or vibration) -. None known.

Incompatibilities/ Materials to Avoid: Alkalis. metals. oxidizing agents. Mercuric sulfate. Perchloric acid. Carbides of calcium, cesium, rubidium. Acetylides of cesium and rubidium. Phosphides of calcium and uranium. Lithium silicide.

Hazardous Decomposition Products: chlorine, hydrogen chloride, hydrogen gas

Hazardous Polymerization: Will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

TOXICITY DATA:

PRODUCT TOXICITY DATA: Hydrochloric Acid (HCl) (All Grades)

LD50 Oral:	LD50 Dermal:	LC50 Inhalation:
700 mg/kg (Rat)	>5010 mg/kg (Rabbit)	3124 ppm (1 hr - Rat), converted to 1562 ppm (4 hr - Rat)

COMPONENT TOXICITY DATA:

HYDROCHLORIC ACID (HCl) (ALL GRADES)

Note: The component toxicity data is populated by the LOLI database and may differ from the product toxicity data given.

Component	LD50 Oral:	LD50 Dermal:	LC50 Inhalation:
Water 7732-18-5	90 mL/kg (Rat)	-----	-----
Hydrochloric Acid [Hydrogen Chloride] 7647-01-0	238 - 277 mg/kg (Rat)	5010 mg/kg (Rabbit)	1.68 mg/L (1 hr-Rat)

****

POTENTIAL HEALTH EFFECTS:

Eye contact: Causes serious eye damage. Eye exposure may cause irritation and burns to the eye lids, conjunctivitis, corneal edema, and corneal burn.

Skin contact: Can cause severe skin burns. Concentrated hydrochloric acid is corrosive to tissue, causing redness, irritation (possibly severe), burns, ulceration, scarring, and possible necrosis (tissue death).

Inhalation: Inhalation of this material may cause: irritation of the respiratory tract with sore throat, coughing, shortness of breath, hoarseness, laryngeal spasms, upper respiratory tract edema, inflammation and ulceration, hemorrhage, chest pain, and pulmonary edema.

Ingestion: Ingestion of concentrated hydrochloric acid can cause nausea, vomiting, abdominal pain, diarrhea, gastrointestinal bleeding, perforation, necrosis and scarring, acidosis, and sudden circulatory collapse. May be fatal if swallowed.

Chronic Effects: Repeated or prolonged skin exposure to dilute solutions may result in dermatitis. Photosensitization has been reported in chronic occupational skin exposures. Discoloration and erosion of the teeth may occur as a result of long term exposure. Chronic occupational inhalation exposure to hydrochloric acid has been reported to cause chronic bronchitis.

SIGNS AND SYMPTOMS OF EXPOSURE:
Listed below.

Inhalation (Breathing): Respiratory System Effects: Inhalation of this material may cause: irritation of the respiratory tract with sore throat, coughing, shortness of breath, hoarseness, laryngeal spasms, upper respiratory tract edema, inflammation and ulceration, hemorrhage, chest pain, and pulmonary edema. Measurements of distress include increased respiration rate and decreased tidal volume, decreased forced expiratory volume, increased airway resistance, and reduced vital capacity. You may observe sudden circulatory collapse, glottis or esophageal edema and death.
Skin: Skin Corrosion: Concentrated hydrochloric acid is corrosive to tissue, possibly causing redness, irritation, burns, ulceration, scarring, and possible necrosis (tissue death). Severe burns have been fatal. Sudden circulatory collapse can occur with shock if large areas of skin have been burned.
Eye: Serious Eye Damage. Exposure to eyes may cause irritation and burns to the eye lids, conjunctivitis, corneal edema, and corneal burn.

Ingestion (Swallowing): Gastrointestinal System Effects: Acute ingestion of concentrated hydrochloric acid may cause nausea, vomiting, abdominal pain, diarrhea, gastrointestinal bleeding, perforation, necrosis, scarring, acidosis, and sudden circulatory collapse. May be fatal if swallowed.

TOXICITY:
Hydrochloric acid is corrosive to skin, eyes, and mucus membranes and causes immediate, severe irritation and corrosion of exposed tissue. Prolonged exposures may cause discoloration and erosion of teeth, gastritis, photosensitization, and bronchitis. Ingestion may be fatal.

Interaction with Other Chemicals Which Enhance Toxicity: None known.

****

GHS HEALTH HAZARDS:

GHS: ACUTE TOXICITY - ORAL: Category 4 - Harmful if swallowed.

GHS: ACUTE TOXICITY - INHALATION: Category 4 - Harmful if inhaled.

GHS: CONTACT HAZARD - EYE: Category 1 - Causes serious eye damage

GHS: CONTACT HAZARD - SKIN: Category 1B - Causes severe skin burns and eye damage

Skin Absorbent / Dermal Route? No.

GHS: CARCINOGENICITY:
Not classified as a carcinogen per GHS criteria. This material is not classifiable as to its carcinogenicity to humans (Group 3 - IARC). ACGIH - A4 Carcinogen - Not classifiable as a human carcinogen.

Component	NTP:	IARC (GROUP 1):	IARC (GROUP 2):	OSHA:
Hydrochloric Acid [Hydrogen Chloride]	Not listed	Not listed	Not listed	Listed

SPECIFIC TARGET ORGAN TOXICITY (Repeated or Prolonged Exposure):
Category 1 - Teeth

SECTION 12. ECOLOGICAL INFORMATION

ECOTOXICITY DATA:

FATE AND TRANSPORT:

BIODEGRADATION: This material is inorganic and not subject to biodegradation

PERSISTENCE: This material is believed not to persist in the environment
This material is believed to exist in the disassociated state in the environment
If released to soil, hydrogen chloride will sink into the soil. The acid will dissolve some soil material (in particular, anything with a carbonate base) and will be somewhat neutralized. The remaining portion is thought to transport downward to the water table. If released to water, it dissociates almost completely and will be neutralized by natural alkalinity and carbon dioxide

BIOCONCENTRATION: This material is not expected to bioconcentrate in organisms.

ADDITIONAL ECOLOGICAL INFORMATION: This material has exhibited toxicity to terrestrial organisms. May decrease pH of waterways and adversely affect aquatic life. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product into sewer systems without previously notifying the sewage treatment plant authority. For guidance, contact your local or regional regulatory water boards and/or other appropriate regulatory offices.

SECTION 13. DISPOSAL CONSIDERATIONS

Waste from material:
Reuse or reprocess, if possible. May be subject to disposal regulations. Dispose in accordance with all applicable regulations.

Container Management:
Dispose of container in accordance with applicable local, regional, national, and/or international regulations. Container rinsate must be disposed of in compliance with applicable regulations.

SECTION 14. TRANSPORT INFORMATION

IMPORTANT: The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport

LAND TRANSPORT

U.S. DOT 49 CFR 172.101:

UN NUMBER:	UN1789
PROPER SHIPPING NAME:	Hydrochloric acid solution
HAZARD CLASS/ DIVISION:	8
PACKING GROUP:	II
LABELING REQUIREMENTS:	8
RQ (lbs):	RQ 5,000 Lbs. (Hydrochloric acid)

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:

UN NUMBER: UN1789
SHIPPING NAME: Hydrochloric acid solution
CLASS OR DIVISION: 8
PACKING/RISK GROUP: II
LABELING REQUIREMENTS: 8

MARITIME TRANSPORT (IMO / IMDG) :

UN NUMBER: UN1789
PROPER SHIPPING NAME: Hydrochloric acid solution
HAZARD CLASS / DIVISION: 8
Packing Group: II
LABELING REQUIREMENTS: 8

SECTION 15. REGULATORY INFORMATION

U.S. REGULATIONS

OSHA REGULATORY STATUS:
This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200)

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):
If a release is reportable under CERCLA section 103, notify the state emergency response commission and local emergency planning committee. In addition, notify the National Response Center at (800) 424-8802 or (202) 426-2675.

Component	CERCLA Reportable Quantities:
Hydrochloric Acid [Hydrogen Chloride]	5000 lb (final RQ)

SARA EHS Chemical (40 CFR 355.30)
If a release is reportable under EPCRA, notify the state emergency response commission and local emergency planning committee. If the TPQ is met, facilities are subject to reporting requirements under EPCRA Sections 311 and 312.

Component	EPCRA RQs	Section 302 Threshold Planning Quantity (TPQs)
Hydrochloric Acid [Hydrogen Chloride]	5000 lb (EPCRA RQ)	500 lb TPQ

EPCRA SECTIONS 311/312 HAZARD CATEGORIES (40 CFR 370.10):
Acute Health Hazard, Reactive Hazard, Chronic Health Hazard, Extremely Hazardous

EPCRA SECTION 313 (40 CFR 372.65):
The following chemicals are listed in 40 CFR 372.65 and may be subject to Community Right-to Know Reporting requirements

Component	Status:
Hydrochloric Acid [Hydrogen Chloride]	1.0 %

DEPARTMENT OF HOMELAND SECURITY (DHS)- Chemical Facility Anti-Terrorism Standards (6 CFR 27):
.? is regulated under DHS as follows:

OSHA PROCESS SAFETY (PSM) (29 CFR 1910.119):
Not regulated

NATIONAL INVENTORY STATUS

Component	U.S. INVENTORY STATUS: Toxic Substance Control Act (TSCA):
Water 7732-18-5 (63 - 91)	Listed
Hydrochloric Acid [Hydrogen Chloride] 7647-01-0 (9-36)	Listed

TSCA 12(b): This product is not subject to export notification.

Canadian Chemical Inventory: All components of this product are listed on either the DSL or the NDSL.

STATE REGULATIONS

Component	California Proposition 65 Cancer WARNING:	California Proposition 65 CRT List - Male reproductive toxin:	California Proposition 65 CRT List - Female reproductive toxin:	Massachusetts Right to Know Hazardous Substance List	New Jersey Right to Know Hazardous Substance List	New Jersey Special Health Hazards Substance List
Hydrochloric Acid [Hydrogen Chloride] 7647-01-0	Not Listed	Not Listed	Not Listed	Listed	1012	corrosive

Component	New Jersey - Environmental Hazardous Substance List	Pennsylvania Right to Know Hazardous Substance List	Pennsylvania Right to Know Special Hazardous Substances	Pennsylvania Right to Know Environmental Hazard List	Rhode Island Right to Know Hazardous Substance List
Water 7732-18-5	Not Listed	Listed	Not Listed	Not Listed	Not Listed
Hydrochloric Acid [Hydrogen Chloride] 7647-01-0	Listed	Listed	Not Listed	Present	Listed

CANADIAN REGULATIONS
• This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations

Component	Water
WHMIS - Classifications of Substances: Uncontrolled product according to WHMIS classification criteria	
Component	Hydrochloric Acid [Hydrogen Chloride]

WHMIS - Classifications of Substances:
A,D1A,E
D1A,E
E
D1B,E

SECTION 16. OTHER INFORMATION

Prepared by: OxyChem Corporate HESS - Product Stewardship

Rev. Date: 21-Jan-2016

Disclaimer:
This information is intended solely for the use of individuals trained in the NFPA and/or HMIS systems.

HMIS: (SCALE 0-4) (Rated using National Paint & Coatings Association HMIS: Rating Instructions, 2nd Edition)

Health Rating: 3*	**Flammability Rating:** 0	**Reactivity Rating:** 0
Health Rating: 3	**Flammability:** 0	**Reactivity Rating:** 1

Reason for Revision:
• Emergency Overview was revised: SEE SECTION 2
• Changed the GHS classification: SEE SECTION 2
• Toxicological Information has been revised: SEE SECTION 11
• Regulatory Information Changes: SEE SECTION 15

IMPORTANT:
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OSHA Standard 29 CFR 1910.1200 requires that information be provided to employees regarding the hazards of chemicals by means of a hazard communication program including labeling, safety data sheets, training and access to written records. We request that you, and it is your legal duty to, make all information in this Safety Data Sheet available to your employees

End of Safety Data Sheet

Isobutylene

Safety Data Sheet P-4614

This SDS conforms to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1979 Revision date: 10/17/2016 Supersedes: 02/27/2015

SECTION: 1. Product and company identification

1.1. Product identifier

Product form	:	Substance
Name	:	Isobutylene
CAS No	:	115-11-7
Formula	:	C4H8 / CH2=C(CH3)2
Other means of identification	:	Isobutene, 2-methylpropene

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture	:	Industrial use. Use as directed.

1.3. Details of the supplier of the safety data sheet

Praxair, Inc.
10 Riverview Drive
Danbury, CT 06810-6268 - USA
T 1-800-772-9247 (1-800-PRAXAIR) - F 1-716-879-2146
www.praxair.com

1.4. Emergency telephone number

Emergency number : Onsite Emergency: 1-800-645-4633

CHEMTREC, 24hr/day 7days/week
— Within USA: 1-800-424-9300, Outside USA: 001-703-527-3887
(collect calls accepted, Contract 17729)

SECTION 2: Hazard identification

2.1. Classification of the substance or mixture

GHS-US classification

Flam. Gas 1 H220
Liquefied gas H280

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :



GHS02 GHS04

Signal word (GHS-US) : DANGER

Hazard statements (GHS-US) :
H220 - **EXTREMELY FLAMMABLE GAS**
H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED
OSHA-H01 - MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION
CGA-HG04 - MAY FORM EXPLOSIVE MIXTURES WITH AIR
CGA-HG01 - MAY CAUSE FROSTBITE

Precautionary statements (GHS-US) :
P202 - Do not handle until all safety precautions have been read and understood
P210 - Keep away from Heat, Open flames, Sparks, Hot surfaces. - No smoking
P271+P403 - Use and store only outdoors or in a well-ventilated place
P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely
P381 - Eliminate all ignition sources if safe to do so
CGA-PG05 - Use a back flow preventive device in the piping
CGA-PG12 - Do not open valve until connected to equipment prepared for use
CGA-PG06 - Close valve after each use and when empty
CGA-PG11 - Never put cylinders into unventilated areas of passenger vehicles
CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F)

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2.3. Other hazards

Other hazards not contributing to the classification : None.

2.4. Unknown acute toxicity (GHS US)

No data available

SECTION 3: Composition/Information on ingredients

3.1. Substance

Name	Product identifier	%
Isobutylene (Main constituent)	(CAS No) 115-11-7	100

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Remove to fresh air and keep at rest in a position comfortable for breathing. If not breathing, give artificial respiration. If breathing is difficult, trained personnel should give oxygen. Call a physician.

First-aid measures after skin contact : The liquid may cause frostbite. For exposure to liquid, immediately warm frostbite area with warm water not to exceed 105°F (41°C). Water temperature should be tolerable to normal skin. Maintain skin warming for at least 15 minutes or until normal coloring and sensation have returned to the affected area. In case of massive exposure, remove clothing while showering with warm water. Seek medical evaluation and treatment as soon as possible.

First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Contact an ophthalmologist immediately.

First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects, both acute and delayed

No additional information available

4.3. Indication of any immediate medical attention and special treatment needed

None.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Carbon dioxide, Dry chemical, Water spray or fog.

5.2. Special hazards arising from the substance or mixture

Fire hazard : **EXTREMELY FLAMMABLE GAS**. If venting or leaking gas catches fire, do not extinguish flames. Flammable vapors may spread from leak, creating an explosive reignition hazard. Vapors can be ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharge, or other ignition sources at locations distant from product handling point. Explosive atmospheres may linger. Before entering an area, especially a confined area, check the atmosphere with an appropriate device.

Explosion hazard : **EXTREMELY FLAMMABLE GAS**. Forms explosive mixtures with air and oxidizing agents.

Reactivity : No reactivity hazard other than the effects described in sub-sections below.

5.3. Advice for firefighters

Firefighting instructions : **DANGER: FLAMMABLE LIQUID AND VAPOR.** Evacuate all personnel from danger area. Use self-contained breathing apparatus. Immediately cool surrounding containers with water spray from maximum distance, taking care not to extinguish flames. Avoid spreading burning liquid with water. Remove ignition sources if safe to do so. If flames are accidentally extinguished, explosive reignition may occur. Reduce vapors with water spray or fog. Stop flow of liquid if safe to do so, while continuing cooling water spray. Remove all containers from area of fire if safe to do so. Allow fire to burn out. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1919 Subpart L - Fire Protection.

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Special protective equipment for fire fighters	:	Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters.
Other information	:	Containers are equipped with a pressure relief device. (Exceptions may exist where authorized by DOT.).

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : **DANGER: Flammable, liquefied gas.** FORMS EXPLOSIVE MIXTURES WITH AIR. Immediately evacuate all personnel from danger area. Use self-contained breathing apparatus where needed. Remove all sources of ignition if safe to do so. Reduce vapors with fog or fine water spray, taking care not to spread liquid with water. Shut off flow if safe to do so. Ventilate area or move container to a well-ventilated area. Flammable vapors may spread from leak and could explode if reignited by sparks or flames. Explosive atmospheres may linger. Before entering area, especially confined areas, check atmosphere with an appropriate device.

6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

Try to stop release. Prevent waste from contaminating the surrounding environment. Prevent soil and water pollution. Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

6.3. Methods and material for containment and cleaning up

No additional information available

6.4. Reference to other sections

See also sections 8 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use only non-sparking tools. Use only explosion-proof equipment

Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g, wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.

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7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Store only where temperature will not exceed 125°F (52°C). Post “No Smoking/No Open Flames” signs in storage and use areas. There must be no sources of ignition. Separate packages and protect against potential fire and/or explosion damage following appropriate codes and requirements (e.g, NFPA 30, NFPA 55, NFPA 70, and/or NFPA 221 in the U.S.) or according to requirements determined by the Authority Having Jurisdiction (AHJ). Always secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand when the container is not in use. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods. For other precautions in using this product, see section 16

OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.

7.3. Specific end use(s)

None.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Isobutylene (115-11-7)		
ACGIH	ACGIH TLV-TWA (ppm)	250 ppm

8.2. Exposure controls

Appropriate engineering controls : Use an explosion-proof local exhaust system. Local exhaust and general ventilation must be adequate to meet exposure standards. MECHANICAL (GENERAL): **Inadequate - Use only in a closed system.** Use explosion proof equipment and lighting.

Eye protection : Wear safety glasses when handling cylinders; vapor-proof goggles and a face shield during cylinder changeout or whenever contact with product is possible. Select eye protection in accordance with OSHA 29 CFR 1910.133.

Skin and body protection : Wear metatarsal shoes and work gloves for cylinder handling, and protective clothing where needed. Wear appropriate chemical gloves during cylinder changeout or wherever contact with product is possible. Select per OSHA 29 CFR 1910.132, 1910.136, and 1910.138.

Respiratory protection : When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure. For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).

Thermal hazard protection : Wear cold insulating gloves when transfilling or breaking transfer connections.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Gas

Molecular mass : 56 g/mol

Color : Colorless.

Odor : Poor warning properties at low concentrations. Sweetish.

Odor threshold : Odor threshold is subjective and inadequate to warn for overexposure.

pH : Not applicable.

Relative evaporation rate (butyl acetate=1) : No data available

Relative evaporation rate (ether=1) : Not applicable.

Melting point : -140.3 °C

Freezing point : No data available

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Boiling point	:	-6.9 °C
Flash point	:	-80 °C (closed cup)
Critical temperature	:	144.7 °C
Auto-ignition temperature	:	465 °C
Decomposition temperature	:	No data available
Flammability (solid, gas)	:	1.8 - 8.8 vol %
Vapor pressure	:	260 kPa
Critical pressure	:	4000 kPa
Relative vapor density at 20 °C	:	No data available
Relative density	:	0.63
Density	:	0.599 g/cm³ (at 20 °C)
Relative gas density	:	2
Solubility	:	Water: 388 mg/l
Log Pow	:	2.35
Log Kow	:	Not applicable.
Viscosity, kinematic	:	Not applicable.
Viscosity, dynamic	:	Not applicable.
Explosive properties	:	Not applicable.
Oxidizing properties	:	None.
Explosion limits	:	No data available

9.2. Other information

Gas group	:	Liquefied gas
Additional information	:	Gas/vapor heavier than air. May accumulate in confined spaces, particularly at or below ground level

SECTION 10: Stability and reactivity

10.1. Reactivity

No reactivity hazard other than the effects described in sub-sections below.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

May occur.

10.4. Conditions to avoid

High temperature. Catalyst.

10.5. Incompatible materials

Halogens. Oxidizing agents. Acids.

10.6. Hazardous decomposition products

Thermal decomposition may produce : Carbon monoxide. Carbon dioxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified

Isobutylene (\f)115-11-7	
LC50 inhalation rat (mg/l)	620 mg/l/4h
LC50 inhalation rat (ppm)	541657 ppm/1h
ATE US (gases)	270828.500 ppmV/4h
ATE US (vapors)	620.000 mg/l/4h
ATE US (dust, mist)	620.000 mg/l/4h

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Skin corrosion/irritation : Not classified

pH: Not applicable.

Serious eye damage/irritation : Not classified

pH: Not applicable.

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Isobutylene (115-11-7)	
National Toxicology Program (NTP) Status	1 - Evidence of Carcinogenicity

Reproductive toxicity : Not classified

Specific target organ toxicity (single exposure) : Not classified

Specific target organ toxicity (repeated exposure) : Not classified

Aspiration hazard : Not classified

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : No known ecological damage caused by this product.

12.2. Persistence and degradability

Isobutylene (115-11-7)	
Persistence and degradability	The substance is biodegradable. Unlikely to persist.

12.3. Bioaccumulative potential

Isobutylene (115-11-7)	
Log Pow	2.35
Log Kow	Not applicable.
Bioaccumulative potential	Not expected to bioaccumulate due to the low log Kow (log Kow < 4). Refer to section 9.

12.4. Mobility in soil

Isobutylene (115-11-7)	
Mobility in soil	No data available.
Ecology - soil	Because of its high volatility, the product is unlikely to cause ground or water pollution.

12.5. Other adverse effects

Effect on ozone layer : None

Effect on the global warming : No known effects from this product

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Do not attempt to dispose of residual or unused quantities. Return container to supplier.

SECTION 14: Transport information

In accordance with DOT

Transport document description : UN1055 Isobutylene, 2.1

UN-No.(DOT) : UN1055

Proper Shipping Name (DOT) : Isobutylene

Class (DOT) : 2.1 - Class 2.1 - Flammable gas 49 CFR 173.115

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Hazard labels (DOT) : 2.1 - Flammable gas



DOT Special Provisions (49 CFR 172.102) : 19 - For domestic transportation only, the identification number UN1075 may be used in place of the identification number specified in column (4) of the 172.101 table. The identification number used must be consistent on package markings, shipping papers and emergency response information
T50 - When portable tank instruction T50 is referenced in Column (7) of the 172.101 Table, the applicable liquefied compressed gases are authorized to be transported in portable tanks in accordance with the requirements of 173.313 of this subchapter

Additional information

Emergency Response Guide (ERG) Number : 115 (UN1055)

Other information : No supplementary information available.

Special transport precautions : Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers: - Ensure there is adequate ventilation. - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap nut or plug (where provided) is correctly fitted. - Ensure valve protection device (where provided) is correctly fitted.

Transport by sea

UN-No. (IMDG) : 1055

Proper Shipping Name (IMDG) : ISOBUTYLENE

Class (IMDG) : 2 - Gases

MFAG-No : 115

Air transport

UN-No. (IATA) : 1055

Proper Shipping Name (IATA) : Isobutylene

Class (IATA) : 2

Civil Aeronautics Law : Gases under pressure/Gases flammable under pressure

SECTION 15: Regulatory information

15.1. US Federal regulations

Isobutylene (115-11-7)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard Delayed (chronic) health hazard Sudden release of pressure hazard Fire hazard

15.2. International regulations

CANADA

Isobutylene (115-11-7)
Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

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Isobutylene (115-11-7)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

15.2.2. National regulations

Isobutylene (115-11-7)
Listed on the AICS (Australian Inventory of Chemical Substances) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Listed on INSQ (Mexican National Inventory of Chemical Substances)

15.3. US State regulations

Isobutylene(115-11-7)	
U.S. - California - Proposition 65 - Carcinogens List	No
U.S. - California - Proposition 65 - Developmental Toxicity	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Female	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List

SECTION 16: Other information

Other information : When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Before using any plastics, confirm their compatibility with this product

Praxair asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information

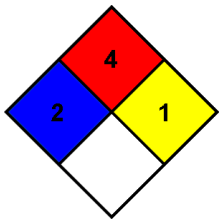
The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Praxair, Inc, it is the user's obligation to determine the conditions of safe use of the product

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NFPA health hazard	: 2 - Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical attention is given.
NFPA fire hazard	: 4 - Will rapidly or completely vaporize at normal pressure and temperature, or is readily dispersed in air and will burn readily.
NFPA reactivity	: 1 - Normally stable, but can become unstable at elevated temperatures and pressures or may react with water with some release of energy, but not violently.



HMIS III Rating

Health	: 1 Slight Hazard - Irritation or minor reversible injury possible
Flammability	: 4 Severe Hazard
Physical	: 2 Moderate Hazard

SDS US (GHS HazCom 2012) - Praxair

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

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SAFETY DATA SHEET

Creation Date 12-Mar-2009 **Revision Date** 25-Apr-2019 **Revision Number** 10

1. Identification

Product Name **Nitric acid (65 - 70%)**

Cat No. : **A198C-212, A200-212, A200-212LC, A200-500, A200-500LC, A200-612GAL, A200C-212, A200S-212, A200S-212LC, A200S-500, A200SI-212, A467-1, A467-2, A467-250, A467-500, A483-212; S719721**

CAS-No 7697-37-2
Synonyms Azotic acid; Engraver's acid; Aqua fortis

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Oxidizing liquids	Category 3
Corrosive to metals	Category 1
Acute Inhalation Toxicity - Dusts and Mists	Category 3
Skin Corrosion/irritation	Category 1 A
Serious Eye Damage/Eye Irritation	Category 1

Label Elements

Signal Word
Danger

Hazard Statements
May intensify fire; oxidizer
May be corrosive to metals
Causes severe skin burns and eye damage

Toxic if inhaled



Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep/Store away from clothing/ other combustible materials
Take any precaution to avoid mixing with combustibles
Keep only in original container
Wear respiratory protection
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Immediately call a POISON CENTER or doctor/physician
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Spills
Absorb spillage to prevent material damage
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Store in corrosive resistant polypropylene container with a resistant inliner
Store in a dry place
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Corrosive to the respiratory tract

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Nitric acid	7697-37-2	65 - 70
Water	7732-18-5	30 - 35

4. First-aid measures

General Advice Immediate medical attention is required. Show this safety data sheet to the doctor in

attendance.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Remove and wash contaminated clothing before re-use. Call a physician immediately.

Inhalation If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Remove from exposure, lie down. Call a physician immediately.

Ingestion Do not induce vomiting. Never give anything by mouth to an unconscious person. Clean mouth with water. Call a physician immediately.

Most important symptoms and effects Causes burns by all exposure routes. Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media CO_2, dry chemical, dry sand, alcohol-resistant foam.

Unsuitable Extinguishing Media No information available

Flash Point Not applicable
Method - No information available

Autoignition Temperature No information available

Explosion Limits
Upper No data available
Lower No data available

Oxidizing Properties Oxidizer

Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. The product causes burns of eyes, skin and mucous membranes. Oxidizer: Contact with combustible/organic material may cause fire. May ignite combustibles (wood paper, oil, clothing, etc.).

Hazardous Combustion Products
Nitrogen oxides (NOx) Thermal decomposition can lead to release of irritating gases and vapors
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
4	0	0	OX

6. Accidental release measures

Personal Precautions Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Use personal protective equipment.

Environmental Precautions Should not be released into the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Sweep up and shovel into suitable containers for disposal. Wear self-contained breathing apparatus and protective suit.

7. Handling and storage

Handling Use only under a chemical fume hood. Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Do not ingest. Do not breathe vapors or spray mist. Keep away from clothing and other combustible materials.

Storage Keep containers tightly closed in a cool, well-ventilated place. Do not store near combustible materials.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Nitric acid	TWA: 2 ppm STEL: 4 ppm	(Vacated) TWA: 2 ppm (Vacated) TWA: 5 mg/m³ (Vacated) STEL: 4 ppm (Vacated) STEL: 10 mg/m³ TWA: 2 ppm TWA: 5 mg/m³	IDLH: 25 ppm TWA: 2 ppm TWA: 5 mg/m³ STEL: 4 ppm STEL: 10 mg/m³	TWA: 2 ppm STEL: 4 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166. Tightly fitting safety goggles. Face-shield.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Keep away from food, drink and animal feeding stuffs. When using, do not eat, drink or smoke. Contaminated work clothing should not be allowed out of the workplace. Provide regular cleaning of equipment, work area and clothing. Avoid contact with skin, eyes and clothing. For environmental protection remove and wash all contaminated protective equipment before re-use. Wear suitable gloves and eye/face protection.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Clear Colorless, Light yellow
Odor	Strong Acrid
Odor Threshold	No information available
pH	< 1.0 (0.1M)
Melting Point/Range	-41 °C / -41.8 °F

Boiling Point/Range	Not applicable
Flash Point	Not applicable
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	0.94 kPa (20°C)
Vapor Density	No information available
Specific Gravity	1.40
Solubility	miscible
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	HNO3
Molecular Weight	63.01

10. Stability and reactivity

Reactive Hazard Yes

Stability Oxidizer: Contact with combustible/organic material may cause fire.

Conditions to Avoid Incompatible products. Combustible material. Excess heat. Exposure to air or moisture over prolonged periods.

Incompatible Materials Combustible material, Strong bases, Reducing agents, Metals, Powdered metals, Organic materials, Aldehydes, Alcohols, Cyanides, Ammonia, Strong reducing agents

Hazardous Decomposition Products Nitrogen oxides (NOx), Thermal decomposition can lead to release of irritating gases and vapors

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50	Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Dermal LD50	Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Mist LC50	Category 3. ATE = 1 - 5 mg/l. Category 4.
Vapor LC50	Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Nitric acid	Not listed	Not listed	LC50 = 2500 ppm. (Rat) 1h
Water	-	Not listed	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes severe burns by all exposure routes

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico

Nitric acid	7697-37-2	Not listed	Not listed	Not listed	Not listed	Not listed
Water	7732-18-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Large amounts will affect pH and harm aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Nitric acid	Not listed	LC50: = 72 mg/L, 96h (Gambusia affinis)	Not listed	Not listed

Persistence and Degradability Miscible with water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

Component	log Pow
Nitric acid	-2.3

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No UN2031
Proper Shipping Name NITRIC ACID
Hazard Class 8
Subsidiary Hazard Class 5.1
Packing Group II

TDG

UN-No UN2031
Proper Shipping Name NITRIC ACID
Hazard Class 8
Subsidiary Hazard Class 5.1
Packing Group II

IATA

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

IMDG/IMO

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
Nitric acid	7697-37-2	X	ACTIVE	-
Water	7732-18-5	X	ACTIVE	-

Legend:
TSCA - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDSL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
Nitric acid	7697-37-2	X	-	231-714-2	X	X	X	X	KE-25911
Water	7732-18-5	X	-	231-791-2	X	-	X	X	KE-35400

U.S. Federal Regulations

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Nitric acid	7697-37-2	65 - 70	1.0

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Nitric acid	X	1000 lb	-	-

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Nitric acid	-	TQ: 500 lb

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Nitric acid	1000 lb	1000 lb

California Proposition 65 This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Nitric acid	X	X	X	X	X
Water	-	-	X	-	-

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security This product contains the following DHS chemicals:
Legend - STQs = Screening Threshold Quantities, APA = A placarded amount

Component	DHS Chemical Facility Anti-Terrorism Standard
Nitric acid	Release STQs - 15000lb Theft STQs - 400lb

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 12-Mar-2009
Revision Date 25-Apr-2019
Print Date 25-Apr-2019
Revision Summary SDS sections updated. 2. 11.

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

1. Identification

Product identifier	**RemOx® L ISCO Reagent**
Other means of identification	Not available.
Recommended use	Liquid oxidant recommended for applications that require a concentrated permanganate solution.
Recommended restrictions	Use in accordance with supplier's recommendations.

Manufacturer / Importer / Supplier / Distributor information

Manufacturer/Supplier	CARUS CORPORATION
Address	315 Fifth Street, Peru, IL 61354, USA
Telephone	815 223-1500 - All other non-emergency inquiries about the product should be directed to the company
E-mail	salesmkt@caruscorporation.com
Website	www.caruscorporation.com
Contact person	Dr. Chithambarathanu Pillai
Emergency Telephone	For Hazardous Materials [or Dangerous Goods] Incidents ONLY (spill, leak, fire, exposure or accident), call CHEMTREC at CHEMTREC®, USA: 001 (800) 424-9300 CHEMTREC®, Mexico (Toll-Free - must be dialed from within country): 01-800-681-9531 CHEMTREC®, Other countries: 001 (703) 527-3887

2. Hazard(s) identification

Physical hazards	Oxidizing liquids	Category 2
Health hazards	Acute toxicity, oral	Category 4
	Skin corrosion/irritation	Category 1B
	Serious eye damage/eye irritation	Category 1
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation

OSHA defined hazards Not classified.

Label elements



Signal word	Danger
Hazard statement	May intensify fire; oxidizer. Harmful if swallowed. Causes severe skin burns and eye damage. May cause respiratory irritation.

Precautionary statement

Prevention	Keep away from heat. Take any precaution to avoid mixing with combustibles. Keep/Store away from clothing//combustible materials. Use only outdoors or in a well-ventilated area. Do not breathe mist or vapor. Wear protective gloves/protective clothing/eye protection/face protection. Do not eat, drink or smoke when using this product. Wash thoroughly after handling.
Response	In case of fire: Use water for extinction. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. If swallowed: Rinse mouth. Do NOT induce vomiting. If inhaled: Remove person to fresh air and keep comfortable for breathing.
Storage	Store locked up. Store in a well-ventilated place. Keep container tightly closed.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) Not classified.

Environmental hazards	Hazardous to the aquatic environment, acute hazard	Category 1
	Hazardous to the aquatic environment, long-term hazard	Category 1

Supplemental information

Hazard symbol



Hazard statement Very toxic to aquatic life with long lasting effects.

Precautionary statement

Prevention Avoid release to the environment.

Response Collect spillage.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Sodium permanganate	10101-50-5	36 - 40

Composition comments All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

Inhalation If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Remove victim to fresh air and keep at rest in a position comfortable for breathing. Move to fresh air. For breathing difficulties, oxygen may be necessary. Call a physician or poison control center immediately. Get medical attention immediately. Call a physician if symptoms develop or persist. Get medical attention if symptoms persist.

Skin contact Take off immediately all contaminated clothing. (Caution: Solution may ignite certain textiles). Immediately flush skin with plenty of water. Get medical attention immediately. Wash contaminated clothing before reuse.

Contact with skin may leave a brown stain of insoluble manganese dioxide. This can be easily removed by washing with a mixture of equal volume of household vinegar and 3% hydrogen peroxide, followed by washing with soap and water.

Eye contact Immediately flush with plenty of water for up to 15 minutes. Remove any contact lenses and open eyelids wide apart. Continue rinsing. Get medical attention immediately.

Ingestion Immediately rinse mouth and drink plenty of water. Never give anything by mouth to a victim who is unconscious or is having convulsions. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Get medical attention immediately.

Before using, read Material Safety Data Sheet (MSDS) for this product. Rinse container at least three times to an absence of pink color before disposing.

Most important symptoms/effects, acute and delayed Contact with this material will cause burns to the skin, eyes and mucous membranes. Corrosive effects. Irritation of eyes and mucous membranes. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. May cause temporary blindness and severe eye damage. Permanent eye damage including blindness could result. Show this safety data sheet to the doctor in attendance.

Indication of immediate medical attention and special treatment needed Provide general supportive measures and treat symptomatically. In case of shortness of breath, give oxygen. Decomposition products are alkaline. Brown stain is insoluble manganese dioxide.

General information In the case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. For personal protection, see Section 8 of the MSDS. Show this safety data sheet to the doctor in attendance. Wash contaminated clothing before reuse.

5. Fire-fighting measures

Suitable extinguishing media Flood with water from a distance, water spray or fog.

Unsuitable extinguishing media The following extinguishing media are ineffective: Dry chemical. Foam. Carbon dioxide (CO2). Halogenated materials.

Specific hazards arising from the chemical May intensify fire; oxidizer. May ignite combustibles (wood, paper, oil, clothing, etc.). Contact with incompatible materials or heat (135 ºC / 275 ºF) could result in violent exothermic chemical reaction. Oxidizing agent, may cause spontaneous ignition of combustible materials. By heating and fire, corrosive vapors/gases may be formed.

Special protective equipment and precautions for firefighters Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace.

Fire-fighting equipment/instructions

Move container from fire area if it can be done without risk. Cool containers exposed to flames with water until well after the fire is out. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply. Dike fire control water for later disposal. Water runoff can cause environmental damage.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Keep unnecessary personnel away. Keep upwind. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Avoid inhalation of vapors and contact with skin and eyes. Wear protective clothing as described in Section 8 of this safety data sheet. Local authorities should be advised if significant spillages cannot be contained.

Methods and materials for containment and cleaning up

Keep combustibles (wood, paper, oil, etc.) away from spilled material. Should not be released into the environment. This product is miscible in water.

Large Spills: Stop leak if possible without any risk. Dike the spilled material, where this is possible. Proceed with either of the following two options depending upon the size of the spill and the availability of the neutralizing agents:

Option # 1: Dilute to approximately 6% with water, and then reduce with sodium thiosulfate, a bisulfite or ferrous salt solution. The bisulfite or ferrous salt may require some dilute sulfuric acid (10% w/w) to promote reduction. Neutralize with sodium carbonate to neutral pH, if acid was used. Decant or filter and deposit sludge in approved landfill. Where permitted, the sludge may be drained into sewer with large quantities of water.

Option # 2: Absorb with inert media like diatomaceous earth or inert floor dry, collect into a drum and dispose of properly. Do not use saw dust or other incompatible media. Disposal of all materials shall be in full and strict compliance with all federal, state, and local regulations pertaining to permanganates.

To clean contaminated floors, flush with abundant quantities of water into sewer, if permitted by federal, state, and local regulations. If not, collect water and treat as described above. Cover with reducing agent (e.g. sodium bisulphite/thiosulphate or a ferrous salt plus 2M H_2SO_4). Transfer to container with water and neutralize with soda ash. Otherwise, absorb spill with vermiculite or other inert material, then place in a container for chemical waste. Do not use sawdust or other combustible material. Following product recovery, flush area with water. Prevent product from entering drains.

Small Spills: Cover with reducing agent (e.g. sodium bisulphite/thiosulphate or a ferrous salt plus 2M H_2SO_4). Transfer to container with water and neutralize with soda ash. Clean surface thoroughly to remove residual contamination.

Never return spills in original containers for re-use. Never return spills in original containers for re-use.

Environmental precautions

Do not allow to enter drains, sewers or watercourses. Contact local authorities in case of spillage to drain/aquatic environment.

7. Handling and storage

Precautions for safe handling

Take any precaution to avoid mixing with combustibles. Keep away from clothing and other combustible materials. Do not get this material in your eyes, on your skin, or on your clothing. Do not breathe mist or vapor. If clothing becomes contaminated, remove and wash off immediately. Spontaneous ignition may occur in contact with cloth or paper. When using, do not eat, drink or smoke. Good personal hygiene is necessary. Wash hands and contaminated areas with water and soap before leaving the work site. Avoid release to the environment.

Conditions for safe storage, including any incompatibilities

Store locked up. Keep container tightly closed and in a well-ventilated place. Store in a cool, dry place. Store away from incompatible materials (See Section 10). Follow applicable local/national/international recommendations on storage of oxidizers. Store in accordance with NFPA 430 requirements for Class II oxidizers.

8. Exposure controls/personal protection

Occupational exposure limits

No exposure limits noted for ingredient(s).

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value
Sodium permanganate (CAS 10101-50-5)	Ceiling	5 mg/m3

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Sodium permanganate (CAS 10101-50-5)	TWA	0.1 mg/m3	Inhalable fraction.
		0.02 mg/m3	Respirable fraction.

US NIOSH Pocket Guide to Chemical Hazards: Recommended exposure limit (REL)

Components	Type	Value	Form
Sodium permanganate (CAS 10101-50-5)	TWA	1 mg/m3	Fume.

US NIOSH Pocket Guide to Chemical Hazards: Short Term Exposure Limit (STEL)

Components	Type	Value	Form
Sodium permanganate (CAS 10101-50-5)	STEL	3 mg/m3	Fume.

Biological limit values No biological exposure limits noted for the ingredient(s).

Exposure guidelines Follow standard monitoring procedures.

Appropriate engineering controls Provide adequate general and local exhaust ventilation. An eye wash and safety shower must be available in the immediate work area.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles). Wear face shield if there is risk of splashes.

Skin protection

Hand protection Wear chemical-resistant, impervious gloves. Use protective gloves made of: Rubber or plastic. Suitable gloves can be recommended by the glove supplier.

Other Wear appropriate chemical resistant clothing. Rubber or plastic apron.

Respiratory protection In case of inadequate ventilation or risk of inhalation of vapors, use suitable respiratory equipment. In the United States of America, if respirators are used, a program should be instituted to assure compliance with OSHA 29 CFR 1910.134.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations When using, do not eat, drink or smoke. Keep from contact with clothing and other combustible materials. Remove and wash contaminated clothing promptly. Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance Dark purple liquid.

Physical state Liquid.

Form Aqueous solution.

Color Dark purple.

Odor Odorless.

Odor threshold Not available.

pH 5 - 8

Melting point/freezing point < 24.8 °F (< -4 °C)

Initial boiling point and boiling range > 213.8 °F (> 101 °C)

Flash point Does not flash.

Evaporation rate As water.

Flammability (solid, gas) Not applicable.

Upper/lower flammability or explosive limits

Flammability limit - lower (%) Not applicable.

Flammability limit - upper (%) Not applicable.

Vapor pressure 760 mm Hg (105 °C)

Vapor density Not available.

Relative density 1.37 - 1.4 (20 °C) (Water = 1)

Solubility(ies) Miscible with water.

Partition coefficient (n-octanol/water) Not available.

Auto-ignition temperature Not available.

Decomposition temperature Not available.

Viscosity Not available.

Other information

Explosive properties	Not explosive. Can explode in contact with sulfuric acid, peroxides and metal powders.
Oxidizing properties	Strong oxidizing agent.

10. Stability and reactivity

Reactivity	The product is non-reactive under normal conditions of use, storage and transport.
Chemical stability	Stable at normal conditions.
Possibility of hazardous reactions	Contact with combustible material may cause fire. Can explode in contact with sulfuric acid, peroxides and metal powders.
Conditions to avoid	Contact with incompatible materials or heat (135 °C / 275 °F) could result in violent exothermic chemical reaction.
Incompatible materials	Acids. Peroxides. Reducing agents. Combustible material. Metal powders.
Hazardous decomposition products	By heating and fire, corrosive vapors/gases may be formed. Contact with hydrochloric acid liberates chlorine gas.

11. Toxicological information

Information on likely routes of exposure

Ingestion	Causes digestive tract burns. Harmful if swallowed. Ingestion causes burns of the upper digestive and respiratory tracts.
Inhalation	May cause irritation to the respiratory system.
Skin contact	Causes severe skin burns.
Eye contact	Causes serious eye damage.
Symptoms related to the physical, chemical and toxicological characteristics	Contact with this material will cause burns to the skin, eyes and mucous membranes. Permanent eye damage including blindness could result.

Information on toxicological effects

Acute toxicity Causes severe skin burns and eye damage. Causes burns. Harmful if swallowed. Health injuries are not known or expected under normal use. Harmful if swallowed.

Components	Species	Test Results
Potassium permanganate (CAS 7722-64-7)		
Acute		
Dermal		
LD50	Rat	2000 mg/kg
Oral		
LD50	Rat	2000 mg/kg

Toxicity data are not available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate.

Skin corrosion/irritation	Causes severe skin burns.
Serious eye damage/eye irritation	Causes serious eye damage.
Respiratory sensitization	Not classified.
Skin sensitization	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	Not classified.
Reproductive toxicity	Not classified.
Specific target organ toxicity - single exposure	May cause irritation of respiratory tract.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not classified.
Further information	Chronic effects are not expected when this product is used as intended. Prolonged exposure, usually over many years, to manganese oxide fume/dust can lead to chronic manganese poisoning, chiefly affecting the central nervous system.

12. Ecological information

Ecotoxicity Very toxic to aquatic life with long lasting effects.

Components		Species	Test Results
Potassium permanganate (CAS 7722-64-7)			
Aquatic			
Fish	LC50	Bluegill (Lepomis macrochirus)	2.7 mg/l, 96 hours, static
			2.3 mg/l, 96 hours, flow through
			2.3 mg/l, 96 hours
			1.8 - 5.6 mg/l
		Carp (Cyprinus carpio)	3.16 - 3.77 mg/l, 96 hours
			2.97 - 3.11 mg/l, 96 hours
		Goldfish (Carassius auratus)	3.3 - 3.93 mg/l, 96 hours, static
		Milkfish, salmon-herring (Chanos chanos)	> 1.4 mg/l, 96 hours
		Rainbow trout (Oncorhynchus mykiss)	1.8 mg/l, 96 hours
			1.08 - 1.38 mg/l, 96 hours
			0.77 - 1.27 mg/l, 96 hours
		Rainbow trout,donaldson trout (Oncorhynchus mykiss)	0.275 - 0.339 mg/l, 96 hours

Toxicity data are not available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate.

Persistence and degradability Expected to be readily converted by oxidizable materials to insoluble manganese oxide.

Bioaccumulative potential Potential to bioaccumulate is low.

Mobility in soil The product is miscible with water. May spread in water systems.

Mobility in general The product is miscible with water. May spread in water systems.

Other adverse effects None known.

13. Disposal considerations

Disposal instructions Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Rinse container at least three times to an absence of pink color before disposing.

Hazardous waste code D001: Ignitable waste
The Waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products Do not allow this material to drain into sewers/water supplies. Dispose of in accordance with local regulations.

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied. Rinse container at least three times to an absence of pink color before disposing. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

UN number UN3214
UN proper shipping name Permanganates, inorganic, aqueous solution, n.o.s. (Sodium permanganate)
Transport hazard class(es) 5.1
Subsidiary class(es) -
Packing group II
Environmental hazards
Marine pollutant Yes
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.
Special provisions 26, 353, IB2, T4, TP1
Packaging exceptions 152
Packaging non bulk 202
Packaging bulk 242

IATA

UN number UN3214
UN proper shipping name Permanganates, inorganic, aqueous solution, n.o.s. (Sodium permanganate)
Transport hazard class(es) 5.1
Subsidiary class(es) -
Packing group II
Environmental hazards Yes
Labels required 5.1
ERG Code 5L

Special precautions for user Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number	UN3214
UN proper shipping name	PERMANGANATES, INORGANIC, AQUEOUS SOLUTION, N.O.S. (Sodium permanganate)
Transport hazard class(es)	5.1
Subsidiary class(es)	-
Packaging group	II
Environmental hazards	
Marine pollutant	Yes
Labels required	5.1
EmS	F-H, S-Q
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code This substance/mixture is not intended to be transported in bulk.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
All components are on the U.S. EPA TSCA Inventory List.

CERCLA/SARA Hazardous Substances - Not applicable.

Drug Enforcement Administration (DEA) (21 CFR 1310.02 (b) 8: List II chemical.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Sodium permanganate (CAS 10101-50-5) LISTED

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - Yes
Delayed Hazard - No
Fire Hazard - Yes
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance No

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Sodium permanganate	10101-50-5	36 - 40
Potassium permanganate	7722-64-7	2

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Sodium permanganate (CAS 10101-50-5)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

Drug Enforcement Administration (DEA). List 2, Essential Chemicals (21 CFR 1310.02(b) and 1310.04(f)(2) and Chemical Code Number

Sodium permanganate (CAS 10101-50-5) 6588

Drug Enforcement Administration (DEA). List 1 & 2 Exempt Chemical Mixtures (21 CFR 1310.12(c))

Sodium permanganate (CAS 10101-50-5) 15 % wt

DEA Exempt Chemical Mixtures Code Number

Sodium permanganate (CAS 10101-50-5) 6588

Food and Drug Administration (FDA) Not regulated.

US state regulations This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US. Massachusetts RTK - Substance List

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Sodium permanganate (CAS 10101-50-5) 500 lbs

US. Pennsylvania RTK - Hazardous Substances

Not regulated.

US. Rhode Island RTK

Sodium permanganate (CAS 10101-50-5)

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Not listed.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	Yes
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

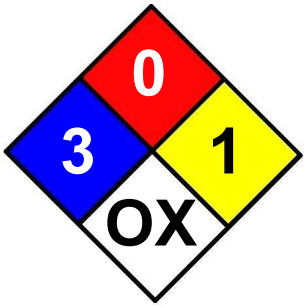
16. Other information, including date of preparation or last revision

Issue date 27-November-2013

Revision date -

Version # 01

NFPA Ratings



References HSDB® - Hazardous Substances Data Bank
Registry of Toxic Effects of Chemical Substances (RTECS)
EPA: AQUIRE database
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

Disclaimer

This safety data sheet was prepared in accordance with the Safety Data Sheet for Chemical Products (JIS Z 7250:2005). The information contained herein is accurate to the best of our knowledge. However, data, safety standards and government regulations are subject to change and, therefore, holders and users should satisfy themselves that they are aware of all current data and regulations relevant to their particular use of product. CARUS CORPORATION DISCLAIMS ALL LIABILITY FOR RELIANCE ON THE COMPLETENESS OR ACCURACY OR THE INFORMATION INCLUDED HEREIN. CARUS CORPORATION MAKES NO WARRANTY, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTIABILITY OR FITNESS FOR PARTICULAR USE OR PURPOSE OF THE PRODUCT DESCRIBED HEREIN. All conditions relating to storage, handling, and use of the product are beyond the control of Carus Corporation, and shall be the sole responsibility of the holder or user of the product.

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Sodium Thiosulfate, Pentahydrate

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 03/07/2005 Revision date: 04/25/2018 Supersedes: 07/09/2013 Version: 1.1

SECTION 1: Identification

1.1. Identification

Product form : Substance

Substance name : Sodium Thiosulfate, Pentahydrate

CAS-No. : 10102-17-7

Product code : LC24990

Formula : Na2S2O3·5H2O

1.2. Recommended use and restrictions on use

Use of the substance/mixture : For laboratory and manufacturing use only.

Recommended use : Laboratory chemicals

Restrictions on use : Not for food, drug or household use

1.3. Supplier

LabChem Inc
Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court
Zelienople, PA 16063 - USA
T 412-826-5230 - F 724-473-0647
info@labchem.com - www.labchem.com

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300 or +1-703-741-5970

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS-US classification

Not classified

2.2. GHS Label elements, including precautionary statements

Not classified as a hazardous chemical.

Other hazards not contributing to the classification : None.

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substances

Substance type : Mono-constituent

Name	Product identifier	%	GHS-US classification
Sodium Thiosulfate, Pentahydrate (Main constituent)	(CAS-No.) 10102-17-7	100	Not classified

Full text of hazard classes and H-statements : see section 16

3.2. Mixtures

Not applicable

SECTION 4: First-aid measures

4.1. Description of first aid measures

First-aid measures general : Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible).

First-aid measures after inhalation : Allow victim to breathe fresh air. Allow the victim to rest.

First-aid measures after skin contact : Remove affected clothing and wash all exposed skin area with mild soap and water, followed by warm water rinse.

First-aid measures after eye contact : Rinse immediately with plenty of water. Obtain medical attention if pain, blinking or redness persists.

First-aid measures after ingestion : Rinse mouth. Do NOT induce vomiting. Obtain emergency medical attention.

4.2. Most important symptoms and effects (acute and delayed)

Symptoms/effects : Not expected to present a significant hazard under anticipated conditions of normal use.

4.3. Immediate medical attention and special treatment, if necessary

No additional information available

SECTION 5: Fire-fighting measures

5.1. Suitable (and unsuitable) extinguishing media

Suitable extinguishing media : Foam. Dry powder. Carbon dioxide. Water spray. Sand.

Unsuitable extinguishing media : Do not use a heavy water stream.

5.2. Specific hazards arising from the chemical

Reactivity : Product is not explosive.

5.3. Special protective equipment and precautions for fire-fighters

Firefighting instructions : Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire. Prevent fire-fighting water from entering environment.

Protection during firefighting : Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Protective equipment : Safety glasses.

Emergency procedures : Evacuate unnecessary personnel.

6.1.2. For emergency responders

Protective equipment : Equip cleanup crew with proper protection.

Emergency procedures : Ventilate area.

6.2. Environmental precautions

Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up : On land, sweep or shovel into suitable containers. Minimize generation of dust. Store away from other materials.

6.4. Reference to other sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Provide good ventilation in process area to prevent formation of vapor.

Hygiene measures : Wash contaminated clothing before reuse.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Keep container closed when not in use.

Incompatible products : Strong oxidizers.

Incompatible materials : Direct sunlight. Air and moisture sensitive. Hygroscopic.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No additional information available

8.2. Appropriate engineering controls

Appropriate engineering controls : Emergency eye wash fountains should be available in the immediate vicinity of any potential exposure.

8.3. Individual protection measures/Personal protective equipment

Personal protective equipment:

Safety glasses.



Hand protection:

Wear protective gloves.

Eye protection:

Chemical goggles or safety glasses

Respiratory protection:

Respiratory protection not required in normal conditions

Other information:

Do not eat, drink or smoke during use.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Solid
Appearance	:	Crystalline solid.
Color	:	Colourless or white
Odor	:	Odorless
Odor threshold	:	No data available
pH	:	No data available
pH solution	:	6 - 8.4 5% solution
Melting point	:	45 °C
Freezing point	:	No data available
Boiling point	:	100 °C
Flash point	:	No data available
Relative evaporation rate (butyl acetate=1)	:	No data available
Flammability (solid, gas)	:	Non flammable.
Vapor pressure	:	No data available
Relative vapor density at 20 °C	:	No data available
Relative density	:	No data available
Specific gravity / density	:	1.73 g/cm³
Molecular mass	:	248.18 g/mol
Solubility	:	Soluble in water. Soluble in ammonia. Insoluble in organic solvents. Water: 79.4 g/100ml
Log Pow	:	-4.35
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available
Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	No data available
Explosion limits	:	No data available
Explosive properties	:	Not applicable.
Oxidizing properties	:	None.

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

Product is not explosive.

10.2. Chemical stability

Hygroscopic.

10.3. Possibility of hazardous reactions

Not established.

10.4. Conditions to avoid

Direct sunlight. Moisture. Air contact.

10.5. Incompatible materials

Strong oxidizers.

10.6. Hazardous decomposition products

Sulfur compounds.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Likely routes of exposure : Skin and eye contact

Acute toxicity : Not classified

Sodium Thiosulfate, Pentahydrate (10102-17-7)	
LD50 oral rat	5000 mg/kg
ATE US (oral)	5000 mg/kg body weight

Skin corrosion/irritation : Not classified

Serious eye damage/irritation : Not classified

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Based on available data, the classification criteria are not met

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

Based on available data, the classification criteria are not met

Specific target organ toxicity – single exposure : Not classified

Specific target organ toxicity – repeated exposure : Not classified

Aspiration hazard : Not classified

Potential Adverse human health effects and symptoms : Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

12.1. Toxicity

Sodium Thiosulfate, Pentahydrate (10102-17-7)	
LC50 fish 1	≥ 10000

12.2. Persistence and degradability

Sodium Thiosulfate, Pentahydrate (10102-17-7)	
Persistence and degradability	Not established.

12.3. Bioaccumulative potential

Sodium Thiosulfate, Pentahydrate (10102-17-7)	
Log Pow	-4.35
Bioaccumulative potential	Not established.

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Other information : Avoid release to the environment.

SECTION 13: Disposal considerations

13.1. Disposal methods

Waste disposal recommendations : Dispose in a safe manner in accordance with local/national regulations.

Ecology - waste materials : Avoid release to the environment.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Not regulated

SECTION 15: Regulatory information

15.1. US Federal regulations

Sodium Thiosulfate, Pentahydrate (10102-17-7)
Listed on the United States TSCA (Toxic Substances Control Act) inventory

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

15.2. International regulations

CANADA

Sodium Thiosulfate, Pentahydrate (10102-17-7)
Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

No additional information available

National regulations

Sodium Thiosulfate, Pentahydrate (10102-17-7)
Not listed on the Canadian IDL (Ingredient Disclosure List)

15.3. US State regulations

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer, developmental and/or reproductive harm

SECTION 16: Other information

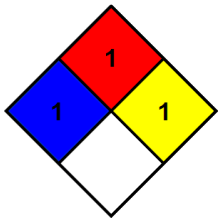
Revision date : 04/25/2018

Other information : None.

NFPA health hazard : 1 - Materials that, under emergency conditions, can cause significant irritation.

NFPA fire hazard : 1 - Materials that must be preheated before ignition can occur.

NFPA reactivity : 1 - Materials that in themselves are normally stable but can become unstable at elevated temperatures and pressures.



Hazard Rating		
Health	:	1 Slight Hazard - Irritation or minor reversible injury possible
Flammability	:	1 Slight Hazard - Materials that must be preheated before ignition will occur. Includes liquids, solids and semi solids having a flash point above 200 F. (Class IIIB)
Physical	:	1 Slight Hazard - Materials that are normally stable but can become unstable (self-react) at high temperatures and pressures. Materials may react non-violently with water or undergo hazardous polymerization in the absence of inhibitors.
Personal protection	:	B B - Safety glasses, Gloves

SDS US LabChem

Information in this SDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc assumes no liability resulting from the use of this SDS. The user must determine suitability of this information for his application.

Attachment 10

Emergency Contact Information
IN CASE OF EMERGENCY, DIAL 911 AS SOON AS POSSIBLE!!!

VERINA Project Name: _Dover-Kirkwood_ VERINA Job Number: ___5101.0002__

29 Industrial Park Drive, Binghamton, New York 13904_____
Site Address

_Joe Fiacco (Modern Marketing Concepts) and Phil Haram (Love's Truck Stop)__
Site Contacts

_Joe: 607-761-6482 (email: jfiacco@mmcglobal.com) Phil: 607-651-9153__
Phone

Emergency Contacts:

Police: 607-723-5321____ Fire: __607-772-3311__

Ambulance/EMS: _____call 911_____ Poison Control: 1-800-222-1222_____

HazMat Response: _NYS DEC Environmental Remediation (518) 402-9543_____

Electric/Gas Utility: _Gas= NYSEG, 1-800-572-1121 Electric= Integrys, 312-228-5400

Telephone/Cable Utility: ____Time Warner, 866-744-1678 (press # to reach operator)_____

Nearest Hospital with Urgent Care Facility: _____UHS Binghamton General Hospital_____

Address: __10-42 Mitchell Avenue, Binghamton, NY 13903_____

General Phone Number: _____607-762-2200_____

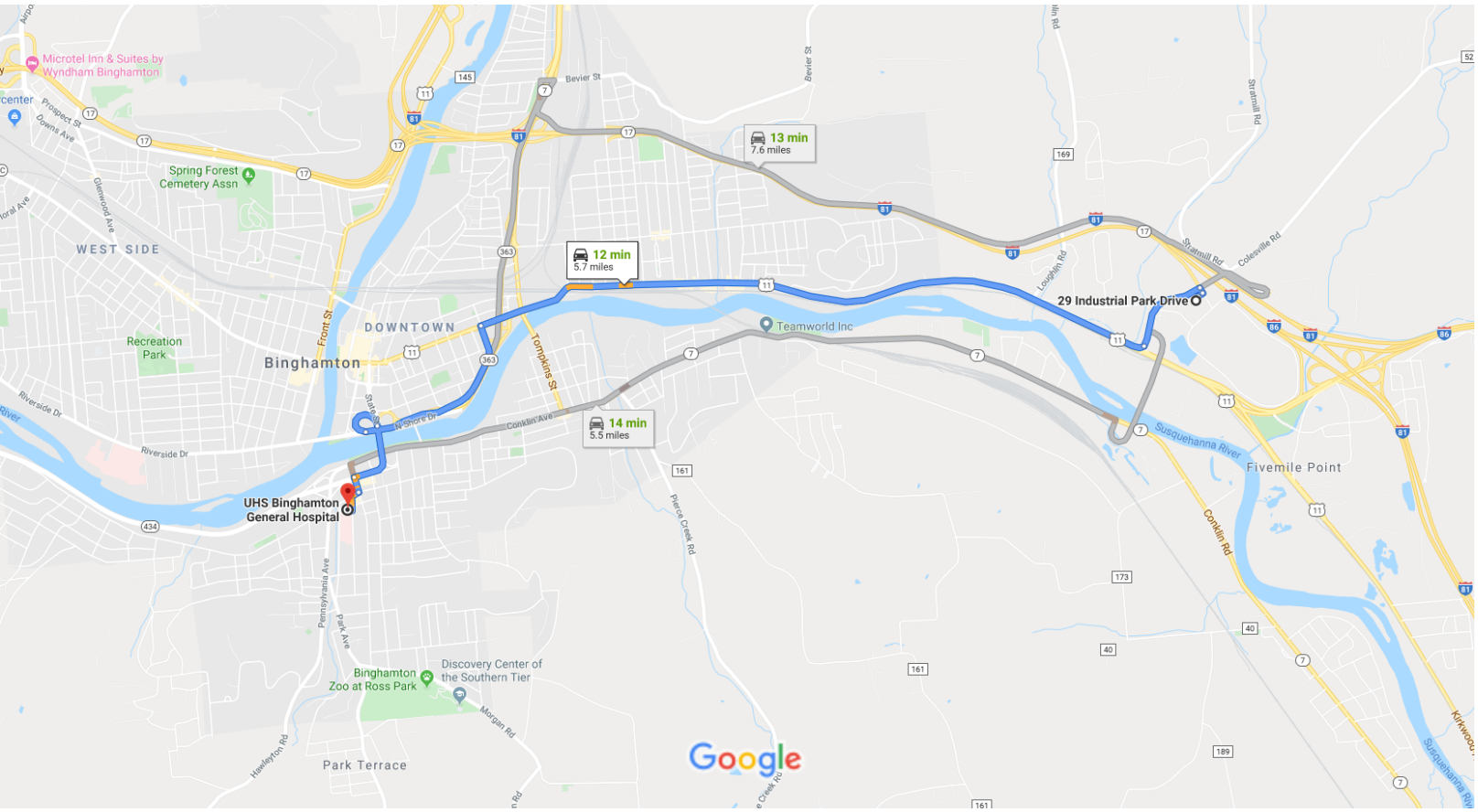
Emergency/Urgent Care Department: _____N/A – call 911_____

Attach Hospital Route Map

Google Maps

29 Industrial Park Drive, Binghamton, NY to UHS Binghamton General Hospital

Drive 5.7 miles, 12 min



Map data ©2019 2000 ft

29 Industrial Park Dr

Binghamton, NY 13904

Take Colesville Rd to US-11 N/Court St

2 min (0.5 mi)

1. Head northeast toward Industrial Park Dr

157 ft

2. Turn left onto Industrial Park Dr

164 ft

3. Turn left onto Colesville Rd

0.4 mi

Get on NY-434 W/State St in Binghamton

8 min (4.6 mi)

4. Turn right onto US-11 N/Court St

3.4 mi

5. Turn left to merge onto NY-363 S/N Shore Dr

0.9 mi

6. Use the right lane to merge onto NY-434 W/State St via the ramp to Vestal

0.2 mi

Continue on NY-434 W to your destination

2 min (0.6 mi)

7. Merge onto NY-434 W/State St
Continue to follow NY-434 W

0.4 mi

8. Turn left onto S Washington St

407 ft

9. Turn right onto Vestal Ave

226 ft

10. Turn left onto Mitchell Ave

384 ft

11. Turn right
Destination will be on the right

105 ft

UHS Binghamton General Hospital

10-42 Mitchell Ave, Binghamton, NY 13903

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Attachment 11

American Red Cross

Adult First Aid/CPR/AED

READY REFERENCE



CHECKING AN INJURED OR ILL ADULT

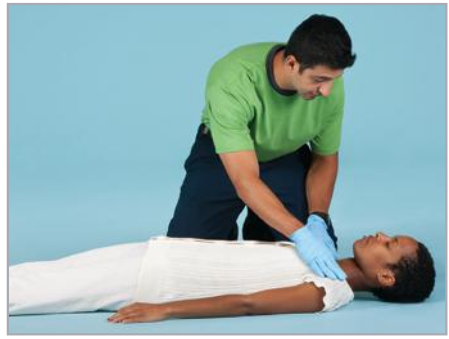
APPEARS TO BE UNCONSCIOUS

TIP: *Use disposable gloves and other personal protective equipment and obtain consent whenever giving care.*

AFTER CHECKING THE SCENE FOR SAFETY, CHECK THE PERSON:

1 CHECK FOR RESPONSIVENESS

Tap the shoulder and shout, "Are you OK?"



2 CALL 9-1-1

If **no** response, **CALL** 9-1-1 or the local emergency number.

- If an unconscious person is face-down, roll face-up, supporting the head, neck and back in a straight line.

If the person responds, obtain consent and **CALL** 9-1-1 or the local emergency number for any life-threatening conditions.

CHECK the person from head to toe and ask questions to find out what happened.

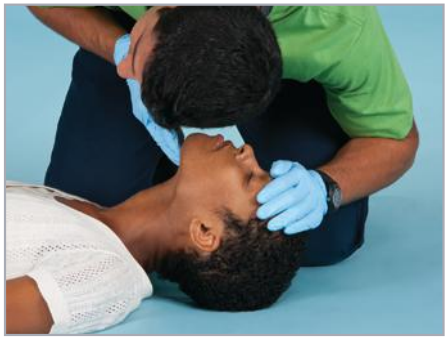
3 OPEN THE AIRWAY

Tilt head, lift chin.

4 CHECK FOR BREATHING

CHECK quickly for breathing for no more than **10** seconds.

- Occasional gasps are not breathing.



5 QUICKLY SCAN FOR SEVERE BLEEDING

WHAT TO DO NEXT

- Give **CARE** based on conditions found.
- IF NO BREATHING—Go to PANEL 6 or PANEL 7 (if an AED is immediately available).
- IF BREATHING—Maintain an open airway and monitor for any changes in condition.

CONSCIOUS CHOKING

CANNOT COUGH, SPEAK OR BREATHE

AFTER CHECKING THE SCENE AND THE INJURED OR ILL PERSON, HAVE SOMEONE CALL 9-1-1 AND GET CONSENT.

1 GIVE 5 BACK BLOWS

Give **5** back blows.

- Bend the person forward at the waist and give **5** back blows between the shoulder blades with the heel of one hand.



2 GIVE 5 ABDOMINAL THRUSTS

- Place a fist with the thumb side against the middle of the person's abdomen, just above the navel.
- Cover your fist with your other hand.
- Give **5** quick, upward abdominal thrusts.



3 CONTINUE CARE

Continue sets of **5** back blows and **5** abdominal thrusts until the:

- Object is forced out.
- Person can cough forcefully or breathe.
- Person becomes unconscious.



WHAT TO DO NEXT

- IF THE PERSON BECOMES UNCONSCIOUS—**CALL** 9-1-1, if not already done, and give care for an unconscious choking adult, beginning with looking for an object (PANEL 5, Step 3).

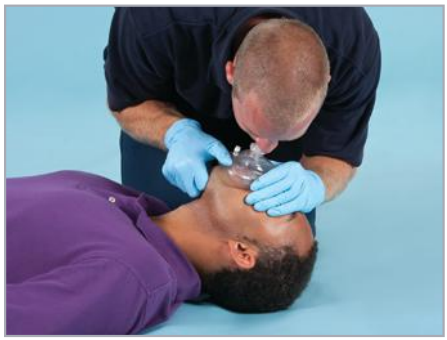
UNCONSCIOUS CHOKING

CHEST DOES NOT RISE WITH RESCUE BREATHS

AFTER CHECKING THE SCENE AND THE INJURED OR ILL PERSON:

1 GIVE RESCUE BREATHS

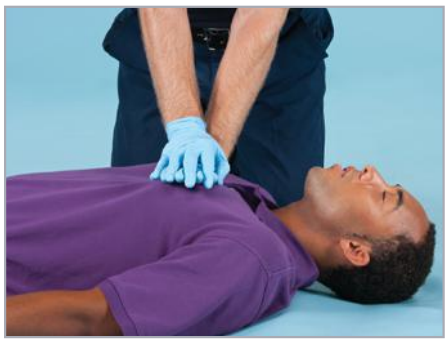
Retilt the head and give another rescue breath.



2 GIVE 30 CHEST COMPRESSIONS

If the chest still does not rise, give **30** chest compressions.

TIP: *Person must be on firm, flat surface. Remove CPR breathing barrier when giving chest compressions.*



3 LOOK FOR AND REMOVE OBJECT IF SEEN



4 GIVE 2 RESCUE BREATHS

WHAT TO DO NEXT

- IF BREATHS DO NOT MAKE THE CHEST RISE—Repeat steps 2 through 4.
- IF THE CHEST CLEARLY RISES—**CHECK** for breathing. Give **CARE** based on conditions found.

CPR

NO BREATHING

AFTER CHECKING THE SCENE AND THE INJURED OR ILL PERSON:

1 GIVE 30 CHEST COMPRESSIONS

Push hard, push fast in the middle of the chest at least 2 inches deep and at least 100 compressions per minute

TIP: *Person must be on firm, flat surface.*



2 GIVE 2 RESCUE BREATHS

- Tilt the head back and lift the chin up.
- Pinch the nose shut then make a complete seal over the person's mouth.
- Blow in for about 1 second to make the chest clearly rise.
- Give rescue breaths, one after the other.

Note: *If chest does not rise with rescue breaths, retilt the head and give another rescue breath.*



3 DO NOT STOP

Continue cycles of CPR. Do not stop CPR except in one of these situations:

- You find an obvious sign of life, such as breathing.
- An AED is ready to use.
- Another trained responder or EMS personnel take over.
- You are too exhausted to continue.
- The scene becomes unsafe.

WHAT TO DO NEXT

- IF AN AED BECOMES AVAILABLE—Go to AED, PANEL 7.
- IF BREATHS DO NOT MAKE THE CHEST RISE— AFTER RETILTING HEAD—Go to Unconscious choking, PANEL 5.

TIP: *If at any time you notice an obvious sign of life, stop CPR and monitor breathing and for any changes in condition.*

AED—ADULT OR CHILD OLDER THAN 8 YEARS OR WEIGHING MORE THAN 55 POUNDS

NO BREATHING

AFTER CHECKING THE SCENE AND THE INJURED OR ILL PERSON:

> **TIP:** *Do not use pediatric AED pads or equipment on an adult or child older than 8 years or weighing more than 55 pounds.*

1 TURN ON AED

Follow the voice and/or visual prompts.



2 WIPE BARE CHEST DRY

> **TIP:** *Remove any medication patches with a gloved hand.*

3 ATTACH PADS



4 PLUG IN CONNECTOR, IF NECESSARY



5 STAND CLEAR

Make sure no one, including you, is touching the person.

- **Say, "EVERYONE, STAND CLEAR."**



6 ANALYZE HEART RHYTHM

Push the "analyze" button, if necessary. Let AED analyze the heart rhythm.

7 DELIVER SHOCK

If SHOCK IS ADVISED:

- **Make sure no one, including you, is touching the person.**
- **Say, "EVERYONE, STAND CLEAR."**
- **Push the "shock" button, if necessary.**



8 PERFORM CPR

After delivering the shock, or if no shock is advised:

- **Perform about 2 minutes (or 5 cycles) of CPR.**
- **Continue to follow the prompts of the AED.**

TIPS:

- *If at any time you notice an obvious sign of life, stop CPR and monitor breathing and for any changes in condition.*
- *If two trained responders are present, one should perform CPR while the second responder operates the AED.*

CONTROLLING EXTERNAL BLEEDING

AFTER CHECKING THE SCENE AND THE INJURED OR ILL PERSON:

1 COVER THE WOUND

Cover the wound with a sterile dressing.

2 APPLY DIRECT PRESSURE UNTIL BLEEDING STOPS



3 COVER THE DRESSING WITH BANDAGE

Check for circulation beyond the injury (check for feeling, warmth and color).



4 APPLY MORE PRESSURE AND CALL 9-1-1

If the bleeding does not stop:

- Apply more dressings and bandages.
- Continue to apply additional pressure.
- Take steps to minimize shock.
- **CALL** 9-1-1 or the local emergency number if not already done.

TIP: *Wash hands with soap and water after giving care.*

BURNS

AFTER CHECKING THE SCENE AND THE INJURED OR ILL PERSON:

1 REMOVE FROM SOURCE OF BURN

2 COOL THE BURN

Cool the burn with cold running water at least until pain is relieved.



3 COVER LOOSELY WITH STERILE DRESSING



4 CALL 9-1-1

CALL 9-1-1 or the local emergency number if the burn is severe or other life-threatening conditions are found.

5 CARE FOR SHOCK

POISONING

AFTER CHECKING THE SCENE AND THE INJURED OR ILL PERSON:

1 CALL 9-1-1 OR POISON CONTROL HOTLINE

For life-threatening conditions (such as if the person is unconscious or is not breathing, or if a change in the level of consciousness occurs), **CALL** 9-1-1 or the local emergency number.

OR

If the person is conscious and alert, **CALL** the National Poison Control Center (PCC) hotline at **1-800-222-1222** and follow the advice given.

2 PROVIDE CARE

Give **CARE** based on the conditions found.

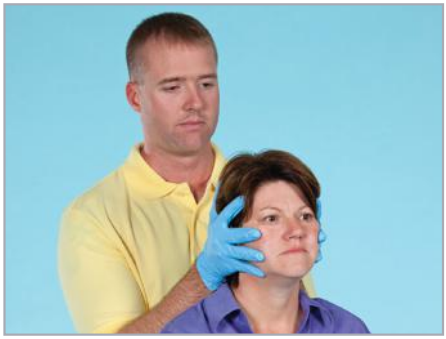
HEAD, NECK OR SPINAL INJURIES

AFTER CHECKING THE SCENE AND THE INJURED OR ILL PERSON:

1 CALL 9-1-1 OR THE LOCAL EMERGENCY NUMBER

2 MINIMIZE MOVEMENT

Minimize movement of the head, neck and spine.



3 STABILIZE HEAD

Manually stabilize the head in the position in which it was found.

- Provide support by placing your hands on both sides of the person's head.
- If head is sharply turned to one side, **DO NOT** move it.

STROKE

FOR A STROKE, THINK F.A.S.T.

AFTER CHECKING THE SCENE AND THE INJURED OR ILL PERSON:

1 THINK F.A.S.T.

Face— Ask the person to smile. Does one side of face droop?

Arm— Ask the person to raise both arms. Does one arm drift downward?

Speech— Ask the person to repeat a simple sentence (such as, "The sky is blue."). Is the speech slurred? Can the person repeat the sentence correctly?

Time— **CALL 9-1-1** immediately if you see any signals of a stroke. Try to determine the time when signals first appeared. Note the time of onset of signals and report it to the call taker or EMS personnel when they arrive.





2 PROVIDE CARE

Give **CARE** based on the conditions found.

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Appendix D

QUALITY ASSURANCE PROJECT PLAN

Former Dover Electronics Site
Kirkwood, New York
NYSDEC Site No. 7-04-026






VERINA Engineering, P.C.

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1.0 – INTRODUCTION

This Quality Assurance Project Plan (QAPP) details the overall approach to quality assurance activities with respect to the implementation of the Site Management Plan (SMP) for the former Dover Electronics Site, Kirkwood, Broome County, New York, New York State Department of Environmental Conservation (NYSDEC) Site No. 7-24-076 (the Site).

1.1 – Site Location and Description

The Site is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York and is identified as Section 162.01, Block 1, and Lot 8 on the Town of Kirkwood, Broome County, New York Assessor's Tax Map (see Figure 3 of the SMP).

The Site is an approximately 9.58 acres in size and is occupied by a one-story building along with associated asphalt parking areas and vegetated areas. The Site is bound to the northeast, southeast and southwest by Industrial Park Drive, and to the northwest by Colesville Road. The properties in the vicinity of the Site are primarily industrial and commercial properties and a major highway. The properties immediately south of the Site include truck stops and auto/truck services; immediately north of the Site a commercial property and a major highway; and, immediately to the east and to the west of the Site include industrial and commercial properties.

1.2 – Description of OM&M Areas

Since remaining contamination exists at the Site, institutional controls (ICs) and engineering controls (ECs) have been established at the Site in order to protect human health and the environment. Each of these ICs and ECs has specific operation, maintenance and monitoring (OM&M) requirements. The ICs and ECs which have been established for the Site include the following:

- ICs – A deed notice with environmental restrictions for eight (8) areas at the Site.
- ECs - An active sub-slab depressurization (ASD) system, a soil cap system and an in-situ chemical oxidation (ISCO) groundwater remediation system.

Each of these ICs and ECs are described below.

1.2.1 – Deed Restriction and Soil Cap Areas

There are eight (8) areas at the Site where soils remain impacted by chlorinated volatile organic compounds (VOCs). To eliminate the potential for human contact with the remaining contaminated soil, a surface cover system was implemented as an engineering control in these deed restriction areas. Each of these areas is covered by asphalt, concrete or a minimum of 3 feet of clean soil with vegetation.

These areas will be inspected monthly to check that the cap is maintained in good condition. With respect to asphalt and concrete caps, the area surface will be visually checked for subsidence/settlement, excessive wear and/or cracking, and for breaches (such as pot holes). Areas with soil cover will be checked for subsidence/settlement, missing vegetative cover and/or excessive erosion. Construction activities (authorized or unauthorized) that have or may interfere with cap integrity will be noted.

If capped surfaces are found to be in unsatisfactory condition during inspections, site management will be notified and cap patches and repairs will be made, as warranted, with suitable material(s) that meet DER-10's definition of unrestricted, clean soil . The locations of the deed restriction and soil cap areas are presented on Figure 8 of the SMP.

1.2.2 – ASD System

The ASD system is comprised of eight (8) PVC extraction points equipped with U-tube vacuum gauges connected to a ventilation fan along the exterior portion of the building along with a power switch. One fan was installed and is used to operate the ASD system. This fan operates the eight sub-slab extraction points through a manifold setup. The fan is an exterior mount Radonaway® brand HS series HS5000 fan. The fan is Underwriter's Laboratory (UL)-approved for outdoor use (UL standard 507) and meets all electrical code requirements. All ASD system electrical components are UL listed or of equivalent specifications. All plastic vent pipes and fittings are made of Schedule 40 PVC.

The ASD system is essentially self-operating and does not require adjustments and operates as either on or off. The ASD system includes mechanisms to monitor system performance and warn of system failure (shut off).

The ASD system has only one mechanical part: the ventilation fan installed in June 2003, and replaced in June 2015. The fan does not require maintenance and has an expected operational life of 7 to 8 years. Other system components, such as piping, gauges, and wiring, could be inadvertently damaged or broken by other site activities. During inspections, these features will be checked for damage. Broken or damaged parts of the system will be repaired or replaced.

The ASD system will be inspected monthly to verify that it is operating and vacuum readings collected from each of the system's extraction points shall be recorded during the monthly inspection.

1.2.3 – ISCO Remediation System

Full-scale implementation of the ISCO injection system began in June and July 2011. The full scale ISCO system consisted of the injection of a 5% solution of sodium permanganate delivered by a gravity-feed system in the source area and manual injection downgradient of the source area. The ISCO injection system includes a 6,500-gallon high-density polyethylene (HDPE) double wall vertical above-ground storage tank (AST), distribution box and associated pipes and fittings installed at the site. The AST was equipped with the following: 1) leak detection sensor; 2) heat tracing elements and insulation; 3) level switches; and 4) required piping and appurtenances. Each injection well was connected to the distribution box by a 1-inch diameter HDPE pipe.

Due to failure of the AST system's piping in December 2013, with NYSDEC's approval, all ISCO injections starting in 2014 are conducted manually on a monthly basis and utilize a 10% sodium permanganate solution. Monthly ISCO tank inspection also occurs to verify the condition of the tank and surrounding areas.

2.0 – PROJECT DESCRIPTION

Sampling protocols to be followed during OM&M activities are described in Section 8 of this QAPP.

The QAPP has been prepared for the use of field personnel. The field personnel will have the following responsibilities and duties while performing work required by the OM&M Plan:

- perform field procedures and sample collection associated with the investigations as set forth in the Work Plan;
- perform field analyses and collect quality assurance (QA) samples;
- calibrate, operate, and maintain field equipment;
- reduce field data;
- maintain sample custody; and
- prepare field records and logs.

3.0 – DATA QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT

The overall objectives of the QAPP are:

- To provide data to support performance evaluation of the ASD system (engineering control), which is being operated to reduce the potential for exposure to VOC vapors in excess of acceptable concentrations;

- To provide data to evaluate the effectiveness of the ISCO groundwater remediation program; and,

- To provide the proper procedures that will ensure the cap systems which cover the remaining areas of soil affected by VOC concentrations above NYSDEC standards continue to function effectively.

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decisions made during site-related activities and are based on the end uses of the data to be collected. Preliminary DQOs were identified to confirm that the data generated during field investigations will be of adequate quality and sufficient quantity to form a sound basis for decision making relative to the above objectives.

A DQO summary for the sampling investigation efforts is presented in the subsequent sections. The summary consists of stated DQOs relative to data uses, data types, data quantity, sampling and analytical methods, and data measurement performance criteria.

Three data categories have been defined to address various analytical data uses and the associated QA/QC effort and methods required to achieve the desired levels of quality. These categories are described below:

Screening Data: Screening data affords a quick assessment of site characteristics or conditions. This objective for data quality is applicable to data collection activities that involve rapid, non-rigorous methods of analysis and quality assurance. This objective is generally applied to physical and/or chemical properties of samples, degree of contamination relative to concentration differences, and preliminary health and safety assessment.

Confirmation Data: Confirmation data provides quantitative data for decision making but can be relatively less precise than more rigorous definitive data. Confirmation data is generated using laboratory analytical methods. This objective for data quality is available for data collection activities that require quantitative verification of field screening data where the verification process can rely on less rigorous laboratory-based methods and reporting.

Definitive Data: Definitive data are generated using analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files.

Only definitive data is needed to satisfy the requirements of the OM&M Plan for the site ICs and ECs.

4.0 – SPECIAL TRAINING REQUIREMENTS/CERTIFICATIONS

In compliance with the Occupational Safety and Health Administration's (OSHA's) final rule, "Hazardous Waste Operations and Emergency Response," 29CFR∋1910.120(e), all personnel performing ASD monitoring, soil cap inspections, manual ISCO injections and groundwater sampling activities at the Site will have completed the requirements for OSHA 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training along with annual 8-hour HAZWOPER refresher training. Persons in field supervisory positions will have also completed the additional OSHA 8-hour Supervisory Training.

5.0 – DOCUMENTATION AND RECORDS

5.1 – GENERAL

The ASD system inspections, the soil cap system inspections, the ISCO system inspections and the manual ISCO injections will all occur on a monthly basis. The groundwater sampling to monitor ISCO remediation progress will be conducted on an annual basis. Indoor air sampling to verify the effectiveness of the ASD system will be conducted on an annual basis. Examples of sample designations, documentation, and reporting requirements are presented below.

5.2 – SAMPLE DESIGNATION SYSTEM

During the monthly ASD inspection events, vacuum readings will be collected from each of the eight extraction points. The designation for each vacuum reading are as follows:

ASD-1, ASD-2, ASD-3, ASD-4, ASD-5, ASD-6, ASD-7, ASD-8

Each extraction point location is clearly labeled and is shown on Figure 7 of the attached SMP.

Additionally, seven indoor air samples and one ambient, outdoor background air sample will be collected at the Site on an annual basis to verify the effectiveness of the ASD system. The sample locations, as shown on Figure 7 of the SMP, will consist of the following:

- Indoor air: A/C Area, Computer Servers, Hallway, Cafeteria, Electrical Area, Office Area #1 and Office Area # 2
- Ambient Air: Background

The individual air sample designations will consist of the sample location plus the date on which the sample was collected in MMDDYY format. For example, and indoor air sample collected from the Hallway location on August 8, 2019 would be designated “Hallway 080819.”

Monthly soil cap inspections will be conducted to check that the caps are maintained in good condition. The designations of the eight capped areas and the type of cap are listed below and shown on Figure 8 of the attached SMP.

1. 1978 and 1984 Building Addition area – 6 inch thick concrete slab
2. Area 1 – soil, mulch, and landscaping
3. Area 2 –asphalt
4. Area 3 –soil with grass surface
5. Area 4 –soil with grass surface
6. Area 5 –soil with grass surface
7. Area 6 –soil with grass surface
8. Area 7 –asphalt

Groundwater samples will be collected from thirty groundwater monitoring wells and points, including:

MW-2, MW-3 ,MW-7A, MW-13, MW-14, MW-16, MW-17, MW-19, MW-22, MW-24, MW-25R, MW-26, MW-27, MW-28, MW-31, MW-32, MW-35, MW-38, MW-39, MP-3D, MP-4, MP-5, MP-6D, MP-6S, MP-8D, MP-8S, MP-11, MP-12, MP-13, and MP-14.

The sample designations of the individual samples will consist of the monitoring well or point ID plus the date in MMDDYY format. For example, a sample collected from well MW-16 on June 4, 2019 would be designated as "MW-16 060419."

5.3 – FIELD DOCUMENTATION

Field personnel will provide comprehensive documentation covering various aspects of field sampling, field analysis, and sample chain-of-custody. This documentation constitutes a record that allows reconstruction of field events to aid in the data review, interpretation and decision-making processes. Documents, records, and information relating to the performance of the field work will be retained in the project file.

The various forms of documentation to be maintained throughout the action include the following:

- Daily Production Documentation - A field logbook consisting of a waterproof, bound notebook that will contain a record of all activities performed at the site.

- Sampling Information - Detailed notes will be made as to the exact sampling location, sampling equipment, sample analyses, physical observations, and weather conditions (as appropriate). This information may be recorded in the field logbook or on specialized field logs.

- Sample Chain-of-Custody - Chain-of-custody (COC) forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. COC forms will be filled out at each sampling location or at the end of each day of sampling by field personnel responsible for sample custody. The COC will list all samples in the order in which they were collected. In the event that the samples are relinquished by the designated sampling person to other sampling or field personnel, the COC form will be signed and dated by the appropriate personnel to document the sample transfer. The original COC form will accompany the samples to the laboratory, and copies will be saved to the project file.

  Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

- Field Equipment, Calibration, and Maintenance Logs - To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory-calibrated.

5.4 – LABORATORY DOCUMENTATION FILES

5.4.1 – Laboratory Project Files

The analytical laboratory will establish a file for pertinent data. The file will include correspondence, faxed information, phone logs, and COC forms. The laboratory will retain project files and data packages for not less than a period of five (5) years.

5.4.2 – Laboratory Logbooks and Electronic Records

Workbooks, bench sheets, instrument logbooks, and instrument printouts will be used to trace the history of samples through the analytical process and to document important aspects of the work, including the associated quality controls. As such, logbooks, bench sheets, instrument logs, and instrument printouts will be part of the permanent record of the laboratory.

Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with a single stroke, without the use of white-out or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used will be completed by lining out unused portions.

Information regarding the sample, analytical procedures performed, and the results of the testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated and will also identify the analyst, the instrument used, and the instrument conditions.

Laboratory notebooks will be periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance to this QAPP. All entries and calculations will be verified by the laboratory group leader. If all entries on the pages are correct, then the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs.

All electronic files and deliverables will be maintained on magnetic tape or disk for not less than five (5) years; hard copy data packages (or electronic copies) will be maintained in the files for five (5) years.

5.5 – DATA REPORTING REQUIREMENTS

5.5.1 – Field Data Reporting

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field logbooks or specialized field logs and/or on forms. Such data will be reviewed by the appropriate Task Manager. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

The original field logbook(s), field logs, documents, and data reductions will be kept in the project file at the VERINA office in Bridgewater, New Jersey.

5.5.2 – Laboratory Data Reporting

The laboratory is responsible for preparing data packages for site-specific parameter list (SSPL) VOCs analyses for groundwater samples. The SSPL VOCs include: PCE, trichloroethene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), cis-1,2-Dichloroethene (c-1,2-DCE); trans-1,2-Dichloroethene (trans-1,2-DCE), 1,1-Dichloroethane (1,1-DCE) and Vinyl Chloride (VC). For air samples, the laboratory is responsible for preparing data packages for full VOCs analyses.

Laboratory data reports for all parameters will include, at a minimum, the following items:

Narrative: Summary of activities that took place during the course of sample analysis, including the following information:

- laboratory name and address;
- date of sample receipt;
- cross reference of laboratory identification number to contractor sample identification;
- analytical methods used;
- deviations from specified protocol; and
- corrective actions taken.

Included with the narrative will be any sample handling documents, including the original and internal COC forms, air bills, and shipping tags.

Analytical Results: Reported according to analysis type and including the following information, as acceptable:

- sample ID;
- laboratory sample ID;
- date of collection;
- date of receipt;
- date of extraction;
- date of analysis; and
- detection limits.

Sample results on the report forms will be corrected for dilutions. Unless otherwise specified, results will be reported uncorrected for blank contamination.

6.0 – SAMPLING METHOD REQUIREMENTS

All water matrices samples will be collected in laboratory-supplied glassware, packaged on ice, and shipped to ALS Environmental (formerly Columbia Analytical Services, Inc.), of Rochester, New York (New York Laboratory Certification 10145) for analysis. These samples will be analyzed for SSPL VOCs using United States Environmental Protection Agency (USEPA) Method 8260C.

All air matrices samples will be collected in laboratory-supplied Summa canisters and will be shipped to ALS Environmental of Simi Valley, California (New York Laboratory Certification 11221) and will be analyzed for VOCs using USEPA Method TO-15.

7.0 – SAMPLE HANDLING AND CUSTODY REQUIREMENTS

7.1 – SAMPLE CONTAINERS AND PRESERVATION

Appropriate sample containers, preservation methods, and laboratory holding times for OM&M samples are shown in Table 1.

The analytical laboratory will supply appropriate sample containers and preservatives, as necessary. The bottles will be purchased pre-cleaned according to USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9240.05A requirements. The field personnel will be responsible for properly labeling containers and preserving samples (as appropriate).

7.2 – FIELD CUSTODY PROCEDURES

The objective of field sample custody is to assure that samples are not tampered with from the time of sample collection through the time of transport to the analytical laboratory. Persons will have "custody of samples" when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

Field custody documentation consists of the field COC form.

7.2.1 – Field Logbooks

Field logbooks will provide the means of recording the data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel during all field activities but will be stored in a secure location when not in use. Each logbook will be identified by the project number and book number, if multiple books exist for the Site. The title page of each logbook will contain the following:

- person or company to whom the logbook is assigned;
- logbook number;
- project name;
- project number;
- logbook start date; and
- logbook end date.

The logbook must accompany field staff each and every time they are on-site. Entries into the logbook will contain a variety of information and will be made on a daily basis for each day on-site. At the beginning of each entry, the date, field objective, weather, start time and the names of all field personnel and subcontractors present. Additionally, the person making the entry will initial the bottom of each logbook page once that page is complete and the signature of the person making the entry will be entered at the end of each day, once all field personnel are off-site. The names of visitors to the Site, including field personnel and subcontractors, and the

purpose of their visit will also be recorded in the field logbook. Lastly, each page of the field book must be numbered at the bottom center of each page.
Measurements made and samples collected will be recorded in the field logbook or on specialized field logs. Entries will be made in ink, and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed by the personnel correcting the entry. All equipment used to make measurements will be identified.

Samples will be collected following the sampling procedures documented in Section 8. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume, and number of containers and preservative used in sample containers, if applicable, within the field logbook. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

7.2.2 – Sample Labeling

Preprinted sample labels will be affixed to sample bottles immediately prior to sampling. The following information is required on each sample label:

- Project name or project number;
- date collected;
- time collected;
- sampler's initials;
- analysis to be performed;
- preservative (if any); and
- sample ID.

The sample labels will be completed using waterproof ink and will be affixed to each sample bottle.

7.2.3 – Field Chain of Custody Forms

Completed COC forms will be required for all samples to be analyzed by the laboratory. The COC forms will be generated by the laboratory and will be signed by the sampling crew in the field upon transfer of sample custody. The COC forms will contain the unique sample identification number(s), sample date(s) and time(s), sample matrix, preservation (if any) and analyses required. The original COC form will accompany the samples to the laboratory. Copies of the COC will be made prior to shipment (or multiple copy forms used) for field documentation. The COC forms will remain with the samples at all times. The samples and signed COC forms will remain in the possession of the field personnel until the samples are delivered to the express carrier (e.g., Federal Express), or hand delivered to a mobile or permanent laboratory, or placed in secure storage.

Whenever samples are split with a government agency or other party, a separate COC will be prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

7.3 – MANAGEMENT OF OM&M-DERIVED MATERIALS AND WASTES

Disposable equipment and small debris/rubbish will be collected in trash bags and removed from the Site subsequent to each field event. Purged groundwater, large debris and decontamination rinsate (e.g., distilled water containing small amounts of solvent) will be containerized during the sampling events, labeled, and staged on-site for future off-site disposal.

7.4 – PACKING, HANDLING, AND SHIPPING REQUIREMENTS

Sample packaging and shipment procedures are designed to ensure that the samples will arrive at the laboratory, with the COC and sample bottles intact. The samples will be packaged for shipment as outlined below:

- Complete sample label with the following information: project name or number, sample ID, sample matrix, sampler initials, analyses required, date and time sampled, and preservative added (if applicable);
- Ensure that sample containers have the sample labels securely affixed to the container;
- Check the caps on the sample containers to ensure that they are properly sealed;
- Complete the COC form with the required sampling information and ensure that the recorded information matches the sample labels. NOTE: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the COC prior to this transfer. The appropriate personnel will sign and date the COC form to document the sample custody transfer;
- Using duct tape, secure the outside drain plug at the bottom of the cooler, if it has one;
- Place each sample container or package in an individual polyethylene bags and seal with clear packing tape;
- Place 1 to 2 inches of cushioning material at the bottom of the cooler;
- Place the sealed sample containers upright into the cooler;
- Place ice in plastic bags and seal with clear packing tape, place loosely in the cooler;
- Fill the remaining space in the cooler with cushioning material;
- Place COC forms in a plastic bag and seal with clear packing tape, and tape this plastic bag to the inside of the cooler lid;
- Close the lid of the cooler, lock, and secure with duct tape or packing tape by wrapping both ends of the cooler at least twice; and
- Mark the cooler on the outside with the following information: shipping address, return address, "Fragile" labels, and arrows indicating “this side up,” place a signed custody seal over the cooler lid where it meets the cooler body, and cover both the labels and custody seal with clear packing tape.

Samples will be packaged by the field personnel and transported as low-concentration environmental samples. The samples will be delivered by an express carrier within 48 hours of the time of collection. Shipments will be accompanied by the COC form identifying the contents. The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading will be used.

Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the COC form as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage.

7.5 – LABORATORY CUSTODY PROCEDURES

7.5.1 – General

Upon sample receipt, laboratory personnel will be responsible for sample custody. The original COC form will accompany all samples requiring laboratory analysis. The laboratory will use COC guidelines described in the USEPA guidance documents. Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for documenting and maintaining sample integrity.

7.5.2 – Sample Receipt and Storage

Immediately upon sample receipt, the laboratory sample custodian will verify the package seal, open the package, and compare the contents against the field COC. If a sample container is received broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, Dover or Dover's representative consulting firm will be notified. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

7.5.3 – Sample Analysis

Analysis of an acceptable sample will be initiated by worksheets that contain all pertinent information for analysis. The analyst will sign and date the laboratory COC form when removing the samples from storage.

Samples will be organized into sample delivery groups (SDGs) by the laboratory. A SDG may contain up to 20 field samples (field duplicates, trip blanks, and rinse blanks are considered field samples for the purposes of SDG assignment). All field samples assigned to a single SDG shall be received by the laboratory over a maximum of 7 calendar days and must be processed through the laboratory (preparation, analysis, and reporting) as a group.

Each SDG will be self-contained for all of the required quality control samples. All parameters within an SDG will be extracted and analyzed together in the laboratory. These rules for analysis will ensure that the QC samples for an SDG are applicable to the field samples of the same SDG and that the best possible comparisons may be made.

7.5.4 – Sample Storage Following Analysis

Samples will be maintained by the laboratory for one month after the final report is delivered to Dover. After this period, the laboratory is responsible for the disposal of the samples. Unused portions of the samples, sample extracts, and associated wastes will be disposed of by the laboratory in accordance with applicable rules and regulations, as specified in their Standard Operating Procedure for waste disposal.

8.0 – QUALITY ASSURANCE/QUALITY CONTROL REQUIRMENTS

8.1 – QUALITY ASSURANCE INDICATORS

The overall quality assurance objective for this QAPP is to develop and implement procedures for sampling, COC documentation, laboratory analysis, instrument calibration, data reduction and reporting, internal quality control, audits, preventive maintenance, and corrective action so that valid data will be generated. These procedures are presented or referenced in the following sections of the QAPP. Specific QC checks are discussed in Section 8.2.

Quality assurance indicators are generally defined in terms of five parameters:

1. Representativeness
2. Comparability
3. Completeness
4. Precision
5. Accuracy

Each parameter is defined below. Specific objectives for the site actions are set forth in other sections of this QAPP, as referenced below.

8.1.1 – Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions and is dependent on sampling and analytical variability and the variability of environmental media at the site. The actions have been designed to assess the presence of the chemical constituents at the time of sampling. This QAPP presents field sampling methodologies and laboratory analytical methodologies. The use of the prescribed field and laboratory analytical methods, with associated holding times and preservation requirements, are intended to provide representative data.

8.1.2 – Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between phases of the actions (if additional phases are required) will be maintained through consistent use of the sampling and analytical methodologies set forth in this QAPP and through the use of established QA/QC procedures and the utilization of appropriately trained personnel.

8.1.3 – Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results, as discussed in Section 8.6.

8.1.4 – Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize precision, sampling and analytical procedures will be followed. All work for the site actions will adhere to

established protocols presented in the QAPP. Checks for analytical precision will include the analysis of matrix spike, matrix spike duplicates, laboratory duplicates, and field duplicates. Checks for field measurement precision will include obtaining duplicate field measurements. Further discussion of precision QC checks is provided in Section 8.4.

8.1.5 – Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, matrix spikes, blank spikes, and surrogate standards will be used to assess the accuracy of the analytical data.

8.2 – FIELD QUALITY CONTROL CHECKS

8.2.1 – Field Measurements

To verify the quality of data using field instrumentation, duplicate measurements will be obtained and reported for all field measurements. A duplicate measurement will involve obtaining measurements a second time at the same sampling location.

8.2.2 – Sample Containers

Certified-clean sample containers (I-Chem 300 Series or equivalent) will be supplied by the laboratory. Certificates of analysis will be filed in the project file.

8.2.3 – Field Duplicates

Field duplicates will be collected for groundwater matrices to verify the reproducibility of the sampling methods. Field duplicates will be prepared by placing well homogenized aliquots from the same sample location into individual sample containers, which are submitted blind to the laboratory. In general, field duplicates will be analyzed at a 10% frequency (one per every 10 samples) and will be analyzed for SSPL VOCs via USEPA Method 8260C. Appropriate sample containers, preservation methods, and laboratory holding times for field duplicate samples are shown in Table 1. Field duplicate samples will not be collected for air matrix samples.

8.2.4 – Rinse Blanks

Rinse blanks are used to monitor the cleanliness of the sampling equipment and the effectiveness of the cleaning procedures. Rinse blanks will be prepared and submitted for analysis once per sampling date during groundwater sampling events. Rinse blanks will be prepared by filling sample containers with analyte-free water (supplied by the laboratory) that has been routed through a cleaned sampling device. When dedicated sampling devices are used or sample containers are used to collect the samples, rinse blanks will not be necessary. For this site, rinse blanks will be collected once per day for each groundwater sampling event and will be analyzed for SSPL VOCs via USEPA Method 8260C. Appropriate sample containers, preservation methods, and laboratory holding times for rinse blank samples are shown in Table 1. Rinse blanks will not be collected for air matrix samples.

8.2.5 – Trip Blanks

Trip blanks will be used to assess whether site samples have been exposed to non-site-related volatile constituents during sample storage and transport. Trip blanks will be submitted at a frequency of once per SDG of aqueous samples to be analyzed for SSPL VOCs only via USEPA Method 8260C. A trip blank will consist of a container filled with analyte-free water (supplied by the laboratory) which is supplied by the laboratory, remains unopened with field samples throughout the sampling event and is submitted for analysis along with the OM&M samples. Appropriate sample containers, preservation methods, and laboratory holding times for trip blank samples are shown in Table 1. Trip blanks will not be collected for air matrix samples.

8.3 – ANALYTICAL LABORATORY QUALITY CONTROL CHECKS

8.3.1 – General

Internal laboratory QC checks will be used to monitor data integrity. These checks will include method blanks, matrix spikes (and matrix spike duplicates), spike blanks, internal standards, surrogate samples, calibration standards, and reference standards. Project QC limits for duplicates, surrogate standards, matrix spikes (MS) and matrix spike duplicates (MSD) are identified below. Laboratory control charts will be used to determine long-term instrument trends.

Parameter	Accuracy - % Recovery		Precision – RPD	
	MS/MSD	Surrogate	MS/MSD	Field Duplicate
Water Matrix				
SSPL Volatile Organic Compounds	72-159	73-125	30	30
Air Matrix				
Volatile Organic Compounds	N/A	70-130	N/A	N/A

8.3.2 – Method Blanks

Sources of contamination in the analytical process, whether specific analyses or interferences, need to be identified, isolated, and corrected. The method blank is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank is initiated at the beginning of the analytical process and encompasses all aspects of the analytical work. As such, the method blank would assist in accounting for any potential contamination attributable to glassware, reagents, instrumentation, or other sources that could affect sample analysis. One method blank will be analyzed with each analytical series associated with no more than 20 samples.

8.3.3 – Surrogate Spikes

Surrogates are compounds that are unlikely to occur under natural conditions that have properties similar to the analytes of interest. This type of control is primarily used for organic samples analyzed by gas chromatography/mass spectrometry (GC/MS) and gas chromatography (GC) methods and is added to the samples prior to purging or extraction. The surrogate spike is utilized to provide broader insight into the proficiency and efficiency of an analytical method on a sample-specific basis. This control reflects analytical conditions that may not be attributable to sample matrix.

If surrogate spike recoveries exceed specified QC limits, then the analytical results need to be evaluated thoroughly in conjunction with other control measures. In the absence of other control measures, the integrity of the data may not be verifiable and reanalysis of the samples with additional control measures may be necessary. Surrogate spike compounds will be selected utilizing the guidance provided in the analytical methods.

8.3.4 – Calibration Standards

Calibration check standards analyzed within a particular analytical series provide insight regarding instrument stability. A calibration check standard will be analyzed at the beginning and end of an analytical series, or periodically throughout a series containing a large number of samples.

In general, calibration check standards will be analyzed after every 12 hours, or more frequently, as specified in the applicable analytical method. If results of the calibration check standard exceed specified tolerances, then samples analyzed since the last acceptable calibration check standard will be reanalyzed.

Laboratory instrument calibration standards will be selected utilizing the guidance provided in the analytical methods summarized in Section 13.

8.3.5 – Reference Standards/Control Samples

Reference standards are standards of known concentration and independent in origin from the calibration standards. The intent of reference standard analysis is to provide insight into the analytical proficiency within an analytical series. This includes the preparation of calibration standards, the validity of calibration, sample preparation, instrument set-up, and the premises inherent in quantitation. Reference standards will be analyzed at the frequencies specified within the analytical methods.

8.4 – DATA PRECISION ASSESSMENT PROCEDURES

Field precision is difficult to measure because of temporal variations in field parameters. However, precision will be controlled through the use of experienced field personnel, properly calibrated meters, and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system, including sampling, handling, shipping, storage, preparation, and analysis.

Laboratory data precision will be monitored through the use of matrix spike/matrix spike duplicate and laboratory duplicate sample analyses. Matrix spike/matrix spike duplicate samples will be collected for water matrices in the field at a frequency one one per every 20 samples. Matrix spike/matrix spike duplicates will not be collected for air matrices.

The precision of data will be measured by calculation of the relative percent difference (RPD) by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = Analytical result from one of two duplicate measurements; and
B = Analytical result from the second measurement.

Precision objectives for duplicate analyses are identified in Section 8.3.1.

8.5 – DATA ACCURACY ASSESSMENT PROCEDURES

The accuracy of field measurements will be controlled by experienced field personnel, properly calibrated field meters, and adherence to established protocols. The accuracy of field meters will be assessed by review of calibration and maintenance logs.

Laboratory accuracy will be assessed via the use of laboratory matrix spikes, surrogate spikes, and reference standards. Where available and appropriate, QA performance standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

$$\% \text{ Recovery} = \frac{A-X}{B} \times 100$$

Where:

A = Value measured in spiked sample or standard;
X = Value measured in original sample; and
B = True value of amount added to sample or true value of standard.

This formula is derived under the assumption of constant accuracy between the original and spiked measurements. Accuracy objectives for matrix spike recoveries are identified in Section 8.3.1.

8.6 – DATA COMPLETENESS ASSESSMENT PROCEDURES

Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90%. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

9.0 – INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE REQUIREMENTS

9.1 – GENERAL

Testing and maintenance schedules have been developed for both field and laboratory instruments. A summary of the testing and maintenance activities to be performed is presented below.

9.2 – FIELD INSTRUMENTS AND EQUIPMENT

VERINA rents the majority of its sampling equipment from Pine Environmental Services, and all rented equipment will be initially calibrated and maintained by Pine. Prior to any field sampling, each piece of field equipment will be inspected to assure it is operational. If the equipment is not operational, it must be serviced or replaced prior to use. All meters that require charging or batteries will be fully charged or have fresh batteries. If instrument servicing is required, it is the responsibility of the appropriate Task Manager or field personnel to follow the maintenance schedule and arrange for prompt service or replacement. Additionally, each piece of field equipment will be calibrated daily by trained field personnel when in use on site.

Field instrumentation to be used in this study include a photoionization detector (PID) to measure organic vapors, multi-parameter water quality meters to measure pH, dissolved oxygen, oxidation-reduction potential, conductivity, turbidity, and temperature and water level meters to determine depth to water in the Site's wells. A logbook will be kept for each field instrument which is owned by VERINA. Each logbook will contain records of operation, maintenance, calibration, problems, and repairs. The VERINA Task Managers will review calibration and maintenance logs.

Field equipment returned from a site will be inspected to confirm it is in working order. This inspection will be recorded in the instrument's logbook or field logbooks as appropriate. It will also be the obligation of the last user to record any equipment problems in the logbook.

Non-operational field equipment will be either repaired or replaced. Appropriate spare parts will be made available for field meters.

9.3 – LABORATORY INSTRUMENTS AND EQUIPMENT

9.3.1 – General

All laboratory instruments and equipment repair and maintenance shall be documented. Documentation will include details of any observed problems, corrective measure(s), routine maintenance, and instrument repair (which will include information regarding the repair and the individual who performed the repair).

Preventive maintenance of laboratory equipment generally will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house staff or through a service call from the manufacturer.

9.3.2 – Instrument Maintenance

Maintenance schedules for laboratory equipment will adhere to the manufacturer's recommendations. Records will reflect the complete history of each instrument and specify the time frame for future maintenance. Major repairs or maintenance procedures will be performed through service contracts with the manufacturer or qualified contractors. Paperwork associated with service calls and preventative maintenance calls will be kept on file by the laboratory.

Laboratory Systems Managers are responsible for the routine maintenance of instruments used in the particular laboratory. Any routine preventative maintenance carried out will be logged into the appropriate logbooks. The frequency of routine maintenance will be dictated by the nature of samples being analyzed, the requirements of the method used, and/or the judgment of the Laboratory Systems Manager.

All major instruments will be backed up by comparable (if not equivalent) instrument systems in the event of unscheduled downtime. An inventory of spare parts will also be available to minimize equipment/instrument downtime.

10.0 – INSTRUMENT CALIBRATION AND FREQUENCY

10.1 – FIELD INSTRUMENTS AND EQUIPMENT

Field personnel are responsible for ensuring that a master calibration/maintenance log is maintained following the procedures specified for each measuring device. Each log will include, at a minimum where applicable, the following:

- name of device and/or instrument calibrated;
- device/instrument serial/identification number;
- frequency of calibration;
- date(s) of calibration(s);
- results of calibration(s); and
- name of person(s) performing calibration(s).

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

Equipment to be used during the field sampling will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manual to ensure that all maintenance requirements are being observed. Field notes from previous sampling events will be reviewed to ensure that any prior equipment problems are not overlooked and that any necessary repairs to equipment have been carried out.

Calibration of field instruments will be performed at the intervals specified by the manufacturer, or more frequently as conditions dictate. Field instruments requiring calibration will include a PID and a multi-parameter water quality meter. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service. All readings and calibrations will be recorded in the field logbook or on specialized field logs.

10.2 – LABORATORY INSTRUMENT AND EQUIPMENT

When analyses are conducted according to the USEPA SW-846 methods, the calibration procedures and frequencies specified in the applicable method will be followed. For analyses governed by SOPs, see the appropriate SOP for the required calibration procedures and frequencies. Records of calibrations will be filed and maintained by the laboratory. These records will be subject to a QA audit. For all instruments, the laboratory will maintain trained repair staff with in-house spare parts or will maintain service contracts with vendors.

All standards used in the calibration of equipment are traceable, directly or indirectly, to National Institute of Standards and Technology (NIST). All standards received shall be logged into standard receipt logs maintained by the individual analytical groups. Each group shall maintain a standards log that tracks the preparation of standards used for calibration and QC purposes.

11.0 – DATA MANGEMENT

The purpose of data management is to ensure that all of the necessary data are accurate and readily accessible to meet the analytical and reporting objectives of the project. The field investigation will encompass a large number of samples and analytes from a large geographic area. From the large amount of resulting data, the need arises for a structured, comprehensive, and efficient program for management of data.

The data management program established for the project includes field documentation and sample QA/QC procedures, methods for tracking and managing the data, and a system for filing all site-related information. More specifically, data management procedures will be employed to efficiently process the information collected so that the data are readily accessible and accurate. These procedures are described in detail in the following sections.

The data management plan has three elements:

1. Sample designation system;
2. Field activities and data management, and
3. Sample tracking and management.

11.1 – SAMPLE DESIGNATION SYSTEM

A concise and easily understandable sample designation system is an important part of the project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy resampling of select locations to evaluate data gaps, if necessary. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sample collected, as outlined in Section 5.2.

11.2 – FIELD ACTIVITIES AND DATA MANAGEMENT

Field activities designed to gather the information necessary to make decisions regarding the offsite areas require consistent documentation and accurate record keeping. During site activities, standardized procedures will be used for documentation of field activities, data security, and QA. These procedures are described in further detail in the following subsections.

11.2.1 – Field Documentation

Complete and accurate record keeping is a critical component of the field activities. When interpreting analytical results and identifying data trends, investigators realize that field notes are an important part of the review and validation process. To ensure that the field activities are thoroughly documented, several different informational records, each with its own specific reporting requirements, will be maintained for the Site, including the following:

- field logbook;
- specialized field logs; and,
- chain-of-custody forms.

A description of each of these types of field documentation is provided below.

Field Logbook

The personnel performing the field activities will record pertinent site information, observations, measurements, sampling information and events directly into the field logbook, which is a site-dedicated, bound notebook. Additional details regarding entries into the field logbook are described in Section 7.2.1 above.

Specialized Field Logs

The personnel performing the field activities may also use specialized logs for the ASD inspection, indoor air sampling, ISCO inspection, ISCO injection and/or groundwater monitoring events. All observations and measurements made during such field events may be recorded onto these logs. At minimum, any analytical samples collected must have the pertinent sampling information recorded into the field logbook in addition to the specialized field log, including sample ID, sample date, sample time, sampler, sample analyses, sample bottle ware, and preservation requirements, if any. The original specialized field logs will be kept in the project folder. Examples of such specialized field logs are included in Appendix D of the attached SMP.

Chain-of-Custody Forms

COC forms are used as a means of documenting and tracking sample possession from time of collection to the time of disposal. The COC forms will be generated by the laboratory and will accompany each field sample collected, and one copy of the form will be filed in the project folder. All field personnel will be briefed on the proper use of the COC procedure. Additional details on the COC procedure can be found in Section 7.2.3 above.

11.2.2 – Data Security

Measures will be taken during the field activities to ensure that samples and records are not lost, damaged, or altered. When not in use, all field logbooks and specialized field logs will be stored at the office or locked in the field vehicle. Access to these files will be limited to the field personnel who utilize them.

11.3 – SAMPLE MANAGEMENT AND TRACKING

A record of all field documentation, as well as analytical and QA/QC results, will be maintained to ensure the validity of data used in the site analysis. To effectively execute such documentation, carefully constructed sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of COC forms. The completed COC forms associated with samples collected accompany the samples. Copies of all completed COC forms will be maintained within the project folder in the office. The laboratory shall verify receipt of the samples via fax or e-mail within two days of receipt.

When analytical data are received from the laboratory, the incoming analytical data packages should be reviewed against the information on the COCs to confirm that the correct analyses were performed for each sample and that results for all samples submitted for analysis were received. Any discrepancies noted must be promptly followed-up with the laboratory.

12.0 - DATA REVIEW, VALIDATION AND VERIFICATION

12.1 – GENERAL

After field and laboratory data are obtained, the data will be subject to the following:

- Reduction, or manipulation mathematically or otherwise, into meaningful and useful forms;
- Review;
- Organization, interpretation, and reporting; and
- Data validation, if warranted.

12.2 – FIELD DATA REDUCTION AND REVIEW

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field logbooks and/or specialized field logs. Such data will be reviewed by the appropriate Task Manager for adherence to the OM&M Plan and this QAPP and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

Field data calculations, transfers, and interpretations will be conducted by the field personnel and reviewed for accuracy by the appropriate supervisor. Logs and documents will be checked for the following:

- general completeness;
- readability;
- usage of appropriate procedures;
- appropriate instrument calibration and maintenance;
- reasonableness in comparison to present and past data collected;
- correct sample locations; and
- correct calculations and interpretations.

12.3 – LABORATORY DATA REDUCTION AND REVIEW

12.3.1 – Laboratory Data Reduction

The calculations used for data reduction will be specified in each of the analytical methods referenced previously. Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be entered into permanently bound laboratory notebooks. The data entered will be sufficient to document all factors used to arrive at the reported value.

Concentration calculations for chromatographic analyses will be based on response factors. Quantitation will be performed using either internal or external standards.

12.3.2 – Laboratory Data Review

Data will be subject to multi-level review by the laboratory. The group leader will review all data reports prior to release for final data report generation. The quality assurance manager will review the final data reports, and the laboratory director will review a cross section of the final data reports prior to shipment.

If discrepancies or deficiencies exist in the analytical results, then corrective action will be taken in accordance with laboratory policy. Deficiencies discovered as a result of internal data review, as well as the corrective actions to be used to rectify the situation, will be documented in the case narrative.

12.4 – DATA VALIDATION AND VERIFICATION

All data generated for health and safety and engineering design/control purposes will be subjected to the data validation and verification procedures outlined in Section 13, if warranted. Data generated for disposal purposes will not be reviewed. Initially a data usability review will be performed on the data.

13.0 – VALIDATION AND VERIFICATION METHODS

Data validation entails a review of the QC data and the raw data to verify that the laboratory was operating within required limits, the analytical results were correctly transcribed from the instrument read outs, and which, if any, environmental samples were related to any QC samples which were out of their laboratory control limits. The objective of data validation is to identify any questionable or invalid laboratory measurements.

No data validation is proposed at this time. However, data will be reviewed for usability. If validation should become warranted, the data will be validated using the most recent versions of the USEPA's and NYSDEC's data validation guidance documents. These procedures and criteria may be modified, as necessary, to address project-specific and method-specific criteria, control limits, and procedures.

Data validation will consist of data screening, checking, reviewing, editing, and interpretation to document analytical data quality and to determine whether the quality is sufficient to meet the data quality objectives. Data validation will include a review of completeness and compliance, including, but not limited to, the elements provided in Table 2.

The data validator will verify that reduction of laboratory measurements and laboratory reporting of analytical parameters is in accordance with the procedures specified for each analytical method and/or as specified in this QAPP. Any deviations from the analytical method or any special reporting requirements apart from that specified in this QAPP will be detailed on COC forms.

Upon receipt of laboratory data, the following procedures will be executed by the data validator:

- Evaluate completeness of the data package;
- Verify that field COC forms were completed and that samples were handled properly;
- Verify that holding times were met for each parameter. Holding time exceedances, should they occur, will be documented. Data for all samples exceeding holding time requirements will be flagged as either estimated or rejected. The decision as to which qualifier is more appropriate will be made on a case-by-case basis;
- Verify that parameters were analyzed according to the methods specified;
- Review QA/QC data (i.e., make sure duplicates, blanks, and spikes were analyzed on the required number of samples, as specified in the method; verify that duplicate and matrix spike recoveries are acceptable);
- Investigate anomalies identified during review. When anomalies are identified, they will be discussed with the Project Manager and/or Laboratory Manager, as appropriate; and
- If data appears suspect, investigate the specific data of concern. Calculations will be traced back to raw data; if calculations do not agree, the cause will be determined and corrected.

Deficiencies discovered as a result of the data review, as well as the corrective actions implemented in response, will be documented and submitted in the form of a written report addressing the following topics as applicable to each method:

- Assessment of the data package;
- Description of any protocol deviations;

- Failures to reconcile reported and/or raw data;
- Assessment of any compromised data;
- Overall appraisal of the analytical data; and
- Table of site name, sample quantities, matrix, and fractions analyzed.

It should be noted that qualified results do not necessarily invalidate data. The goal to produce the best possible data does not necessarily mean producing data without QC qualifiers. Qualified data can provide useful information.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the data validator. Suggestions for reanalysis may be made by the data validator at this point.

Tables

Table 1 - Sample Containers, Preservation and Holding Times- Former Dover Electronics, Kirkwood, New York

Parameter	USEPA Method	Bottle Type	Preservation	Holding Time*
Water Matrix				
SSPL Volatile Organic Compounds (clear water)	8260C	2-40ml glass vials with Teflon®-lined lid	HCl to pH<2 Cool to 4°C	14 days to analysis
SSPL Volatile Organic Compounds (pink or purple water)	8260C	2-40ml glass vials with Teflon®-lined lid	Cool to 4°C	7 days to analysis
Air Matrix				
Volatile Oganic Compounds	TO-15	1-6 L stainless steel Summa Canister	None	30 days

NOTES:

Water matrix samples which are clear in color will be collected in vials with HCl preservative; those with a pink or purple color will be collected in vials free of preservatives.

* All holding times are measured from date of collection.

SSL Volatile Organic Compounds = Tetrachloroethene, Trichloroethene, 1,1,1-Trichloroethane, 1,1-Dichloroethane, 1,1-Dichloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene, and Vinyl chloride.

ml = milliliter

L = liter

For water matrix samples only:

Trip blank samples are to be collected for VOCs only at a frequency of 1 per sample shipment (aka once per laboratory SDG).

Rinse blank samples are to be collected for each parameter analyzed at a frequency of 1 per sampling day.

Field duplicate samples are to be collected for each parameter analyzed at a frequency of 1 per every 10 field samples.

Matrix spike and matrix spike duplicate samples are to be collected for each parameter analyzed at a frequency of 1 per every 20 field samples.

Table 2 - Data Validation Checklist - Former Dover Electronics, Kirkwood, New York

Review for Completeness	
1.	All chain-of-custody forms included.
2.	Case narratives.
3.	QA/QC summaries of analytical data, including supporting documentation.
4.	All relevant calibration data, including supporting documentation.
5.	Instrument and method performance data.
6.	Documentation showing laboratory's ability to attain specified method detection limits.
7.	Data report forms of examples for calculations of concentrations.
8.	Raw data used in identification and quantification of the analysis required.
Review for Compliance	
1.	Data package completed as described above.
2.	QAPP requirements for data production and reporting have been met.
3.	QA/QC criteria have been met.
4.	Instrument type and calibration procedures have been met.
5.	Initial and continuing calibration have been met.
6.	Data reporting forms are completed.
7.	Problems and corrective actions documents.

Appendix E

Appendix E

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ACTIVE SUB-SLAB DEPRESSURIZATION (ASD) INSPECTION LOG

Former Dover Electronics Site, Kirkwood, NY (5101.0002)

Date	Time	System On? (Y/N)	Vaccum Reading (inches water)								Comments
			ASD-1	ASD-2	ASD-3	ASD-4	ASD-5	ASD-6	ASD-7	ASD-8	

NOTES:

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MONTHLY CAP INSPECTION CHECKLIST

Former Dover Electronics Site, Kirkwood, NY (5101.0002)

Date: _____

Personnel: _____

Item No.	Description	Yes	No	Actions	Comments
1	1978 Building Addition floor slab in good condition?				
2	1984 Building Addition floor slab in good condition?				
3	Area 1 (front employee entrance) landscape cover intact?				
4	Area 2 (driveway at north catch basin CB-2044) asphalt surface in good condition?				
5	Area 3 (transformer pad location) vegetative cover intact?				
6	Area 4 (drainage ditch along CR 181) in good condition?				
7	Area 5 (drainage ditch along CR 181) in good condition?				
8	Area 6 (drainage ditch along CR 181) in good condition?				
9	Area 7 (parking lot at southeast loading dock) asphalt surface in good condition?				
10	ASD system operational?				
11	ASD system vacuum readings normal?				
12	ASD system components in good condition?				

LOW FLOW GROUND WATER PURGE/SAMPLING LOG

Former Dover Electronics Site, Kirkwood, NY (5101.0002)

Project Name: Dover-Kirkwood Project #: 5101.0002 Page ____ of ____

Monitoring Well: _____ Date: _____

Field Personnel: _____ Weather: _____

PRE-PURGE INFO:

Well Depth (ft btoc): _____ Depth to Water (ft btoc): _____

PID Beneath PVC Cap (ppm) _____ Screened/Open Interval (ft btoc): _____

Pump Used: _____ Depth of Pump (ft btoc): _____

POST-PURGE INFO:

Color: _____ Mn/MnO_4 (mg/L): _____

Volume Purged (gal): _____ Sample ID: _____

Final Depth to Water (ft btoc): _____ Sample Time _____

WELL PURGE DATA:

Time 5 minute intervals	**Temperature (°C)**	**pH (units)**	**Conductivity (ms/cm)**	**REDOX (Eh-mV)**	**DO (mg/L)**	**Turbidity (NTU)**	**Depth to Water (ft)**	**Salinity (PPT)**	**Pumping Rate (ml/min)**	**Comment**
	Reading	Reading	Reading	Reading	Reading	Reading	Reading			
	3%	0.1 unit	3%	10 mV	10%	10%	0.3 ft		100 - 500	

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INDOOR/AMBIENT AIR SAMPLING LOG

Former Dover Electronics Site, Kirkwood, NY (5101.0002)

Date: _____ Personnel: _____

Weather: 40's F. Cloudy, cool Canister Type: 6.0 L Stainless Summa

Sample ID	Start Time	Start Canister Pressure	End Time	End Canister Pressure	Temperature (F)	Air Speed (mph)	Indoor/ Outdoor	Canister ID	Canister Size	Flow Control ID	Sample Height (ft)
Office Area #2											
Office Area #1											
Cafeteria											
Computer Servers											
A/C Area											
Electrical Area											
Hallway											
Background											

Comments:

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IN-SITU CHEMICAL OXIDATION INJECTION WELL AND SYSTEM INSPECTION LOG

Former Dover Electronics Site, Kirkwood, New York (5101.0002)

Date	Time	Personnel Initials	Condition						Comments
			ISCO AST Area	ISCO Distribution Box	ISCO AST	ISCO Trench Area	Electrical Meter Reading (kWh)	Liquid Level in AST (ft from manway)	

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Sch. 40 PVC conversion factors:
2" PVC = 0.171 gal/ft
4" PVC = 0.652 gal/ft
6" PVC = 1.484 gal/ft

SODIUM PERMANGANATE MANUAL INJECTION LOG

Project Number: 5101.0002 Personnel: _____

Weather: _____

Injection Solution Characteristics:

NaMnO4 Concentration (%): 40 Concentration of Injection Solution (%): 10

Date:									Total Injected Volume (gal)	Water Level (ft)	Comments
Tank #		1	2	3	4	5	6	7			
Injection Well ID	Target Volume (gal)	Volume Injected (gal)	Volume Injected (gal)	Volume Injected (gal)	Volume Injected (gal)	Volume Injected (gal)	Volume Injected (gal)	Volume Injected (gal)			
MW-7A	50										
MW-16	75										
MW-24	25										
MW-25R	75										
MW-28	75										
MP-4	75										
MP-5	50										
MP-8S	25										
MP-11	50										
MP-12	25										
MP-14	25										
IJ-1	75										
IJ-2	25										
IJ-5	25										
IJ-6	25										
IJ-7	50										
IJ-8	50										
Total Injected Volume	**0**										

Appendix F

Appendix F

APPENDIX F OF SMP: SITE-SPECIFIC FIELD ACTIVITIES PLAN

Site Name:	Former Dover Electronics Site
Scope of Work	Monthly ASD inspection, monthly ISCO injections, monthly ISCO system inspection, monthly soil cap system inspection, semi-annual groundwater monitoring and annual indoor air sampling
Work Location:	29 Industrial Park Drive, Kirkwood, Broome County, New York

PURPOSE:

The intent of this form is to ensure the project team members understand each field activity; have communicated with one another; and have reviewed applicable historical documentation that may affect the project. It is recommended that this plan be distributed and reviewed to all involved with the activity prior to conducting the activity.

THINGS TO REMEMBER:

1. **Review field work plan carefully and know the exact scope of work before heading to the job site. If you have any questions – ask for clarification.**
2. **Always review the site-specific health and safety plan before heading to the job site, and ensure this plan is kept in an accessible location while on-site.**
3. **Always conduct tailgate safety meetings at the beginning of each work day and maintain records of all safety meetings; go through the scope of work and identify common chemical, physical, and biological hazards associated with job content and specific job site during the daily tailgate safety meeting.**
4. **Wear proper PPE and clothing for the weather conditions and work**

The Former Dover Electronics site is currently under the site management phase as a result of a previous remedial action for soil and groundwater due to the former use of PCE at the site. Site management activities scheduled for this site are listed in the "Scope of Work" above and are detailed below.

Task 1 – ASD System Inspection

The ASD system will be checked to verify that it is running properly and that the equipment is in good condition. Vacuum readings and observations at each ASD system monitoring locations will be recorded on the ASD Inspection Log (see Figure 9 and Appendix E of the Site Management Plan [SMP]). The inspection of the ASD system includes observing and documenting the conditions of ASD system components and any structural changes or modifications to the buildings, as well as recording the pressure gauge measurements at each of the eight vapor extraction points.

Task 2 – Monthly ISCO Injections

On a monthly basis, a 10% sodium permanganate ISCO solution will be manually injected into 17 select wells. A target volume of 1,000 gallons is expected to be injected during each event. The ISCO solution will be stored in the 6,500 gallon AST at the site and transferred into a smaller 250-gallon "turtle tank", which will then be driven around the site to deliver the ISCO solution to the proper wells. The volume of solution injected into each well on a monthly basis will be recorded on the Sodium Permanganate Manual Injection Log provided in Appendix E of the SMP.

Task 3 – Monthly ISCO System Injections

The ISCO system AST will be inspected on a monthly basis during the ISCO injections. Components of the system to check are the integrity of the AST, its electrical components and secondary containment system, as well as the ISCO solution level prior to and after a given month's injection event. The ISCO system inspection information will be recorded on the In-Situ Chemical Oxidation Injection Well and System Inspection Log as provided in Appendix E of the SMP.

Task 4 – Monthly Soil Cap System Inspection

The soil cap system will be inspected to verify that soil and asphalt caps are in good place and in good condition on a monthly basis. Asphalt and concrete caps will be visually checked for subsidence/settlement, excessive wear and/or cracking, and for breaches (such as pot holes). Areas with soil cover are checked for subsidence/settlement, missing vegetative cover and/or excessive erosion. Upon inspecting these locations, recordings of findings will be recorded on the Monthly Cap Inspection Checklist log as provided in Appendix E of the SMP.

Task 5 - Groundwater Monitoring

All of the on-site wells will be initially gauged using a water level meter for groundwater elevation measurements. Upon completion of the gauging, select wells will have samples taken for SSPL VOC analysis as listed in Appendix D of the SMP. Analytical samples will be collected via the low-flow purging and sampling method utilizing bladder pumps. Groundwater conditions will be continuously monitored with a multi-parameter water quality meter with flow cell, a turbidity meter, and a water level meter. The groundwater conditions to be monitored include temperature, pH, specific conductivity, redox potential (ORP), dissolved oxygen, turbidity, salinity, depth to water, and pumping rate. These parameters are to be recorded every 5 minutes on the Low-Flow Groundwater Purge/Sampling log provided in Appendix E of the SMP. Additionally, color will also be noted as a field parameter. If a purple to pink color is noted at a particular monitoring well, manganese and permanganate concentration will be analyzed via a colorimeter. The wells will be purged until stabilization is achieved, then the sample will be collected. The groundwater samples are to be analyzed via USEPA Method 8260C for SSPL VOCs, which include: PCE; trichloroethene (TCE); 1,1,1-trichloroethane (1,1,1-TCA); 1,1-dichloroethene (1,1-DCE); cis-1,2-dichloroethene (1,2-DCE); trans 1,2-DCE; 1,1-dichloroethane (1,1-DCA); and vinyl chloride (VC). The bladder pump, water level probe, and flow control valve (if needed) will be decontaminated and the tubing will be discarded before moving on to the next well for sampling. The flow cell should also be rinsed out.

As part of the QA/QC procedures, one duplicate sample, on matrix spike sample, one matrix spike duplicate sample, one trip blank, and one field blank sample per sampling date will be collected during each sampling event. All samples will be collected in laboratory-supplied glassware, packaged on ice, and shipped to ALS Environmental (formerly Columbia Analytical Services, Inc.), of Rochester, New York (New York Laboratory Certification 10145) for analysis under chain-of-custody.

Task 6 – Annual Indoor Air Sampling

To verify the effectiveness of the ASD system, indoor and ambient air samples will be collected on an annual basis during March of each year. The sampling locations are presented on Figure 7 of the SMP. The air samples will be collected using laboratory-provided 6 liter stainless steel Summa canisters with flow controllers over an 8-hour sampling period. All relevant sampling information will be recorded on the Indoor/Ambient Air Sampling Log provided in Appendix E of the SMP. Samples will be submitted under chain-of-custody to ALS Environmental of Simi Valley, California (New York Laboratory Certification 11221) and will be analyzed for VOCs using USEPA Method TO-15.

Appendix G

Operations, Maintenance and Monitoring Plan Soil Operable Unit

Prepared for: Universal Instruments Corporation Kirkwood, New York

October 2005

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BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Transmitted Via Priority Mail

October 31, 2005

James A. Moras, Project Manager
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau D, 12th Floor
625 Broadway
Albany, NY 12233-7013

Re: Operations, Maintenance and Monitoring Plan – Soil Operable Unit
Universal Instruments, Kirkwood, Broome County, New York
NYSDEC Site No. 7-04-026

Dear Mr. Moras:

On behalf of Universal Instrument Corporation, Blasland, Bouck & Lee, Inc. (BBL) has prepared this Operations, Maintenance and Monitoring (OM&M) Plan for the Soil Operable Unit at the Universal Instruments Corporation (UIC) site in Kirkwood, New York. The OM&M Plan is supplemental to the March 2004 Soil Remedial Action Report submitted to the New York State Department of Environmental Conservation (NYSDEC) and conditionally approved by NYSDEC in a letter dated March 31, 2004.

OPERATIONS, MAINTENANCE AND MONITORING PLAN

Introduction

The OM&M Plan described below provides the guidance for checking and maintaining engineering controls at the site. The OM&M Plan includes procedures for documenting inspection and maintenance activities and any future changes that may occur to the engineering controls. Engineering controls at the site consist of two primary types: Cover systems that cap areas of remaining PCE-affected soil and an Active-Slab Depressurization (ASD) system that addresses indoor air quality within the facility building.

The purpose and objective of the OM&M Plan is provide for proper procedures that will ensure the cap systems covering remaining areas of soil affected by concentrations of contaminants of concern (COCs) above NYSDEC standards and the ASD system continue to function as effective engineering controls.

A summary of OM&M activities, the required performance frequency, and schedule is presented in Table 1.

Site Description

The former Dover facility is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. The facility is located on a site approximately 9.58 acres in size. A site location map is shown on Figure 1 and Figure 2 is the site plan.

The property is situated in an industrial setting. Major plants in the area include Truckstops of America Landfill (0.5 mile southeast), Frito Lay Plant (0.5 mile south), Universal Instruments (147 Industrial Park Drive, 0.5 mile east), Kason Industries (eastern property boundary), Consolidated Freightways (northern property boundary), and the newly developed Pilot Truck Stop to the south. Industrial properties surround the property to the north, east, and west. The site presently serves as one of Universal's service facilities with the site's uses including product training, research and development, and Odd Form Assembly (OFA), which involves the engineering and assembly of non-standard/specialty circuit boards.

Soil remediation activities conducted at the site during June and July 2003 were performed to mitigate PCE-affected soils in the unsaturated zone beneath and adjacent to the facility building at the site. The remedial action work included:

- abandonment and replacement of the roof leader from the roof drain system that handles stormwater runoff from the front part of the roof for the original building section of the facility;
- removal of specified soil from seven separate excavations;
- offsite transportation and disposal of non-hazardous and possible hazardous soil excavated;
- extension of the stormwater outfall from the southwest catch basin (CB-1547);
- restoration of excavated areas using compacted certified clean fill; and
- installation of an ASD system.

Deed Notice Areas

A deed notice with environmental restrictions was filed with the Broome County Clerk's Office to provide an institutional control for inaccessible soils that remain below facility floor slabs. The NYSDEC-approved deed notice was forwarded by UIC to the site owner on April 26, 2004 for signature and subsequent filing with the Broome County Clerk. The deed notice was filed by the Broome County Redevelopment Authority on October 20, 2005 (Attachment A).

The deed notice stipulates that there shall be no construction, use or occupancy of the property that results in the disturbance of the cover systems or which will result in human exposure to the contaminated soils, unless prior written approval by the NYSDEC is obtained.

The deed notice is for the areas beneath the footprints of the 1978 and 1984 building additions, areas beneath parts of the original building (1973) and the 1982 addition, and for seven additional areas where

complete removal of soil to below the NYSDEC criterion for PCE was not achieved. The areas that have environmental restrictions on the deed notice are shown on Figure 3.

An annual certification will be included with the last semi-annual OM&M report of each year. The certification will state that the approved institutional and engineering controls are in place and functioning as intended.

Soil Cap Monitoring and Maintenance

There are eight areas of the site were PCE-affected soils are capped. The PCE-affected soils are capped by asphalt, concrete, or a minimum of 3 feet of clean soil. The capped areas and the type of cap are listed below.

1. 1978 and 1984 Building Addition Area – 6-inch thick concrete slab
2. Area 1 of Figure 3 – soil, mulch, and landscaping
3. Area 2 of Figure 3 – asphalt (driveway)
4. Area 3 of Figure 3 – soil with grass surface
5. Area 4 of Figure 3 – soil with grass surface (drainage ditch)
6. Area 5 of Figure 3 – soil with grass surface (drainage ditch)
7. Area 6 of Figure 3 – soil with grass surface (drainage ditch)
8. Area 7 of Figure 3 – asphalt (parking lot)

These capped areas will be inspected monthly by UIC to check that the cap is being maintained in good condition. With respect to asphalt and concrete caps, the area surface will be visually checked for subsidence/settlement, excessive wear and/or cracking, and for breaches (such as pot holes). Areas with soil cover will be checked for subsidence/settlement, missing vegetative cover and/or excessive erosion. Construction activities (authorized or unauthorized) that have or may interfere with cap integrity will be noted.

If capped surfaces are found to be in unsatisfactory condition during inspections, site management will be notified and cap patches and repairs will be made, as warranted, with suitable material(s).

Should site activities necessitate that a cap be breached and PCE-affected soil removed, the soils will be placed either in drums or be placed on plastic sheeting and be covered by plastic sheeting. Removed soils will be tested for waste classification and will be properly disposed of offsite.

A Soils Management Plan (SMP) is attached to this OM&M Plan as Appendix A. The SMP provides a detailed description of the guidelines to be used for the handling and disposal of soil material that may be generated during future activities that may disturb or breach any or all of the capped areas. The SMP contains four standard operating procedures (SOPs) for performing various field activity functions; soil sampling, decontamination water sampling, monitoring equipment calibration, and sampling equipment cleaning. The SMP has been reviewed and approved by NYSDEC.

A Quality Assurance/Sampling Analysis Project Plan (QA/SAPP) was prepared to supplement both the OM&M Plan and the SMP. The QA/SAPP presents sampling and analytical methods and procedures to be used during implementation of the OM&M plan. The QA/SAPP is attached as Appendix B.

ASD System Operations, Maintenance, and Monitoring

Construction of the ASD system occurred during June 2003. The ASD system was installed within the 1978 and 1984 additions to see if it could be helpful in reducing indoor air concentrations of PCE within the building. The ASD system installation was performed as a field fabrication. The ASD system fabrication used typical design criteria, specifications, and technology common to the radon control industry (see ASTM International Standard Practice E 212-01, March 2001). ASD system construction details are shown on Figures 4 and 5.

Four extraction points, ASD-1 through ASD-4, were installed at the approximate locations shown on Figure 4. Suction pits for each extraction point were prepared by coring a 4.25-inch- diameter hole through the slab and then clearing gravel and soil from beneath the slab to create a hemispherical pit. The suction pits are approximately 12 inches in diameter and have a nominal volume of at least one cubic foot. The extraction point riser pipe was constructed of Schedule 40 PVC with a 4-inch-diameter. The slab penetration for the depressurization points were cleaned, prepared, and sealed in an air-tight manner with a compatible sealant that will not shrink or crack (see Figure 5 for details).

One ventilation fan was installed and is used to operate the ASD system. This fan operates the four sub-slab depressurization points through a manifold setup. The fan is an exterior mount (Radonwaway brand HS series HS5000 fan). The fan is Underwriter's Laboratory (UL)-approved for outdoor use (UL standard 507) and meets all electrical code requirements.

The performance range of this fan is: electrical usage 180-320 watts, 50 inches of water maximum pressure, 53 standard cubic feet per minute (scfm) at 0.1 inch of water to 24 scfm at 35 inches of water. Fan installation followed the manufacturer's instructions. The fan manufacturer's installation booklet for the HS series is found in Attachment B.

All ASD system electrical components are UL listed or of equivalent specifications. All plastic vent pipes and fittings are made of Schedule 40 PVC.

<u>Operations</u>

The ASD system is essentially self-operating and does not require adjustments. The ASD system essentially operates as either on or off. The ASD system includes mechanisms to monitor system performance and warn of system failure (shut off). The electrical monitor is installed on non-switched circuits and is designed to reset automatically after a power supply interruption.

Manometer-type pressure gauges are clearly marked to indicate the pressure readings that existed prior to system start. The circuit breakers controlling the circuits on which the vent fan and electrical system monitor operate are "ASD System."

Maintenance

The ASD system has only one mechanical part, the suction fan. The fan does not require maintenance and has an expected operational life of 7 to 8 years. Other systems components, such as piping, gauges, and wiring could be inadvertently damaged or broken by other site activities. During inspections these features will be checked for damage. Broken or damaged parts of the system will be repaired or replaced.

Monitoring

The ASD system will be checked daily by UIC to verify that it is operating. Vacuum readings on the system shall be recorded weekly.

Indoor air quality samples shall be collected within the facility building semi-annually (March/April and September) at five locations with one background sampling location outside the building. All sampling locations for indoor air quality monitoring are shown on Figure 6.

Indoor air quality is monitored through the collection of 8-hour time-weighted averaged (TWA) samples. The indoor air samples are collected in summa canisters following procedures provided by the analytical laboratory. The indoor air samples shall be analyzed by an NYSDEC and NYSDOH approved analytical laboratory using USEPA method TO-15.

Modification

The ASD system is a basic design based on radon mitigation type technology. Essentially the system consists of extraction points (suction pits) within the floor slab, plastic piping, and a fan. This system can be easily modified should future conditions warrant such changes. Additional extraction points can be added and plumbed to the existing system. Should additional points be added, an additional fan will be needed and the present system can be split into two separate operating systems.

Additionally, the present system can be operated in different configurations. The normal operating mode is for all four extraction point to be open. The existing system is flexible in that all points can be open or closed in any combination. This can allow for focused ASD if future testing would indicate a specific area of greater concern beneath the floor slab.

OM&M Reporting

Semi-annual reports will be submitted by UIC to NYSDEC that describe OM&M activities that were performed during the reporting period with respect to site engineering controls. The report will state that engineering controls inspections are being performed according to schedule and that the engineering controls are being maintained. The report will provide ASD system operational data and the results of indoor air quality monitoring. The report will describe any modifications that are made to the ASD system.

Self-inspection logs and ASD system operational logs will be provided to NYSDEC as attachments to the report. An example self-inspection log for the engineering controls at the site is provided in Attachment C. An example of the ASD system operational log is provided in Attachment D.

The report will state whether land use in the restricted property areas was consistent with use restrictions during the reporting period. Any changes to land use will be described and reported. Any excavations or disturbances (approved or unapproved) to the cover systems will be described and reported. The nature and extent, duration, and dates of occurrence for excavations or disturbances of the cover systems will be reported. The amounts of soil, if any, generated during excavations into or disturbances of the cover system will documented along with management of the soil onsite and final disposition off site.

OM&M reports will be submitted to NYSDEC at the end of June and the end of December of each year. The December report will contain a certification, signed by the site owner or operator that states the institutional and engineering controls are in place and functioning as intended.

Please call if you have further comments or questions.

Sincerely,

BLASLAND, BOUCK & LEE, INC.

Gregory Albright, R.G., C.HG.
Senior Geologist/Project Manager

GRA/jmp
Enclosure

cc: Ivonne M. Cabrera (Dover Corporation)
Patrick J. Gillard (Universal Instruments Corporation)
Mark A. Gialanella (Universal Instruments Corporation)
D. Robert Gan (Arcadis)
Philip Gitlin (Whiteman Osterman & Hanna)

Tables

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engineers, scientists, economists

TABLE 1
OM&M ACTIVITIES, FREQUENCY, AND SCHEDULE

OPERATIONS, MAINTENANCE & MONITORING PLAN
UNIVERSAL INSTRUMENTS CORPORATION – FORMER DOVER ELECTRONICS SITE
KIRKWOOD, NEW YORK

OM&M Activity	Frequency	1Q[1]	2Q	3Q	4Q
CAP Monitoring	Monthly	3	3	3	3
ASD System Monitoring					
System Check	Daily	65	65	65	65
System Readings	Monthly	3	3	3	3
Indoor Air Sampling	Semi-Annual	1 (March)		1 (September)	
OM&M Reporting	Semi-Annual		1 (May)		1 (December)
OM&M Certification	Annual				1 (December)

Notes:

1. 1Q = First Quarter, numbers shown below in each column represent the number of activity events for that quarter. Months in parentheses indicate month activity is to be completed.

TABLE 1 (continued)

DOVER CORPORATION/UNIVERSAL INSTRUMENTS
KIRKWOOD, NEW YORK

POST EXCAVATION SOIL ANALYTICAL RESULTS - VOLATILE ORGANIC COMPOUNDS
Former Dover Electronics Site
Kirkwood, New York

Blasland, Bouck & Lee, Inc.	Sample I.D.	PX-C-1	PX-C-2	PX-C-3	PX-C-4	PX-C-5	PX-C-6	PX-C-7	PX-C-8	PX-C-9	PX-C-10
	Laboratory I.D.	650559	650560	650561	650562	650563	650564	650565	650566	650567	650568.00
	Date Collected	6/19/2003	6/19/2003	6/19/2003	6/19/2003	6/19/2003	6/19/2003	6/19/2003	6/19/2003	6/19/2003	6/19/2003
Volatile Organic Compounds	Regulatory Limit (ug/kg)										
1,1,1-Trichloroethane	760	<480	<620	<600	<480	<430	<480	<560	<440	<490	<460
1,1-Dichloroethane	200	<480	<620	<600	<480	<430	<480	<560	<440	<490	<460
1,1-Dichloroethene	400	<480	<620	<600	<480	<430	<480	<560	<440	<490	<460
trans-1,2-Dichloroethene	100	<480	<620	<600	<480	<430	<480	<560	<440	<490	<460
cis-1,2-Dichloroethene	300	<480	<620	<600	<480	<430	<480	<560	<440	<490	<460
Tetrachloroethene	1,400	270 J	620	130 J	380 J	240 J	1,300	**4,700**	**1,900**	890	930
Trichloroethene	700	<480	<620	<600	<480	<430	<480	<560	<440	<490	<460
Vinyl Chloride	120	<480	<620	<600	<480	<430	<480	<560	<440	<490	<460

Blasland, Bouck & Lee, Inc.	Sample I.D.	PX-C-11	PX-C-12	PX-C-13	PX-C-14	PX-C-15	PX-D-1	PX-D-2	PX-D-3	PX-D-4	PX-D-5
	Laboratory I.D.	652398	652399	652400	652401	650563	651153	651154	651155	651156	651157
	Date Collected	6/26/2003	6/26/2003	6/26/2003	6/26/2003	6/26/2003	6/23/2003	6/23/2003	6/23/2003	6/23/2003	6/23/2003
Volatile Organic Compounds	Regulatory Limit (ug/kg)										
1,1,1-Trichloroethane	760	390 J	380 J	350 J	<460	<430	<530	<610	<430	<420	<480
1,1-Dichloroethane	200	<490	<530	<400	<460	<430	<530	<610	<430	<420	<480
1,1-Dichloroethene	400	<490	<530	<400	<460	<430	<530	<610	<430	<420	<480
trans-1,2-Dichloroethene	100	<490	<530	<400	<460	<430	<530	<610	<430	<420	<480
cis-1,2-Dichloroethene	300	<490	<530	<400	<460	<430	<530	<610	<430	<420	<480
Tetrachloroethene	1,400	**1,600**	850	510	1,100	<430	<530	**4,600**	**17,000**	**2,800**	**1,300**
Trichloroethene	700	<490	<530	<400	<460	<430	<530	<610	<430	<420	<480
Vinyl Chloride	120	<490	<530	<400	<460	<430	<530	<610	<430	<420	<480

Blasland, Bouck & Lee, Inc.	Sample I.D.	PX-D-6	PX-D-7	PX-D-8	PX-D-9	PX-D-10	PX-D-11	PX-D-12	PX-D-13	PX-D-14	
	Laboratory I.D.	651158	651159	651160	652403	652504	652405	652406	652407	652408	
	Date Collected	6/23/2003	6/23/2003	6/23/2003	6/26/2003	6/26/2003	6/26/2003	6/26/2003	6/26/2003	6/26/2003	
Volatile Organic Compounds	Regulatory Limit (ug/kg)										
1,1,1-Trichloroethane	760	<490	<420	<430	<420	<390	<400	<400	<450	<410	
1,1-Dichloroethane	200	<490	<420	<430	<420	<390	<400	<400	<450	<410	
1,1-Dichloroethene	400	<490	<420	<430	<420	<390	<400	<400	<450	<410	
trans-1,2-Dichloroethene	100	<490	<420	<430	<420	<390	<400	<400	<450	<410	
cis-1,2-Dichloroethene	300	<490	<420	<430	<420	<390	<400	<400	<450	<410	
Tetrachloroethene	1,400	**3,500**	**5,300**	980	<420	<390	<400	1,100	630	**86,000**	
Trichloroethene	700	<490	<420	<430	<420	<390	<400	<400	<450	<410	
Vinyl Chloride	120	<490	<420	<430	<420	<390	<400	<400	<450	<410	

NOTES:
J - Estimated result less than reporting limit
denotes second round of post excavation sampling

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK

TABLE 2

HISTORICAL INDOOR AIR VOC SAMPLE RESULTS
FORMER DOVER ELECTRONICS SITE

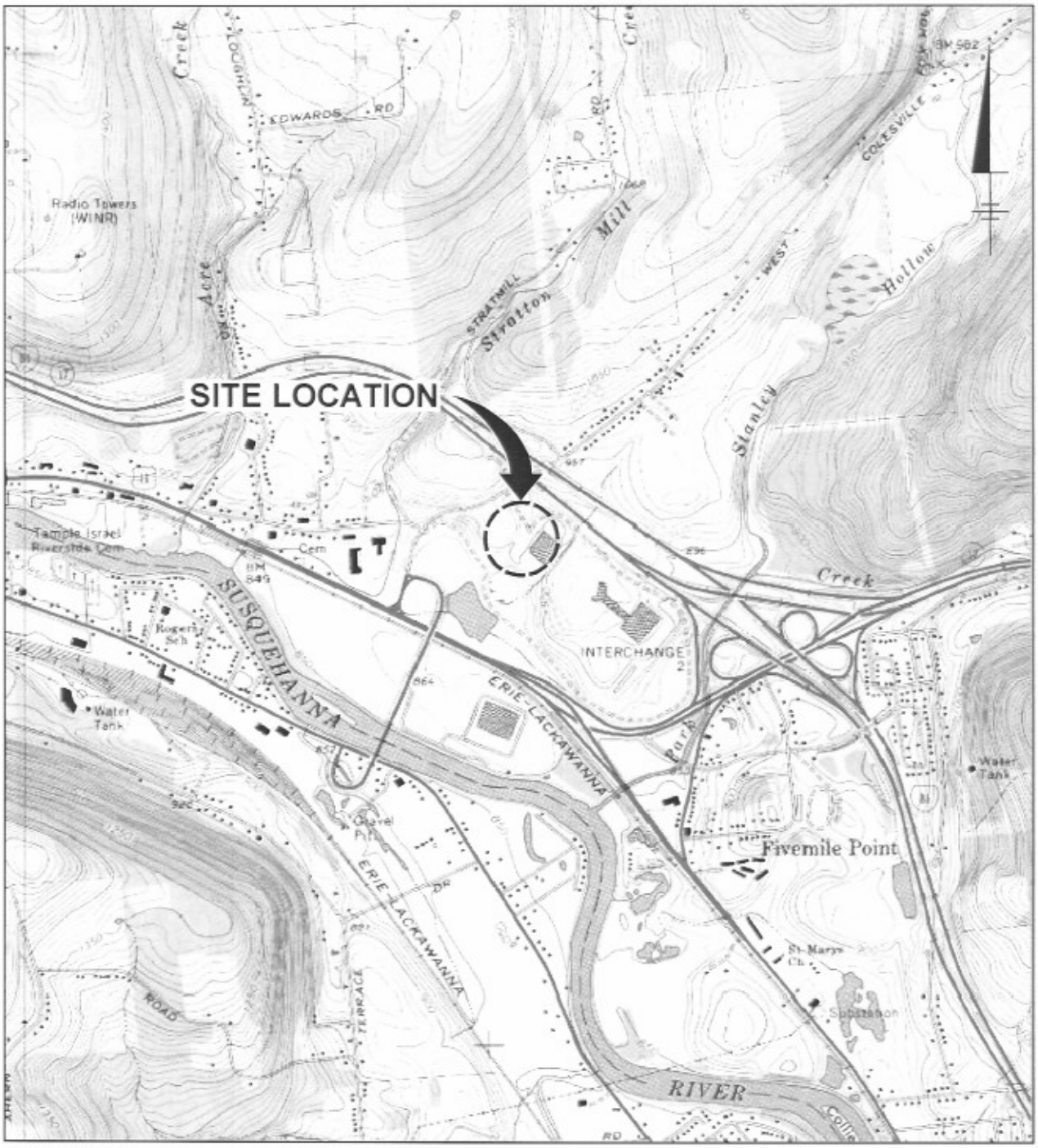
	PCE µg/m3	TCE µg/m3	Cis-1,2-DCE µg/m3	Vinyl Chloride µg/m3	
OFFICE #1					
Nov-98	61	-	-	-	
Dec-98	35	-	-	-	
Mar-99	58	-	-	-	
Feb-02	36	-	-	-	
Apr-02	68	-	-	-	
May-02	27	-	-	-	
Sep-02	60	1.3	-	-	
Aug-03	20	-	-	-	
Sep-03	52	-	-	-	
Jan-04	110	1.3	-	-	
Apr-04	79	-	-	-	
Sep-04	66	-	-	-	
Mar-05	51	-	-	-	
OFFICE #2					
Aug-03	28	-	-	-	
Sep-03	24	-	-	-	
Jan-04	87	-	-	-	
Apr-04	44	-	-	-	
Sep-04	41	-	-	-	
Mar-05	39	-	-	-	
CAFETERIA					
Aug-03	17	-	-	-	
Sep-03	23	-	-	-	
Jan-04	110	1.7	3.5	-	
Apr-04	43	-	1.5	-	
Sep-04	27	-	-	-	
Mar-05	40	-	-	-	
ELECTRICAL AREA					
Nov-98	1,017	-	17.8	-	
Dec-98	678	-	9.5	-	
Mar-99	387	-	6.3	-	
Feb-02	186	4.4	6.1	-	
Apr-02	406	8.2	14.1	1.6	
May-02	165	1.9	4.8	-	
Sep-02	124	2.6	3.7	-	
Aug-03	64	-	-	-	
Sep-03	62	-	-	-	
Jan-04	75	-	-	-	
Apr-04	88	2.7	2.1	-	
Sep-04	70	-	-	-	
Mar-05	60	-	-	-	

Table 2 continued

A/C AREA					
Nov-98	482	6.5	15.9	-	
Dec-98	244	3.6	7.5	-	
Mar-99	183	-	5.6	-	
Feb-02	165	4.9	8.1	-	
Apr-02	248	4.9	10.5	-	
May-02	138	2.1	5.2	-	
Sep-02	110	2.6	3.6	-	
Aug-03	94	-	1.4	-	
Sep-03	88	-	-	-	
Jan-04	85	1.7	3.6	-	
Apr-04	100	1.4	2.1	-	
Sep-04	62	-	-	-	
Mar-05	85	-	1.4	-	
BACKGROUND					
Nov-98	-	-	-	-	
Dec-98	-	-	-	-	
Mar-99	-	-	-	-	
Feb-02	-	-	-	-	
Apr-02	13	4	-	-	
May-02	-	-	-	-	
Sep-02	-	-	-	-	
Aug-03	-	-	-	-	
Sep-03	2.2	-	-	-	
Jan-04	-	-	-	-	
Apr-04	1.8	-	-	-	
Sep-04	-	-	-	-	
Mar-05	-	-	-	-	

Figures

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REFERENCE: Base Map Source USGS 7.5 Minute Quad. Series Binghamton East, New York, 1968, Photorevised 1976.

2000' 0 2000'

Approximate Scale: 1" = 2000'



AREA LOCATION

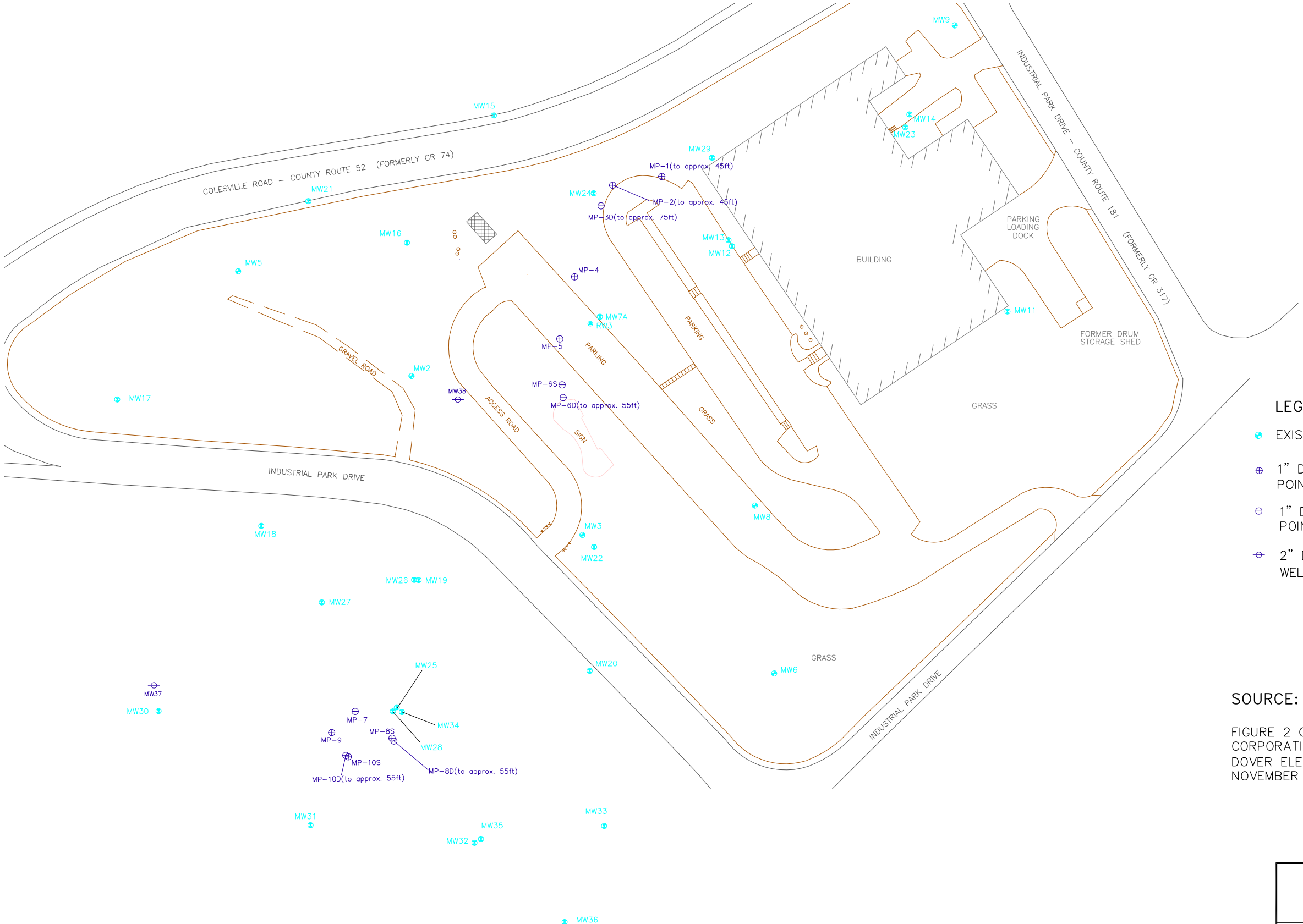
07/18/01 CRA-54-IY
05203003/05203n01.cdr

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK

LOCATION MAP

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FIGURE
1



LEGEND

- EXISTING MONITORING WELL
- ⊕ 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- ⊖ 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- ⊖ 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH

SOURCE:

FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

0 60' 120'
GRAPHIC SCALE

X:
L: OFF=REF
P: PAGESET/PLT-DL
06/22/04 CRA-85-IY, TLF
05203011/05203B01.DWG

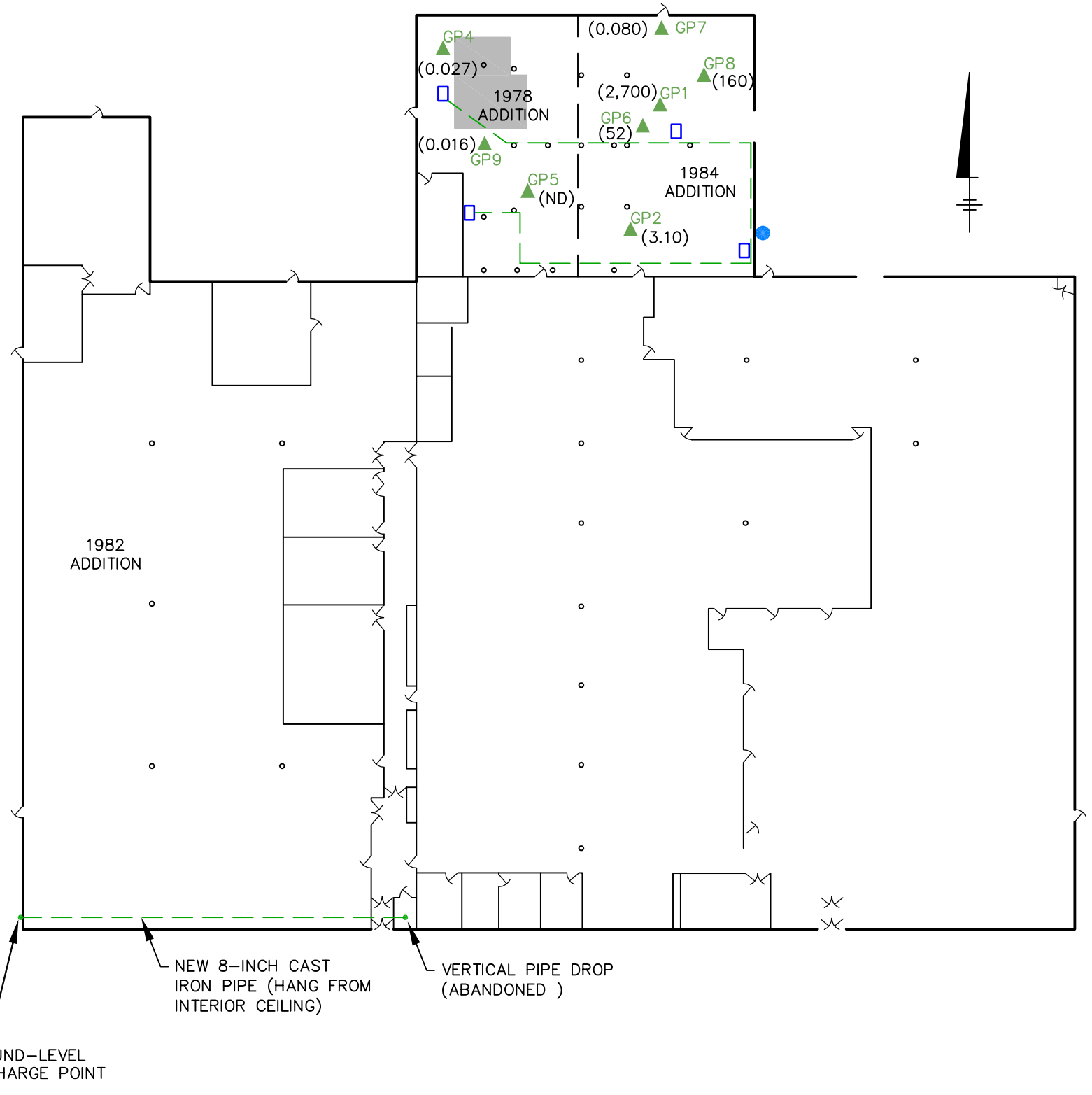
UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK

OPERATIONS, MAINTENANCE AND MONITORING PLAN

SITE MAP

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FIGURE
2



LEGEND:

- ACTIVE SUB-SLAB DEPRESSURIZATION POINT LOCATION
- PIPING RUN
- VERTICAL BUILDING POST
- EXTERIOR FAN AND EXHAUST LOCATION
- SOIL SAMPLE LOCATIONS
- (2,700) PCE CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM (mg/kg)
- INACCESSIBLE AREA

SOURCE:

BUILDING LAYOUT DIGITIZED FROM PHOTOCOPY OF DRAWING FAXED FROM UNIVERSAL INSTRUMENTS CORPORATION FACILITIES DEPARTMENT. NO FILE NAME OR SCALE PROVIDED.

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK

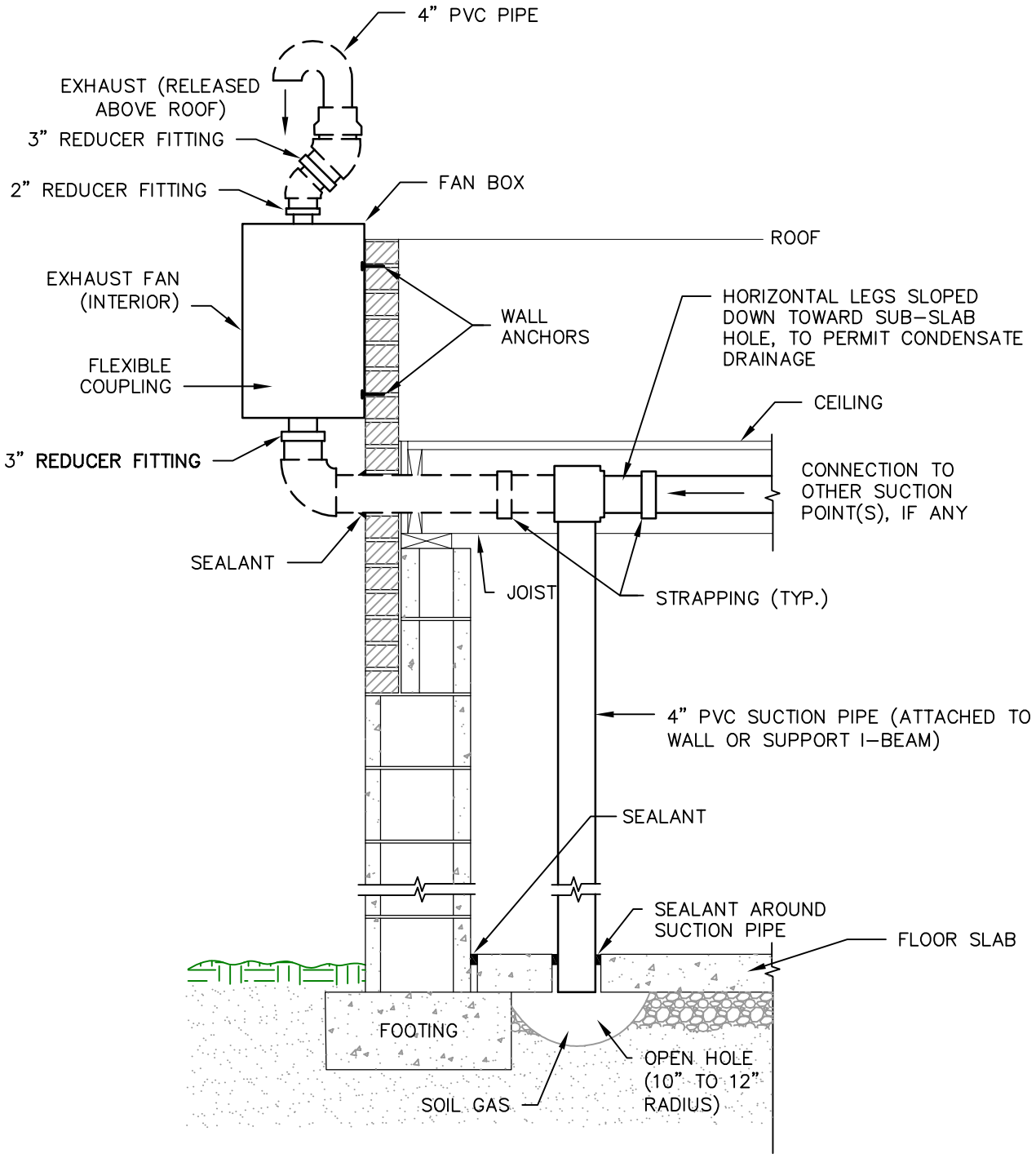
OPERATIONS, MAINTENANCE AND MONITORING PLAN

ASD EXTRACTION POINT LOCATIONS

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FIGURE **4**

X:
L: OFF-REF*
P: PAGESET/PLT-BL
06/22/04 CRA-85-TLF
05203011/05203G02.DWG



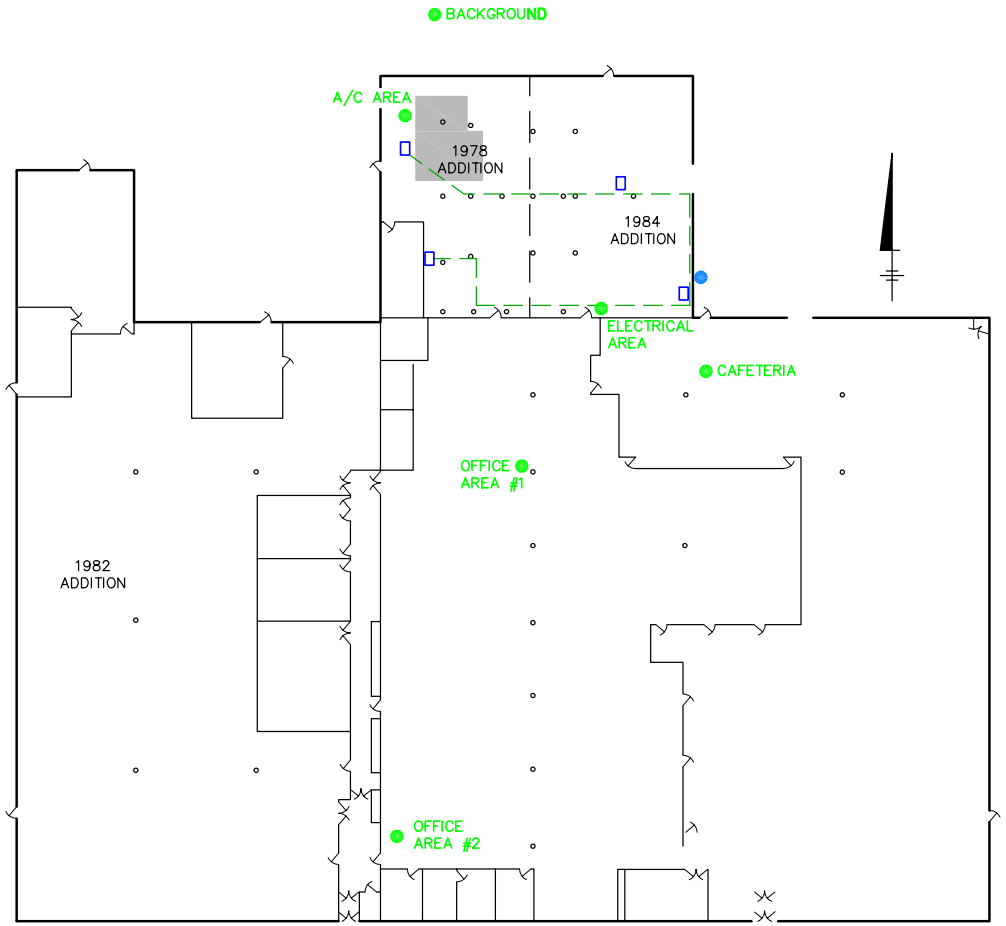
UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
OPERATIONS, MAINTENANCE AND MONITORING PLAN

ASD SYSTEM DETAILS

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 5

X:
L: OFF=REF*
P: PAGESET/PLT-AP
06/22/04 CRA-85-TLF
05203011/05203M01.DWG



LEGEND:

- ACTIVE SUB-SLAB DEPRESSURIZATION POINT LOCATION
- PIPING RUN
- VERTICAL BUILDING POST
- EXTERIOR FAN AND EXHAUST LOCATION
- INACCESSIBLE AREA
- INDOOR AIR SAMPLING LOCATION

SOURCE:

BUILDING LAYOUT DIGITIZED FROM PHOTOCOPY OF DRAWING FAXED FROM UNIVERSAL INSTRUMENTS CORPORATION FACILITIES DEPARTMENT. NO FILE NAME OR SCALE PROVIDED.

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
OPERATIONS, MAINTENANCE AND MONITORING PLAN

INDOOR AIR SAMPLING LOCATIONS

BBL BARLAND, BOUCK & LEE, INC.
engineers, scientists, consultants

FIGURE
6

X:
L: OFF-REF*
P: PAGESET/PLT-BL
06/22/04 CRA-85-TLF
05203011/05203G03.DWG

Attachments

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Attachment A

Deed Notice

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

RECEIVED
OCT 2 0 2005
BROOME COUNTY CLERK

DECLARATION of COVENANTS and RESTRICTIONS

THIS COVENANT, made the 12 day of August, 2005, by the BROOME COUNTY INDUSTRIAL DEVELOPMENT AGENCY, a public benefit corporation organized and existing under the laws of the State of New York, and having its principal place of business at the Edwin L. Crawford County Office Building, 44 Hawley Street, Binghamton, New York 13902.

WHEREAS, the BROOME COUNTY INDUSTRIAL DEVELOPMENT AGENCY is the owner of the Universal Instruments/ Dover Electronics inactive hazardous waste disposal site which is listed in the Registry of Inactive Hazardous Waste Disposal Sites in New York State as Site Number 704026, located at 29 Industrial Park Drive, Kirkwood, Broome County, New York, which is part of lands conveyed to the Broome County Industrial Development Agency by deed dated January 22, 1997 and recorded in the Broome County Clerk's Office on January 23, 1997 in Book 1876 of Deeds at Page 145 and being more particularly described in Appendix "A" (as shown on Figure A-1) attached to this declaration and made a part hereof, and hereinafter referred to as "the Property"; and

WHEREAS, the Property is the subject of a consent order issued by the New York State Department of Environmental Conservation to Universal Instruments Corporation, dated January 19, 2001; and

WHEREAS, the New York State Department of Environmental Conservation set forth a remedy to eliminate or mitigate all significant threats to the environment presented by hazardous waste disposal at the Site in a Record of Decision ("ROD") dated March 30, 2000, and such ROD or the Work Plan for the implementation of the ROD required that the Property be subject to restrictive covenants.

NOW, THEREFORE, BROOME COUNTY INDUSTRIAL DEVELOPMENT AGENCY, for itself and its successors and/or assigns, covenants

First, the Property subject to this Declaration of Covenants and Restrictions is described in Appendix "A" (as shown on Figure A-1) attached to this Declaration and made a part hereof.

Second, unless prior written approval by the New York State Department of Environmental Conservation or, if the Department shall no longer exist, any New York State agency or agencies subsequently created to protect the environment of the State and the health of the State's citizens, hereinafter referred to as "the Relevant Agency," is first obtained, no person shall engage in any activity that will, or that reasonably is anticipated to, prevent or interfere significantly with any proposed, ongoing or completed program at the Property or that will, or is reasonably foreseeable to, expose the public health or the environment to a significantly increased threat of harm or damage.

Third, the portion of the Property consisting of the area of the 1978, 1982, and 1984 building additions at the Property, part of the area of the original building (1973), an exterior area outside the front employees entrance (#1 on Figure B-1), an exterior area adjacent to catch basin

COPY

CB-2044 (#2 on Figure B-1), an area east of the east-side transformer pad (#3 on Figure B-1), an exterior area of the southeast parking area (#7 on Figure B-1), and three exterior areas along the eastern property boundary adjacent to County Route 181 [Industrial Park Drive] (#4, #5, and #6 on Figure B-1); hereinafter referred to as the "Restricted Building Property", is shown on the map attached hereto and made a part hereof in Appendix "B" (Figure B-1).

Fourth, the owner or operator of the Restricted Building Property shall either maintain the building covering the Restricted Building Property or, after obtaining written approval of the Relevant Agency, excavate and remove the inaccessible soils under the Restricted Building Property which are contaminated with hazardous wastes or constituents thereof in accordance with regulatory standards and criteria.

Fifth, the owner of the Restricted Building Property shall prohibit the Restricted Building Property from ever being used for purposes other than for industrial or commercial use excluding use for daycare, child care and medical care without the express written waiver of such prohibition by the Relevant Agency.

Sixth, the owner of the Property shall prohibit the use of the groundwater underlying the Property without treatment rendering it safe for drinking water or industrial purposes, as appropriate, unless the user first obtains permission to do so from the Relevant Agency.

Seventh, the owner of the Property shall continue in full force and effect any institutional and engineering controls the Department required Respondent to put into place and maintain unless the owner first obtains permission to discontinue such controls from the Relevant Agency.

Eighth, this Declaration is and shall be deemed a covenant that shall run with the land and shall be binding upon all future owners of the Property and shall provide that the owner, and its successors and assigns, consent to the enforcement by the Relevant Agency of this Declaration and hereby covenant not to contest the authority of the Department to seek enforcement.

Ninth, any deed of conveyance of the Property, or any portion thereof, shall recite, unless the Relevant Agency has consented to the termination of such covenants and restrictions, that said conveyance is subject to this Declaration of Covenants and Restrictions.

IN WITNESS WHEREOF, the undersigned has executed this instrument the day written below.

BROOME COUNTY INDUSTRIAL DEVELOPMENT AGENCY

By: _____
Name: Richard D'Attilio
Title: Executive Director

State of New York
SS:
County of Broome

On the 12th day of August, 2005, before me, the undersigned, appeared RICHARD D'ATTILIO personally known to me or proved to me on the basis of satisfactory evidence to be the individual whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his capacity and that by his signature on the instrument the person on behalf of which the individual acted, executed the instrument.

Ruth L Manning (Fiato)
Notary Public

RUTH L. MANNING (Fiato)
Notary Public, State of New York
No. 01MA6044000
Qualified in Broome County
Commission Expires June 26, 20 06

This Indenture made January 22, 19 97

Between UNIVERSAL INSTRUMENTS CORP., a Delaware Corporation, having an office and place of business at 90 Bevier Street, Binghamton, New York 13901

party of the first part, and

BROOME COUNTY INDUSTRIAL DEVELOPMENT AGENCY, P.O. Box 995, Binghamton, New York 13902

party of the second part,

Witnesseth that the party of the first part, in consideration of ONE Dollars ($1.00) lawful money of the United States, and other good and valuable consideration paid by the party of the second part, does hereby grant and release unto the party of the second part, the heirs or successors and assigns of the party of the second part forever,

ALL THAT TRACT OR PARCEL OF LAND, situate in the Town of Kirkwood, County of Broome and State of New York, bounded and described as follows: Commencing at the intersection of the centerline of Barlow Road, extended southeasterly, with the former southeasterly boundary of Colesvile Road (County Road 52); thence along said former highway boundary, the following three courses: 1) N 30-46-37 E, a distance of 37 feet to a point; 2) N 49-46-49 E, a distance of l44.00 feet to a point; and 3) N 79-38-34 E, a distance of l92.84 feet to the Point of Beginning; thence along the southeasterly boundary of Colesville Road, the following seven (7) courses: 1) N 00-00-00 E, a distance of 9.73 feet to a point; 2) N 77-28-44 E, a distance of 137.07 feet to a point; 3) N 66-44-45 E, a distance of 87.32 feet to a point; 4) N 77-45-24 E, a distance of 225.63 feet to a point; 5) N 56-03-01 E, a distance of 257.84 feet to a concrete mon., 6) S 43-15-39 E, a distance of l.64 feet to a concrete mon., 7) N 55-57-51 E, a distance of 126.63 feet to a point; thence S 31-15-18 E, along the southwesterly boundary of Industrial Park Drive (County Road 181) a distance of 534.29 feet to a point; thence S 45-49-11 W, along the northwesterly boundary of Industrial Park Drive, a distance of 552.84 feet to a point; thence N 51-25-41 W, along the northeasterly boundary of Industrial Park Drive, a distance of 812.49 feet to the Point of Beginning.

Containing 9.5887 acres of land as surveyed by Warren D. Jennings, L.S., August 10, 1995 and shown on a map dated September 5, 1995 (file no. 4269).

The above mentioned parcel is subject to a 30 foot Town of Kirkwood permanent easement for sanitary, sewer and water main.

Being the same premises conveyed to the Grantor herein by Warranty Deed from Dovatron, Inc., dated November l5, l995 and recorded November 29, l995 in the Broome County Clerk's Office in Liber 1859 of Deeds at page 1446.

Appendix A (1 of 2)

Together with the appurtenances and all the estate and rights of the party of the first part in and to said premises,

To have and to hold the premises herein granted unto the party of the second part, the heirs or successors and assigns of the party of the second part forever.

And the party of the first part covenants as follows:

First, That the party of the second part shall quietly enjoy the said premises;

Second, That the party of the first part will forever Warrant the title to said premises.

Third, the party of the first part, in compliance with Section 13 of the Lien Law, covenants that the party of the first part will receive the consideration for this conveyance and will hold the right to receive such consideration as a trust fund to be applied first for the purpose of paying the cost of the improvement and will apply the same first to the payment of the cost of the improvement before using any part of the total of the same for any other purpose.

The word "party" shall be construed as if it read "parties" whenever the sense of this indenture so requires.

In Witness Whereof, the party of the first part has duly executed this deed the day and year first above written.

In Presence of

UNIVERSAL INSTRUMENTS CORP. L.S.

By: L.S.
Patrick J. Gillard
Vice President, Finance

L.S.

L.S.

STATE OF NEW YORK, COUNTY OF ss.:
On 19 , before me personally came

to me known to be the individual described in, and who executed the foregoing instrument, and acknowledged that he executed the same.

STATE OF NEW YORK, COUNTY OF ss.:
On 19 , before me personally came

to me known to be the individual described in, and who executed the foregoing instrument, and acknowledged that he executed the same.

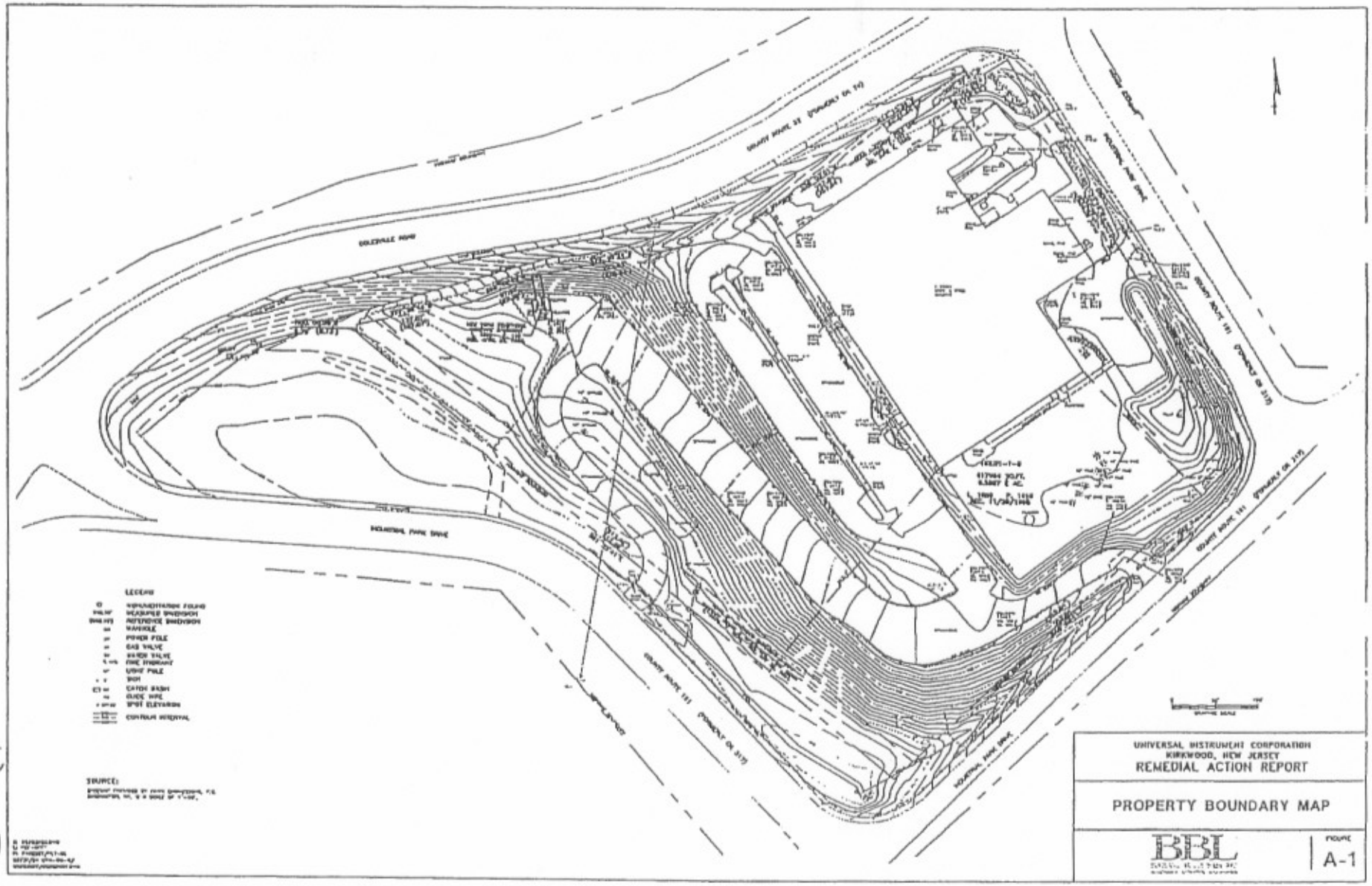
STATE OF NEW YORK, COUNTY OF BROOME ss.:
On January 22, 19 97 before me personally came PATRICK J. GILLARD to me known, who, being by me duly sworn, did depose and say that deponent resides at No.
deponent is V.P., Finance of Universal Instruments Corp. the corporation described in and which executed, the foregoing instrument; deponent knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation; deponent signed deponent's name thereto by like order.

Notary Public, State of New York
No. 02GC4721704
Qualified in Broome County
My Commission Expires Jan. 31, 1999

STATE OF NEW YORK, COUNTY OF ss.:
On 19. , before me personally came
the subscribing witness to the foregoing instrument, with whom I am personally acquainted, who, being by me duly sworn, did depose and say that he resides at No.

that he knows to be the individual described in and who executed the foregoing instrument; that he, said subscribing witness, was present and saw executed the same; and that he, said witness, at the same time subscribed h name as witness thereto.

Appendix A "(2of2)


UNIVERSAL INSTRUMENT CORPORATION
KIRKWOOD, NEW JERSEY
REMEDIAL ACTION REPORT
PROPERTY BOUNDARY MAP
BBL
FIGURE
A-1

Appendix B

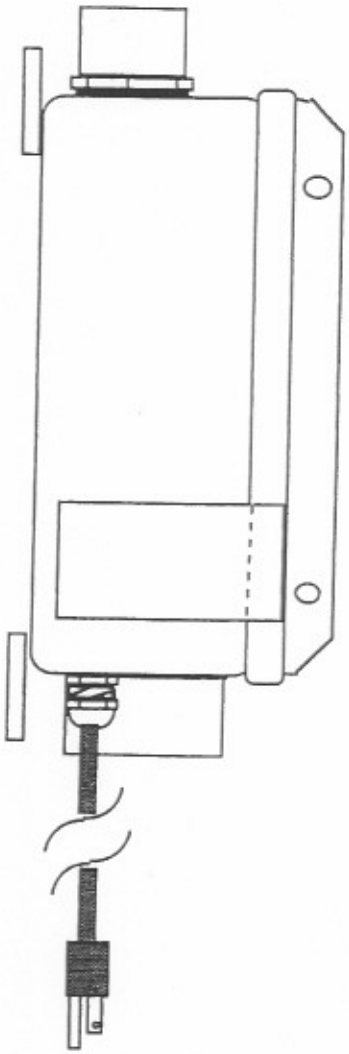
Attachment B

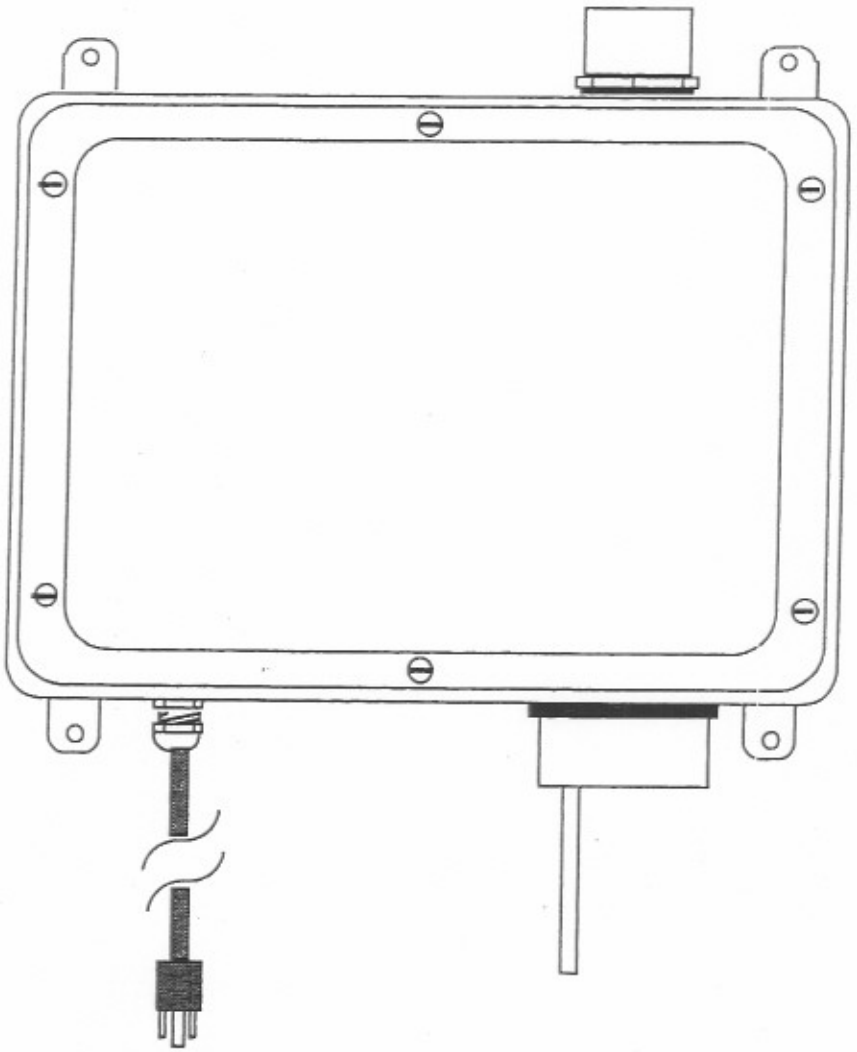
Manufacturer's Installation Booklet

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

HS SERIES INSTALLATION INSTRUCTIONS

BY RadonAway™





RadonAway, Inc. Haverhill, MA.

P/N IN007 Rev D

RadonAway™
Your Full Service Radon Specialists

INSTALLATION INSTRUCTIONS (Rev D)
for DynaVac High Suction Series
HS2000 p/n 23004-1
HS3000 p/n 23004-2
HS5000 p/n 23004-3

1.0 SYSTEM DESIGN CONSIDERATIONS

1.1 INTRODUCTION

The DynaVac is intended for use by trained, professional Radon mitigators. The purpose of this instruction is to provide additional guidance for the most effective use of the DynaVac. This instruction should be considered as a supplement to EPA standard practices, state and local building codes and state regulations. In the event of a conflict, those codes, practices and regulations take precedence over this instruction.

1.2 ENVIRONMENTALS

The DynaVac is designed to perform year-round in all but the harshest climates without additional concern for temperature or weather. For installations in an area of severe cold weather, please contact RadonAway for assistance. When not in operation, the DynaVac should be stored in an area where the temperature is never less than 32 degrees F. or more than 100 degrees F. The DynaVac is thermally protected such that it will shut off when the internal temperature is above 104 degrees F. Thus if the DynaVac is idle in an area where the ambient temperature exceeds this shut off, it will not restart until the internal temperature falls below 104 degrees F.

1.3 ACOUSTICS

The DynaVac, when installed properly, operates with little or no noticable noise to the building occupants. There are, however, some considerations to be taken into account in the system design and installation. When installing the DynaVac above sleeping areas, select a location for mounting which is as far away as possible from those areas. Avoid mounting near doors, fold-down stairs or other uninsulated structures which may transmit sound. Insure a solid mounting for the DynaVac to avoid structure-borne vibration or noise.

The velocity of the outgoing air must also be considered in the overall system design. With small diameter piping, the "rushing" sound of the outlet air can be disturbing. The system design should incorporate a means to slow and quiet the outlet air. The use of the RadonAway Exhaust Muffler, p/n 24001, is strongly recommended.

1.4 GROUND WATER

Under no circumstances should water be allowed to be drawn into the inlet of the DynaVac as this may result in damage to the unit. The DynaVac should be mounted at least 5 feet above the slab penetration to minimize the risk of filling the DynaVac with water in installations with occasional high water tables.

In the event that a temporary high water table results in water at or above slab level, water will be drawn into the riser pipes thus blocking air flow to the DynaVac. The lack of cooling air will result in the DynaVac cycling on and off as the internal temperature rises above the thermal cutoff and falls upon shutoff. Should this condition arise, it is recommended that the DynaVac be disconnected until the water recedes allowing for return to normal operation.

1.5 CONDENSATION & DRAINAGE

(***WARNING!***: Failure to provide adequate drainage for condensation can result in system failure and damage the DynaVac).

Condensation is formed in the piping of a mitigation system when the air in the piping is chilled below its dew point. This can occur at points where the system piping goes through unheated space such as an attic, garage or outside. The system design must provide a means for water to drain back to a slab hole to remove the condensation.

The use of small diameter piping in a system increases the speed at which the air moves. The speed of the air can pull water uphill and at sufficient velocity it can actually move water vertically up the side walls of the pipe. This has the potential of creating a problem in the negative pressure (inlet) side piping. For DynaVac inlet piping, the following table provides the minimum recommended pipe diameters as well as minimum pitch under several system condition. Use this chart to size piping for a system.

Pipe Diam.	Minimum Rise per Foot* @ 25 CFM	@ 50 CFM	@ 100 CFM
4"	1/32"	3/32"	3/8"
3"	1/8"	3/8"	1 1/2"



*Typical operational flow rates:

HS3000, or HS5000	20 - 40 CFM
HS2000	50 - 90 CFM

(For more precision, determine actual depressurization in the inlet pipe using a Magnehelic or other pressure differential device and determine flow rate by using chart in addendum.)

All exhaust piping should be 2" PVC.

1.6 "SYSTEM ON" INDICATOR

A properly designed system should incorporate a "System On" Indicator for affirmation of system operation. A Magnehelic pressure gauge is recommended for this purpose. The indicator should be mounted at least 5 feet above the slab penetration to minimize the risk of filling the gauge with water in installations with occasional high water tables.

1.7 SLAB COVERAGE

The DynaVac can provide coverage of well over 1000 sq. ft. per slab penetration. This will, of course, depend on the sub-slab aggregate in any particular installation and the diagnostic results. In general, sand and gravel are much looser aggregates than dirt and clay. Additional suction points can be added as required. It is recommended that a small pit (2 to 10 gallons in size) be created below the slab at each suction hole.

1.8 ELECTRICAL WIRING

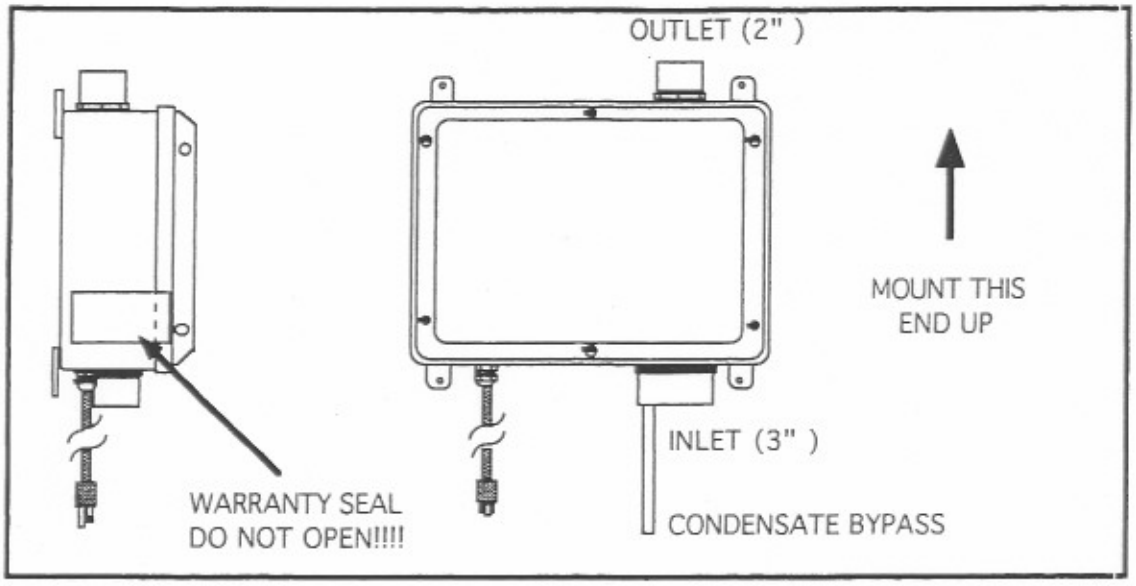
The DynaVac plugs into a standard 120V outlet. All wiring must be performed in accordance with the National Electrical Code and state and local building codes.

1.8a ELECTRICAL BOX (optional)

The optional Electrical Box (p/n 20003) provides a weathertight box with switch for outdoor hardwire connection. All wiring must be performed in accordance with the National Electrical Code and state and local building codes. All electrical work should be performed by a qualified electrician. Outdoor installations require the use of a U.L. listed watertight conduit.

1.9 SPEED CONTROLS

Electronic speed controls can **NOT** be used on HS series units.



2.0 INSTALLATION

2.1 MOUNTING

Mount the DynaVac to the wall studs, or similar structure, in the selected location with (4) 1/4" x 1 1/2" lag screws (not provided). Insure the DynaVac is both plumb and level.

2.2 DUCTING CONNECTIONS

Make final ducting connection to DynaVac with flexible couplings. Insure all connections are tight. Do not twist or torque inlet and outlet piping on DynaVac or leaks may result.

2.3 VENT MUFFLER INSTALLATION

Install the muffler assembly in the selected location in the outlet ducting. Solvent weld all connections. The muffler is normally installed above the roofline at the end of the vent pipe.

2.5 OPERATION CHECKS

____ Make final operation checks by verifying all connections are tight and leak-free.

____ Insure the DynaVac and all ducting is secure and vibration-free.

____ Verify system vacuum pressure with Magnehelic. Insure vacuum pressure is less than the maximum recommended as shown below:

DynaVac	HS2000	14" WC
DynaVac	HS3000	21" WC
DynaVac	HS5000	40" WC

(Above are based on sea-level operation, at higher altitudes reduce above by about 4% per 1000 Feet.)
If these are exceeded, increase number of suction points.

____ Verify Radon levels by testing to EPA protocol.

3.0 IMPORTANT INSTRUCTIONS TO INSTALLER

3.1 Inspect DynaVac for shipping damage within 15 days of receipt. Notify carrier of any damages immediately. RadonAway is not responsible for damages incurred during shipping.

3.2 There are no user servicable parts inside the DynaVac. Do not attempt to open. Return unit to the factory for service.

3.3 Install the DynaVac in accordance with all EPA standard practices, and state and local building codes and state regulations.

3.4 In the event the DynaVac is immersed in water, return unit to factory for service before operating.

3.5 Do not twist or torque inlet and outlet piping on the DynaVac. Leakage can result.

4.0 WARRANTY INFORMATION

Subject to applicable consumer protection legislation, RadonAway, Inc. warrants that the DynaVac will be free from defective materials and workmanship for a period of (1) year from the date of purchase. Warranty is contingent on installation in accordance with the instructions provided. This warranty does not apply where repairs or alterations have been made or attempted by others; or the unit has been abused or misused. Warranty does not include damage in shipment unless the damage is due to the negligence of RadonAway, Inc. To make a claim under these limited warranties, you must return the defective item to RadonAway, Inc. with a copy of the purchase receipt. All other warranties, expressed or written, are not valid. RadonAway, Inc. is not responsible for installation or removal cost associated with this warranty.

5.0 OPTIONAL THREE YEAR EXTENDED WARRANTY

Under this option all warranty terms and conditions are extended to (3) years from date of purchase. Purchase receipt provides proof of purchase of this option and Serial Number of DynaVac covered.

Record the following for your records:

Serial No._____

Receipt Date_____

ADDENDUM

PRODUCT SPECIFICATIONS

Model	Maximum Static Suction	Typical CFM vs Static Suction WC (Recommended Operating Range) 0"	10"	15"	20"	25"	35"	Power* Watts @ 115 VAC
HS2000	18"	110	72	40	--	--	--	150-270
HS3000	27"	40	33	30	23	18	--	105-195
HS5000	50"	53	47	42	38	34	24	180-320

*Power consumption varies with actual load conditions

Inlet: 3.0" PVC

Outlet: 2.0" PVC

Mounting: Brackets for vertical mount

Weight: Approximately 18 lbs.

Size: Approximately 15"W x 13"H x 8"D

Minimum recommended inlet ducting (greater diameter may always be used):

Main line of 3.0" or greater PVC Pipe
Any branch lines may be 2.0" or greater PVC Pipe

Outlet ducting: 2.0" PVC

Storage temperature range: 32 - 100 degrees F.

Thermally protected

Locked rotor protection

Internal Condensate Bypass

Attachment C

Self Inspection Log

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Monthly Inspection Checklist
Universal Instruments Site
Kirkwood, New York

Date: XX/XX/200X

Representative: Xxx Xxxxx

Item No.	Description	Yes	No	Actions	Comments
1	1978 Building Addition floor slab in good condition?	X		No maintenance required	None
2	1984 Building Addition floor slab in good condition?	X			
3	Area 1 (front employee entrance) landscape cover intact?	X			
4	Area 2 (driveway at north catch basin CB-2044) asphalt surface in good condition?	X			
5	Area 3 (transformer pad location) vegetative cover intact?	X			
6	Area 4 (drainage ditch along CR 181) in good condition?	X			
7	Area 5 (drainage ditch along CR 181) in good condition?	X			
8	Area 6 (drainage ditch along CR 181) in good condition?	X			
9	Area 7 (parking lot at southeast loading dock) asphalt surface in good condition?	X			
10	ASD system operational?	X			
11	ASD system vacuum readings normal?	X			
12	ASD system components in good condition?	X			
13					
14					
15					
16					
17					
18					
19					

Attachment D

ASD System operational Log

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

UNIVERSAL INSTRUMENTS CORPORATION

ACTIVE SUB-SLAB DEPRESSURIZATION (ASD) OPERATIONAL DATA
Former Dover Electronics Site
Kirkwood, New York

Date	Time	System On? (Y/N)	Vaccum Reading (inches water)				Comments
			ASD-1	ASD-2	ASD-3	ASD-4	

Appendices

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Appendix A

Soil Management Plan

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

SOILS MANAGEMENT PLAN

Overview and Objectives

The former Dover facility is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. The facility is located on a site approximately 9.58 acres in size. Figure 1 is the site plan.

The property is situated in an industrial setting. Major plants in the area include Truckstops of America Landfill (0.5 mile southeast), Frito Lay Plant (0.5 mile south), Universal Instruments (147 Industrial Park Drive, 0.5 mile east), Kason Industries (eastern property boundary), Consolidated Freightways (northern property boundary), and the newly developed Pilot Truck Stop to the south. Industrial properties surround the property to the north, east, and west. The site presently serves as one of Universal's service facilities with the site's uses including product training, research and development, and Odd Form Assembly (OFA), which involves the engineering and assembly of non-standard/specialty circuit boards.

Soil remediation activities conducted at the site during June and July 2003 were performed to mitigate tetrachlorethene (PCE)-affected soils in the unsaturated zone beneath and adjacent to the facility building at the site.

The objective of this Soils Management Plan (SMP) is to set guidelines for management of soil material during any future activities which would breach the cover system (engineering control) at the site. This SMP addresses environmental concerns related to soil management and has been reviewed and approved by the New York State Department of Environmental Conservation (NYSDEC) in a letter dated December 21, 2004 (Exhibit 1).

Nature and Extent of Remaining PCE-Affected Soils

Based on data from previous investigations and the remediation performed at the site, a soil remedial action report was prepared by Blasland, Bouck and Lee (BBL) (*Remedial Action Report, July 2004*). The constituents of concern in soil at the site are volatile organic compounds: PCE and its breakdown products – cis-1,2-dichloroethene and vinyl chloride.

Remedial action for soils was performed at the site by removing soil from seven separate accessible areas on the site that had been identified during remedial investigation as areas of concern. One area beneath the facility building was deemed inaccessible. An approximate total of 487 cubic yards was excavated from these seven areas of the facility (see Figure 2). Post-excavation sampling showed that some PCE-affected soils remained that were above NYSDEC TAGM #4046 standards for PCE.

Deed Notice

A deed notice with environmental restrictions is to be filed with the Broome County Clerk's Office to provide an institutional control for inaccessible soils that remain below facility floor slabs. The NYSDEC-approved deed notice was forwarded by UIC to the site owner on April 26, 2004 for signature and subsequent filing with the Broome County Clerk.

The deed notice stipulates that there shall be no construction, use or occupancy of the property that results in the disturbance of the cover systems or which will result in human exposure to the contaminated soils, unless prior written approval by the NYSDEC is obtained.

The deed notice is for the areas beneath the footprints of the 1978 and 1984 building additions, areas beneath parts of the original building (1973) and the 1982 addition, and for seven additional areas where complete removal of soil to below the NYSDEC criterion for PCE was not achieved. The areas that have environmental restrictions on the deed notice are shown on Figure 3.

Remaining PCE-Affected Soils

Field personnel assessed the excavation limits through field screening. All post-excavation soil samples were collected as grab samples. Sidewall samples were collected from the excavation sidewalls at a depth interval coincident with 0 to 6 inches above the excavation base at the time of collection. Bottom post-excavation samples were collected along the central long-axis of each excavation. The post-excavation sample locations were biased based on field judgment, towards sidewall and bottom areas that were suspected to most likely contain residual contamination.

Verification post-excavation samples were collected as undisturbed grab samples and were analyzed offsite by a New York State-certified laboratory (Columbia Analytical Services, Rochester, New York) for VOC SSPL analysis using United States Environmental Protection Agency (USEPA) Method 8260 to assess compliance with New York State groundwater protection requirements (NYSDEC, *TAGM #4046*, 1994).

Because some of the analytical results from the first set of post-excavation samples exceeded the NYSDEC criterion for PCE, additional excavation work was performed and a second round or verification samples were collected and analyzed for SSPL VOCs. During the first round of post-excavation sampling, results for 23 of 52 samples exceeded the NYSDEC soil criterion for PCE of 1,400 micrograms per kilogram (µg/kg). During the second round of post-excavation sampling, results for 5 of 26 samples exceeded the criterion for PCE.

The PCE exceedances in soil were detected in Excavation A-1, Excavation C, Excavation D, and Excavation E, and the unsatisfactory verification results in the final post-excavation samples [from first and/ or second round] are summarized below.

- The PCE soil concentration in the unsatisfactory verification sample collected in Excavation A-1 (PXA1-5, second round) was 18,000 µg/kg. This sample was collected against the base of the stairway leading to the employee entrance.
- The PCE soil concentration in the high verification samples collected in Excavation C were 4,700 µg/kg (PXC-7, first round) and 1,600 µg/kg (PXC-11, second round). Sample PXC-7 was collected at the upper end of Excavation "C" where the entrance to the southeast parking area and loading dock is located. This post-excavation sample was collected from between the highway drainage swale culvert pipe that runs beneath the driveway and the stormwater outfall pipe from Catch Basin CB-1845 (an 18- inch distance between the two pipes). Sample PXC-11 was collected from the base of the excavation at the downslope end of the excavation.

- The PCE soil concentration in the high verification samples collected in Excavation D were 3,500 µg/kg (PXC-6, first round) and 86,000 µg/kg (PXD-14, second round). Sample PXD-6 was collected from the west end of Excavation D where the excavation terminated against the cedar tree hedge and the transformer pad. Sample PX-14 was collected in the most downslope corner of Excavation D where a minor amount of free-phase PCE was observed before removal.

- The PCE soil concentrations in the two high verification sample collected in Excavation E (PXE-11 and PXE-12, second round) were 14,000 µg/kg and 2,000 µg/kg, respectively. These samples were collected from the downslope end of the excavation.

Additional areas were added to the proposed deed notice to address the PCE soil exceedances associated with Excavation E (see Figure 17). The PCE soil exceedance detected at Excavation A-1 was already addressed by existing proposed deed notice areas. The PCE soil exceedance detected at Excavation C is minor and does not warrant further action. Although the PCE soil exceedance detected in sample PXD-14 is elevated, the location next to the county road and the presence of a large water main preclude further soil excavation at this location. At the time of sample collection, the visual evidence from observation of the excavation sidewall and bottom showed that all free-phase PCE had been removed. Areas of Excavation C and Excavation D were also added to the deed notice.

The analytical results of both rounds of post-excavation sampling are presented in Table 1. The locations of the 78 post-excavation samples are shown on Figures 4 through 10.

The depth to PCE-affected soils in the deed notice areas is shown on Figure 3. These depths range from 3 feet to 8 feet below the ground surface.

Contemplated Site Use

The site is zoned industrial by the Town of Kirkwood and is located in an area known as the Kirkwood Industrial Park. The property is presently owned by the Broome County Redevelopment Authority and leased to Universal Instruments Corporation (UIC), a subsidiary of Dover Corporation. Allowable uses for the site include offices, manufacturing, warehousing, research laboratories, and associated commercial activities.

The present zoning specifically prohibits residential uses.

Surface Cover System

The purpose of the surface cover system is to eliminate the potential for human contact with fill material and remaining contaminated soil, and eliminate the potential for soil erosion and contaminated soil and storm water runoff from the property. The cover system consists of two types, depending upon location of the area of concern. These cover system types are soil with vegetated cover and soil with an asphalt cover.

The cover systems at the site for accessible areas consist of the following two types:

1. Soil and vegetated cover – clean native and/or imported fill stabilized by grass or landscaping (tan bark/peat moss and shrubbery)

2. Soil and asphalt cover – clean native and/or imported fill covered by 4 to 6 inches of asphalt base and a 2-inch thick layer of asphaltic concrete

Cover system type #1 is found at deed notice areas **1, 3, 4, 5, and 6**. Cover system type #2 is found at deed notice areas **2 and 7**. The deed notice areas are shown on Figure 3.

There are eight areas of the site were PCE-affected soils are capped by a cover system. The PCE-affected soils are capped by asphalt, concrete, and/or a minimum of 3 feet of clean soil. The capped areas and the type of cap are listed below.

1. 1978 and 1984 Building Addition Area – 6-inch thick concrete slab
2. Area 1 of Figure 3 – soil, mulch, and landscaping
3. Area 2 of Figure 3 – asphalt (driveway)
4. Area 3 of Figure 3 – soil with grass surface
5. Area 4 of Figure 3 – soil with grass surface (drainage ditch)
6. Area 5 of Figure 3 – soil with grass surface (drainage ditch)
7. Area 6 of Figure 3 – soil with grass surface (drainage ditch)
8. Area 7 of Figure 3 – asphalt (parking lot)

Management of Soils and Long-Term Cover System Maintenance

The purpose of this section is to provide environmental guidelines for management of subsurface soils and the long-term maintenance of the cover system during any future intrusive work that may breach the cover system.

The SMP includes the following conditions:

- Any breach of the cover system, including for the purposes of construction or utility work, must be replaced or repaired using materials such as clean soil with grass seed or sod or impervious asphaltic or cementious concrete (as described in Section 4 or materials that will perform the same function) to prevent future possible erosion.
- Control of surface erosion and storm water runoff from the deed notice areas at all times, including during construction activities in these areas.
- Site soil that is excavated from a deed notice area and is intended for removal from the property must be managed, characterized, and properly disposed of in accordance with NYSDEC regulations and directives.
- Prior to any construction activities within the deed notice areas, workers are to be notified of the site conditions with clear instructions regarding how the work is to proceed safely. Invasive/intrusive work performed in the deed notice areas will be conducted in accordance with applicable local, state, and federal regulations to protect worker health and safety.
- The controlling entity on the site (owner and/or tenant) shall complete and submit to NYSDEC an annual report by January 15th of each year. The annual report shall contain a certification that the institutional controls put in place (Deed Notice with Environmental Restrictions[1]) are still in place; have not been altered and are still effective, that the remedy and protective cover

[1] Filed in Broome County at the Office of the County Clerk

have been maintained; and that the conditions at the site are fully protective of public health and the environment.

If any (or all) of the cover systems was breached during the year covered by the Annual Report, the responsible party shall include a certification that all work, including repair/replacement, was performed in conformance with this SMP.

These capped areas will be inspected monthly by the responsible party to check that the cap is being maintained in good condition. With respect to asphalt and concrete caps, the area surface will be visually checked for subsidence/settlement, excessive wear and/or cracking, and for breaches (such as pot holes). Areas with soil cover will be checked for subsidence/settlement, missing vegetative cover and/or excessive erosion. Construction activities (authorized or unauthorized) that have or may interfere with cap integrity will be noted.

If capped surfaces are found to be in unsatisfactory condition during inspections, site management will be notified and cap patches and repairs will be made, as warranted, with suitable material(s) as described in this SMP.

Attachment A – Field Equip. Calibration, Operation, and Maintenance Standard Operating Procedure

A-1 HNU Photoionization Detector Calibration, Operation, and Maintenance Procedures

A-2 pH Meter Calibration, Operation, and Maintenance Procedures

Attachment A-1 – HNU Photoionization Detector Calibration, Operation, & Maintenance Procedures

I. Introduction

The HNU meter measures relative concentrations of total organic and inorganic vapors and will be calibrated daily prior to use. The HNU meter is certified by Factory Mutual for use in Class 1, Division 2, Group A, B, C, and D environments. The HNU will be used to monitor breathing zones and work zones as specified in the Health and Safety Plan.

II. Materials

- HNU Photoionization Detector (PID)
- Isobutylene calibration gas tank with pressure regulator
- Plastic tubing to connect the PID probe to the calibration gas tank
- PID calibration log

III. Calibration Procedures

1. Turn the HNU meter dial to the standby position and zero the meter needle with the zero dial.

2. Switch the meter dial to the appropriate concentration range so as to be able to accurately read the calibration gas value.

3. Loosen the dial on the regulator allowing the calibration gas to flow from the tank, through the plastic tubing to the HNU probe.

4. Adjust the HNU calibration dial so that the meter value is equal to the calibration gas concentration.

5. Record the calibration dial value and the other information on the PID Calibration and Maintenance Log.

IV. Operation Procedure

1. Put on health and safety equipment (as required by the Health and Safety Plan).

2. Turn the FUNCTION switch to the BATTERY CHECK position. Check that the indicator is within or beyond the green battery arc. If indicator is below the arc or the red LED is lit, the battery must be charged.

3. Turn the FUNCTION switch to the STANDBY position and rotate the ZERO POTENTIOMETER until the meter reads zero. Wait 15 to 20 seconds to confirm the adjustment. If unstable, readjust.

4. Check to see that the SPAN POTENTIOMETER is set for the appropriate setting for the probe being used (5.0 for 9.5 eV probe, 9.8 for 10.2 eV, and 5.0 for 11.7 eV).

5. Set the FUNCTION switch to the desired ppm range (0-20, 0-200, or 0-2,000). A violet glow from the UV source should be visible at the sample inlet of the probe/sensor unit.

6. Listen for the fan operation to verify fan function (HNU only).

7. Measure and record the background PID reading.

8. Use PID as specified in the Health and Safety Plan.

V. Maintenance Procedures

1. At the end of each day or after 8 hours of monitoring with the HNU, recharge the batteries for 12 hours.

2. Store the instrument in protective case when not in use.

3. Keep records of operation, maintenance, calibration, problems, and repairs.

4. After use, the instrument will be inspected and the inspection recorded in the field notebook.

5. A replacement instrument will be available on-site or ready for overnight shipment, if necessary.

6. The HNU will be sent back to the manufacturer for service, if needed.

7. Record calibration information on PID Calibration and Maintenance Log.

Attachment A-2 – pH Meter Calibration, Operation, & Maintenance Procedures

I. Introduction

The pH meter will be calibrated daily prior to use.

II. Materials

- 10.0, 7.0, 4.0 pH buffer solutions
- Thermometer
- Distilled water
- Disposable plastic beakers
- Calibration and maintenance log

III. Calibration Procedures

The pH meter will be calibrated as follows:

1. Switch on instrument.

2. Connect electrode to meter and remove protective cap.

3. Rinse electrode in distilled water.

4. Measure and record temperature of buffer solutions.

5. Immerse pH electrode in pH buffer 7.00, set the temperature control to that of the buffer 7.00 and allow sufficient time for the electrode to stabilize. Adjust the Standardize Control for the correct readout.

6. Rinse electrode with distilled water.

7. Immerse pH electrode in buffer 4.0, set the temperature control to that of the buffer 4.0 and allow sufficient time for the electrode to stabilize. Adjust the Slope Control for the correct readout.

8a. Rinse the electrode with distilled water. The meter is calibrated and ready for use.

8b. (Optional step) If the pH is expected or could be between 7.0 to 10.0, then immerse the pH electrode in buffer 10.0, set temperature control, and allow sufficient time for the electrode to stabilize. Adjust the slope control for the correct read out.

9. Record calibration information on the Temperature/pH/DO/ORP/Conductivity Meter Calibration and Maintenance Log.

IV. Operation Procedures

1. Calibrate pH meter.

2. Rinse probe in distilled water.

3. Fill a disposable beaker with the water sample.

4. Insert probe into one sample beaker and obtain a reading. The meter will read between 0 and 14, in 0.01 increments.

5. Repeat Step 4.

6. Log results in field notebook and the average will be the actual result.

7. Rinse probe off in distilled water.

V. Maintenance Procedures

1. Replace batteries on a regular basis.

2. Store electrode in protective casing when not in use.

3. Keep records of operation, maintenance, calibration, problems, and repairs.

4. After use, the meter will be inspected and the inspection recorded in the field notebook.

5. A replacement meter will be available on-site or ready for overnight shipment, if necessary.

6. pH meter will be sent back to manufacturer for service, if needed.

7. Record maintenance information on the Temperature/pH/DO/ORP/Conductivity Meter Calibration and Maintenance Log.

Attachment B – Soil Sample Collection Procedures

I. Introduction

Prior to commencing any soil excavation activities, the Underground Facility Protection Organization (UFPO) must be contacted to have appropriate utility company (e.g., cable, gas, telephone) representatives mark the location of underground utilities at and in the vicinity of the proposed digging locations.

II. Equipment and Materials

The following materials, as needed, will be available during the soil sampling activities:

- photoionization detector (PID) - HNU, Microtip, Multi-RAE, or equivalent;
- appropriate health and safety equipment;
- plastic sheeting for each location;
- appropriate sample containers;
- appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials;
- chain-of-custody forms;
- indelible ink pens; and
- site map with sampling locations.

III. Soil Sampling

Soil samples will be collected from excavated soil taken from deed notice areas. The soil samples will be analyzed for waste classification purposes so that the waste soil may be properly disposed offsite or re-used onsite depending upon analytical results. Representative portions of soil for each sample batch will be placed in the appropriate laboratory containers and a one-pint container for visual observations and headspace screening. This container will be labeled with: 1) site; 2) sample number; 3) date; and 4) initials of sampling personnel. All samples will be screened with a PID to assess the presence of organic vapors using the procedures described in Section IV below.

The descriptions will be recorded in a dedicated field notebook. The person responsible for sampling will also be responsible for recording the following information in the field notebook:

- start and finish dates of sampling;
- name and location of project;
- project location;
- sample number and depth;
- type and size of samples;
- depth to water;
- type of sampling equipment;
- size of casing;
- names of equipment operators, inspectors, or people at the project area; and

Any excess soils generated during sampling activities be returned to its place of origin, either a steel 55-gallon drums or stockpile on plastic sheeting for subsequent disposal.

IV. Field Screening Procedures

All soil samples will be field screened upon collection with the PID for a relative measure of the total volatile concentration. The readings will be recorded in the field book or on the soil boring logs.

The PID meter will be calibrated in accordance with Appendix B. The procedures for selection of subsurface soil samples are detailed in the Initial Soil and Groundwater Sampling Work Plan.

V. Procedures for Collecting Soil Samples for Laboratory Analysis

Soil samples will be collected from the drums or stockpiles so as to be representative of the larger whole. Samples designated for laboratory analysis will be placed in the appropriate containers. Soils collected for volatile organic analysis will be placed in individual and separate without mixing. Other soil for other analyses will be homogenized by mixing in a stainless steel bowl with a clean stainless steel trowel, and distributed to the appropriate sample containers.

VI. Equipment Cleaning

Equipment cleaning will occur prior to use on the site, between each soil boring location, and upon completion of the soil boring activities prior to leaving the site. All soil boring equipment and associated tools that may have come in contact with the soil will be cleaned in accordance with the equipment cleaning procedures described in Attachment D. The soil boring equipment will be cleaned in an area designated by the supervising geologist. Cleaning water, PPE, dedicated equipment, and residual materials will be collected and containerized for subsequent disposal.

Attachment C – Water Sampling Procedures

I. Introduction

This protocol describes the procedures to be used to collect decontamination water samples from drums or other containers.

II. Materials

The following materials, as required, shall be available during water sampling:

- Sample tubing, drum thief, or disposable bailer;
- Photoionization detector (PID);
- Appropriate health and safety equipment as specified in the Health and Safety Plan;
- Plastic sheeting (for each sampling location);
- New disposable polypropylene rope;
- Appropriate water sample containers;
- Appropriate blanks (trip blank supplied by the laboratory);
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials;
- Groundwater sampling logs;
- Chain-of-custody forms; and
- Indelible ink pens;

III. Procedures for Water Sampling

The procedures to sample water from drums or other container will be as follows:

1. Review materials check list (Part II) to ensure the appropriate equipment has been acquired.

2. Record the date and time. Identify the personnel and equipment utilized and other pertinent data requested on the logs.

3. Label all sample containers using the laboratory-supplied label.

4. Don safety equipment, as required in the Health and Safety Plan.

5. Place plastic sheeting adjacent to well to use as a clean work area.

6. Establish the background reading with the PID and record the reading on the field log.

7. Set out on plastic sheeting the dedicated or disposable sampling device and meters.

8. Fill in the sample label and cover the label with clear packing tape to secure the label onto the container.

9. Insert the sampling device (tubing, thief, or bailer – as appropriate) into the drum or container and obtain the water sample needed for analysis directly from the sampling device in the appropriate container and tightly

screw on the caps. The sample collection order (as appropriate) will be as follows: VOCs, SVOC, PCBs/pesticides, metals and cyanide, and others.

10. Secure with packing material and store at 4ºC on wet ice in an insulated transport container provided by the laboratory.

11. Record the time sampling procedures were completed on the field logs.

12. Place all disposable sampling materials (plastic sheeting, disposable bailers, and health and safety equipment) in an appropriately labeled containers.

13. Complete the procedures for packaging, shipping, and handling with associated chain-of-custody.

IV. Field Quality Control

The following quality control procedures should be observed in the field:

- Equipment blanks should include the sampling device; and

- All monitoring instrumentation shall be operated in accordance with manufacturer's instructions and calibration procedures. Instruments should be calibrated at the beginning of the sampling event.

V. Equipment Cleaning

All re-usable sampling equipment should be cleaned at the end of the sampling event.

VI. Material Disposal

Materials generated during groundwater sampling activities, including disposable equipment will be placed in appropriate containers and disposed of by the client/owner.

Attachment D – Equipment Decontamination and Cleaning Standard Operating Procedures

I. Introduction

This attachment presents procedures which will be used to decontaminate equipment used to collect soil and decontamination water samples. The adequacy of cleaning procedures will be monitored through the collection of QA/QC rinse blank samples, as required, which will be submitted for laboratory analysis, if needed.

II. Sampling Equipment Decontamination

Generally, dedicated sampling equipment will be used during the investigations (i.e., stainless-steel trowels, plastic scoops, groundwater sample bailers). However, equipment that is not dedicated (i.e., direct push sampler) will be decontaminated prior to each use to mitigate the potential for cross-contamination of the samples collected for laboratory analysis. The decontamination procedures to be utilized during the investigation are presented below:

<u>For PCB, VOC, SVOC, and Inorganic Sampling</u>

1. Alconox (or equivalent) detergent solution wash.
2. Tap water rinse.
3. 10% nitric acid (HNO3) ultrapure rinse (if carbon steel split spoon is used, then 1% nitric acid should be used instead).
4. Distilled water rinse.
5. Methanol rinse (pesticide grade or better).
6. Distilled water rinse.
7. Hexane rinse (pesticide grade or better).
8. Distilled (demonstrated analyte free) water rinse.
9. Allow to air-dry.
10. Wrap in aluminum foil for storage or transport if it is not going to be used immediately.

III. Disposal Methods

All waste materials generated during cleaning procedures will be collected, containerized and staged onsite.

Appendix B

Quality Assurance/Sampling and Analysis Project Plan

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Quality Assurance/Sampling and Analysis Project Plan

OM&M Plan Program
Former Dover Electronics Site
Kirkwood, New York

Prepared for:
Universal Instruments Corporation

December 2004

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

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Preface

This Quality Assurance/Sampling and Analysis Project Plan (QA/SAPP) supplements the Operations, Maintenance and Monitoring (OM&M) Plan and presents the sampling and analytical methods and procedures that will be used during implementation of the post-remediation for the Soils Operable Unit (OU#1) at the former Dover Electronics site (now Universal Instruments Corporation site) in Kirkwood, New York.

This QA/SAPP was prepared in a manner consistent with the following reference and guidance documents:

- United States Environmental Protection Agency's (USEPA's) "Test Methods for Evaluating Solid Waste, SW-846" (USEPA, 1996);
- USEPA's guidance document entitled, "EPA Requirements for Quality Assurance Project Plans for Environmental Operations," EPA-QA/R-5 (USEPA, 2001), which replaces QAMS-005/80 "Interim Guidance and Specifications for Preparing Quality Assurance Project Plans" (USEPA, 1980); and
- The National Enforcement Investigations Center (NEIC) Policies and Procedures Manual (USEPA, 1991).

Information contained in this QA/SAPP has been organized into the following sections:

Section	Content
Project Management	
1	Project Background
2	Project Description
3	Quality Objectives and Criteria for Measurement Data
4	Special Training Requirements/Certification
5	Documentation and Records
Measurement/Data Acquisition	
6	Sampling Method Requirements
7	Sample Handling and Custody Requirements
8	Quality Control Requirements
9	Instrument/Equipment Testing, Inspection, and Maintenance Requirements
10	Instrument Calibration and Frequency
11	Data Management
Data Validation and Usability	
12	Data Review, Validation, and Verification
13	Validation and Verification Methods

Details are provided in the subsequent sections. This document also contains pertinent information from the OM&M Plan related to measuring and evaluating the analytical data.

1. Project Background

The following summarizes background information for the former Dover Electronics site with respect to implementation of the OM&M Plan.

1.1 Site Location and Description

The former Dover facility is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. The facility is located on a site approximately 9.58 acres in size.

The property is situated in an industrial setting. Major plants in the area include Truckstops of America Landfill (0.5 mile southeast), Frito Lay Plant (0.5 mile south), Universal Instruments (147 Industrial Park Drive, 0.5 mile east), Kason Industries (eastern property boundary), Consolidated Freightways (northern property boundary), and the newly developed Pilot Truck Stop to the south. Industrial properties surround the property to the north, east, and west. The site presently serves as one of Universal's service facilities with the site's uses including product training, research and development, and Odd Form Assembly (OFA), which involves the engineering and assembly of non-standard/specialty circuit boards.

Soil remediation activities conducted at the site during June and July 2003 were performed to mitigate PCE-affected soils in the unsaturated zone beneath and adjacent to the facility building at the site. The remedial action work included:

- abandonment and replacement of the roof leader from the roof drain system that handles stormwater runoff from the front part of the roof for the original building section of the facility;
- removal of specified soil from seven separate excavations;
- offsite transportation and disposal of non-hazardous and possible hazardous soil excavated;
- extension of the stormwater outfall from the southwest catch basin (CB-1547);
- restoration of excavated areas using compacted certified clean fill; and
- installation of an ASD system.

1.2 Description of OM&M Areas

A deed notice with environmental restrictions is to be filed with the Broome County Clerk's Office to provide an institutional control for inaccessible soils that remain below facility floor slabs. The NYSDEC-approved deed notice was forwarded by UIC to the site owner on April 26, 2004 for signature and subsequent filing with the Broome County Clerk.

The deed notice stipulates that there shall be no construction, use or occupancy of the property that results in the disturbance of the cover systems or which will result in human exposure to the contaminated soils, unless prior written approval by the NYSDEC is obtained.

The deed notice is for the areas beneath the footprints of the 1978 and 1984 building additions, areas beneath parts of the original building (1973) and the 1982 addition, and for seven additional areas where complete

removal of soil to below the NYSDEC criterion for PCE was not achieved. The areas that have environmental restrictions on the deed notice are shown on Figure 3 of the OM&M Plan.

Deed Notice Areas (Engineering Controls)

There are eight areas of the site were PCE-affected soils are capped. The PCE-affected soils are capped by asphalt, concrete, or a minimum of 3 feet of clean soil. The capped areas and the type of cap are listed below.

1. 1978 and 1984 Building Addition Area – 6-inch thick concrete slab
2. Area 1 of Figure 3 – soil, mulch, and landscaping
3. Area 2 of Figure 3 – asphalt (driveway)
4. Area 3 of Figure 3 – soil with grass surface
5. Area 4 of Figure 3 – soil with grass surface (drainage ditch)
6. Area 5 of Figure 3 – soil with grass surface (drainage ditch)
7. Area 6 of Figure 3 – soil with grass surface (drainage ditch)
8. Area 7 of Figure 3 – asphalt (parking lot)

These capped areas will be inspected monthly by UIC to check that the cap is being maintained in good condition. With respect to asphalt and concrete caps, the area surface will be visually checked for subsidence/settlement, excessive wear and/or cracking, and for breaches (such as pot holes). Areas with soil cover will be checked for subsidence/settlement, missing vegetative cover and/or excessive erosion. Construction activities (authorized or unauthorized) that have or may interfere with cap integrity will be noted.

If capped surfaces are found to be in unsatisfactory condition during inspections, site management will be notified and cap patches and repairs will be made, as warranted, with suitable material(s).

Should site activities necessitate that a cap be breached and PCE-affected soil removed, the soils will be placed either in drums or be placed on plastic sheeting and be covered by plastic sheeting. Removed soils will be tested for waste classification and will be properly disposed of off-site.

ASD System

Construction of the ASD system occurred during June 2003. The ASD system was installed within the 1978 and 1984 additions to see if it could be helpful in reducing indoor air concentrations of PCE within the building. The ASD system installation was performed as a field fabrication. The ASD system fabrication used typical design criteria, specifications, and technology common to the radon control industry.

Four extraction points, ASD-1 through ASD-4, were installed at the approximate locations shown on Figure 4. Suction pits for each extraction point were prepared by coring a 4.25-inch- diameter hole through the slab and then clearing gravel and soil from beneath the slab to create a hemispherical pit. The suction pits are approximately 12 inches in diameter and have a nominal volume of at least one cubic foot. The extraction point riser pipe was constructed of Schedule 40 PVC with a 4-inch-diameter. The slab penetration for the depressurization points were cleaned, prepared, and sealed in an air-tight manner with a compatible sealant that will not shrink or crack.

One ventilation fan was installed and is used to operate the ASD system. This fan operates the four sub-slab depressurization points through a manifold setup. The fan is an exterior mount (Radonwaway brand HS series HS5000 fan). The fan is Underwriter's Laboratory (UL)-approved for outdoor use (UL standard 507) and meets

all electrical code requirements. All ASD system electrical components are UL listed or of equivalent specifications. All plastic vent pipes and fittings are made of Schedule 40 PVC.

The ASD system is essentially self-operating and does not require adjustments. The ASD system essentially operates as either on or off. The ASD system includes mechanisms to monitor system performance and warn of system failure (shut off).

The ASD system has only one mechanical part, the suction fan. The fan does not require maintenance and has an expected operational life of 7 to 8 years. Other systems components, such as piping, gauges, and wiring could be inadvertently damaged or broken by other site activities. During inspections these features will be checked for damage. Broken or damaged parts of the system will be repaired or replaced.

The ASD system will be checked daily by UIC to verify that it is operating. Vacuum readings on the system shall be recorded weekly.

Indoor air quality samples shall be collected within the facility building semi-annually (March and September) at five locations with one background sampling location outside the building. All sampling locations for indoor air quality monitoring are shown on Figure 6.

Indoor air quality is monitored through the collection of 8-hour time-weighted averaged (TWA) samples. The indoor air samples are collected in summa canisters following procedures provided by the analytical laboratory. The indoor air samples shall be analyzed by an NYSDEC and NYSDOH approved analytical laboratory using USEPA method TO-15.

2. Project Description

This section describes the activities to be conducted during OM&M Plan implementation. Sampling activities associated with the OM&M Plan will be conducted to provide data the will satisfy the following objectives:

- Worker Health and Safety/Community Concerns
- Soil and Water Handling and Disposal

Sampling protocols to be followed during OM&M activities are described in Section 8 of this QA/SAPP. Samples collected during will be analyzed in accordance with the methods presented in Table 1.

The QASAPP has been prepared for the use of field personnel. The field personnel will have the following responsibilities and duties while performing work required by the OM&M Plan:

- perform field procedures associated with the investigations as set forth in the Work Plan;
- perform field analyses and collect QA samples;
- calibrate, operate, and maintain field equipment;
- reduce field data;
- maintain sample custody; and
- prepare field records and logs.

2.1 Worker Health and Safety/Community Concerns

Office workers may be potentially exposed to elevated concentrations of volatile organic vapors, particularly tetrachloroethene (PCE), emanating from affected-soils beneath the building. Indoor air samples will be collected to monitor the indoor air quality at the UIC facility.

Workers could potentially be exposed (i.e., through dermal contact, ingestion, or inhalation) to contaminated soil during demolition/construction activities and during handling and transport of soil and decontamination water generated during demolition/construction activities. To assess these issues, field monitoring with a photoionization detector (PID) or flame-ionization detector (FID) should be performed during soil excavation work in deed noticed areas. Depending on the results, specific mitigation measures during demolition and construction may be needed as described in the Health and Safety Plan.

2.2 Soil and Water Handling/Disposal

Any soil generated during excavation work within any of the deed noticed areas will be sampled so that the analytical results can be used to determine transportation and disposal requirements for the soil and any decontamination water generated. Since the soil intended for disposal is regulated as a solid waste, a hazardous waste determination must be performed. In support of this determination, the QA/SAPP includes testing for specific parameters included in state and federal regulations.

3. Quality Objectives and Criteria for Measurement Data

The overall objectives of the OM&M Plan activities are as follows:

- To provide data to support performance evaluation of the ASD system (engineering control), which is being operated to reduce the potential for exposure to PCE vapors in excess of acceptable concentrations; and
- To provide data to evaluate handling and disposal options for soil and decontamination water removed during demolition/construction activities.

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decisions made during site-related activities and are based on the end uses of the data to be collected. Preliminary DQOs were identified to confirm that the data generated during field investigations will be of adequate quality and sufficient quantity to form a sound basis for decision making relative to the above objectives.

A DQO summary for the sampling investigation efforts is presented in the subsequent sections. The summary consists of stated DQOs relative to data uses, data types, data quantity, sampling and analytical methods, and data measurement performance criteria.

Two data categories have been defined to address various analytical data uses and the associated QA/QC effort and methods required to achieve the desired levels of quality. These categories are described below:

Screening Data: Screening data affords a quick assessment of site characteristics or conditions. This objective for data quality is applicable to data collection activities that involve rapid, non-rigorous methods of analysis and quality assurance. This objective is generally applied to physical and/or chemical properties of samples, degree of contamination relative to concentration differences, and preliminary health and safety assessment.

Confirmation Data: Confirmation data provided quanitative data for decision making by can be relatively less precise that more rigorous definitive data. Confirmation data is generated using laboratory analytical methods. This objective for data quality is available for data collection activities that require quantitative verification of field screening data where the verification process can rely on less rigorous laboratory-based methods and reporting.

A third category of data is:

Definitive Data: Definitive data are generated using analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files.

Only screening and confirmation type data are needed to satisfy the requirements of the OM&M Plan. Definitive data is not necessary for this project.

Subsequently for this project, two levels of data reporting have been defined. They are as follows:

Level 1 - Minimal Reporting: Minimal or "results only" reporting is used for analyses that, either due to their nature (i.e., field monitoring) or the intended data use (i.e., preliminary screening), do not generate or require extensive supporting documentation.

Level 2 - Modified Reporting: Modified reporting is used for analyses that are performed following standard USEPA-approved methods and QA/QC protocols. Based on the intended data use, modified reporting may require some supporting documentation but not, however, full "CLP-type" reporting.

Screening data and Level 1 reporting will be used for field activities, such as monitoring soil excavation work. Confirmation data and Level 2 reporting will be used for sampling activities associated with waste disposal (soil excavation) and indoor air quality (ASD monitoring).

4. Special Training Requirements/Certification

In compliance with the Occupational Safety and Health Administration's (OSHA's) final rule, "Hazardous Waste Operations and Emergency Response," 29CFR§1910.120(e), all personnel performing soil and groundwater sampling activities at the site will have completed the requirements for OSHA 40-hour Hazardous Waste Operations and Emergency Response training. Persons in field supervisory positions will have also completed the additional OSHA 8-hour Supervisory Training.

5. Documentation and Records

5.1 General

Indoor air, soil and decontamination water samples will be collected as described in the OM&M Plan and Section 8 of this document. Examples of sample designations, documentation, and reporting requirements are presented below.

5.2 Sample Designation System

Indoor air samples will be designated by the location of the sample collection point. There are six locations for indoor air sample collection. The designation for each location shall be as follows:

Background Sample	=	BACKGROUND
Air Conditioning Area	=	A/C AREA
Switch Gear Area	=	ELECTRICAL AREA
Office Space North	=	OFFICE #1
Office Space South	=	OFFICE #2
Cafeteria	=	CAFETERIA

Should additional samples be collected from the same location during the same indoor air monitoring and sampling event, they may be labeled as "-1", "-2" or "A", "B".

Soil samples collected for waste classification purposes should be labeled according to the drum or stockpile from which they are collected. The designation should read "Drum #1, Stockpile #1" or if a composite as "Composite #1) and so on in a consecutive manner as needed. Likewise, decontamination water samples should be labeled according to the drum or container from which they are collected.

5.3 Field Documentation

Field personnel will provide comprehensive documentation covering various aspects of field sampling, field analysis, and sample chain-of-custody. This documentation constitutes a record that allows reconstruction of field events to aid in the data review and interpretation process. Documents, records, and information relating to the performance of the field work will be retained in the project file.

The various forms of documentation to be maintained throughout the action include the following:

- Daily Production Documentation - A field notebook consisting of a waterproof, bound notebook that will contain a record of all activities performed at the site.

- Sampling Information - Detailed notes will be made as to the exact sampling location, physical observations, and weather conditions (as appropriate).

- Sample Chain-of-Custody - Chain-of-custody (COC) forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. COC forms will be filled out at each

sampling site, at a group of sampling sites, or at the end of each day of sampling by field personnel responsible for sample custody. In the event that the samples are relinquished by the designated sampling person to other sampling or field personnel, the COC form will be signed and dated by the appropriate personnel to document the sample transfer. The original COC form will accompany the samples to the laboratory, and copies will be forwarded to the project files.

Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

- Field Equipment, Calibration, and Maintenance Logs - To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory-calibrated.

5.4 Laboratory Documentation Files

5.4.1 Laboratory Project Files

The analytical laboratory will establish a file for pertinent data. The file will include correspondence, faxed information, phone logs, and COC forms. The laboratory will retain project files and data packages for not less than a period of 5 years.

5.4.2 Laboratory Logbooks and Electronic Records

Workbooks, bench sheets, instrument logbooks, and instrument printouts will be used to trace the history of samples through the analytical process and to document important aspects of the work, including the associated quality controls. As such, logbooks, bench sheets, instrument logs, and instrument printouts will be part of the permanent record of the laboratory.

Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with a single stroke, corrected without the use of white-out or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used will be completed by lining out unused portions.

Information regarding the sample, analytical procedures performed, and the results of the testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated and will also identify the analyst, the instrument used, and the instrument conditions.

Laboratory notebooks will be periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance to this QA/SAPP. All entries and calculations will be verified by the laboratory group leader. If all entries on the pages are correct, then the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs.

All electronic files and deliverables will be maintained on magnetic tape or disk for not less than 5 years; hard copy data packages (or electronic copies) will be maintained in the files for 5 years.

5.5 Data Reporting Requirements

5.5.1 Field Data Reporting

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks or data sheets and/or on forms. Such data will be reviewed by the appropriate Task Manager. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

The original field logs, documents, and data reductions will be kept in the project file at the BBL office in Syracuse, New York.

5.5.2 Laboratory Data Reporting

The laboratory is responsible for preparing Level 1-equivalent data packages for all total VOCs, SVOCs, PCBs, metals, and reduced data packages and case narratives for all TCLP and characteristics analyses.

Data reports for all parameters will include, at a minimum, the following items.

Narrative: Summary of activities that took place during the course of sample analysis, including the following information:

- laboratory name and address;
- date of sample receipt;
- cross reference of laboratory identification number to contractor sample identification;
- analytical methods used;
- deviations from specified protocol; and
- corrective actions taken.

Included with the narrative will be any sample handling documents, including field and internal COC forms, air bills, and shipping tags.

Analytical Results: Reported according to analysis type and including the following information, as acceptable:

- sample ID;
- laboratory ID;
- date of collection;
- date of receipt;
- date of extraction;
- date of analysis; and
- detection limits.

Sample results on the report forms will be corrected for dilutions. Soil samples will be reported on a dry-weight basis. Unless otherwise specified, results will be reported uncorrected for blank contamination.

The data for total VOCs, SVOCs, PCBs, and metals analyses will be expanded to include supporting documentation necessary to provide a reduced deliverable-equivalent package when requested. This additional documentation will include, but is not limited to, raw data required to recalculate any result, including instrument printouts and quantitation reports. The report also will include standards used in calibration and calculation of analytical results; sample extraction, digestion, and other preparation logs; standard preparation logs; instrument run logs; and moisture content calculations.

6. Sampling Method Requirements

As part of the field investigations, several standard field procedures will be utilized. This section of the QA/SAPP introduces and references the appropriate detailed procedure in the Appendices to the OM&M Plan. Included are the ancillary procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments. Sample analytical constituents and parameters are summarized in Table 1. The required sample containers, volumes, preservation, and holding times are summarized in Table 3.

Sampling equipment and procedures will be as discussed in Appendices B, C, D, E, and G in the OM&M Plan.

7. Sample Handling and Custody Requirements

7.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for OM&M samples are shown in Table 3.

The analytical laboratory will supply appropriate sample containers and preservatives, as necessary. The bottles will be purchased pre-cleaned according to USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9240.05A requirements. The field personnel will be responsible for properly labeling containers and preserving samples (as appropriate). Sample labeling procedures are described in ISGSP Work Plan Appendix G.

7.2 Field Custody Procedures

The objective of field sample custody is to assure that samples are not tampered with from the time of sample collection through the time of transport to the analytical laboratory. Persons will have "custody of samples" when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

Field custody documentation consists of both field logbooks and field COC forms.

7.2.1 Field Logbooks

Field logbooks will provide the means of recording the data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- person to whom the logbook is assigned;
- logbook number;
- project name;
- project start date; and
- end date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. Entries will be made in ink, and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Whenever a sample is collected or a measurement is made, a detailed description of the location of the MTS shall be recorded. The number of the photographs taken of the MTS, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in Section 8. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume, and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

7.2.2 Sample Labeling

Preprinted sample labels will be affixed to sample bottles prior to delivery at the sampling site. The following information is required on each sample label:

- project;
- date collected;
- time collected;
- location;
- sampler;
- analysis to be performed;
- preservative; and
- sample number.

7.2.3 Field Chain of Custody Forms

Completed COC forms will be required for all samples to be analyzed. COC forms will be initiated by the sampling crew in the field. The COC forms will contain the unique sample identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. The original COC form will accompany the samples to the laboratory. Copies of the COC will be made prior to shipment (or multiple copy forms used) for field documentation. The COC forms will remain with the samples at all times. The samples and signed COC forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., Federal Express), or hand delivered to a mobile or permanent laboratory, or placed in secure storage.

Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. The labels will include sample information such as: sample number and location, type of sample, date and time of sampling, sampler's name or initials, preservation, and analyses to be performed. The completed sample labels will be affixed to each sample bottle and covered with clear tape.

Whenever samples are split with a government agency or other party, a separate COC will be prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative’s signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the “Received By” space.

7.3 Management of OM&M-Derived Materials and Wastes

Disposable equipment, debris, and decontamination rinsate (e.g., distilled water containing small amounts of solvent) will be containerized during the sampling events, labeled, and staged onsite.

7.4 Packing, Handling, and Shipping Requirements

Sample packaging and shipment procedures are designed to ensure that the samples will arrive at the laboratory, with the COC intact.

Samples will be packaged for shipment as outlined below:

- complete sample label with the following information: sample type, project number, site name, sample identification code, analyses required, date, time sampled, and preservative added (if applicable);
- ensure that sample containers have the sample labels securely affixed to the container with clear packing tape;
- check the caps on the sample containers to ensure that they are properly sealed;
- wrap the sample container cap with clear packing tape to prevent it from becoming loose;
- complete the COC form with the required sampling information and ensure that the recorded information matches the sample labels. NOTE: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the COC prior to this transfer. The appropriate personnel will sign and date the COC form to document the sample custody transfer;
- using duct tape, secure the outside drain plug at the bottom of the cooler;
- place each sample container or package in individual polyethylene bags and seal;
- place 1 to 2 inches of cushioning material at the bottom of the cooler;
- place the sealed sample containers upright into the cooler;
- place ice in plastic bags and seal; place loosely in the cooler;
- fill the remaining space in the cooler with cushioning material;
- place COC forms in a plastic bag and seal; tape the forms to the inside of the cooler lid;
- close the lid of the cooler, lock, and secure with duct tape;
- wrap strapping tape around both ends of the cooler at least twice; and
- mark the cooler on the outside with the following information: shipping address, return address, "Fragile" labels, and arrows indicating “this side up;” cover the labels with clear plastic tape; place a signed custody seal over the cooler lid.

Samples will be packaged by the field personnel and transported as low-concentration environmental samples. The samples will be hand-delivered or delivered by an express carrier within 48 hours of the time of collection. Shipments will be accompanied by the COC form identifying the contents. The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading will be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the COC form as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage.

Additional procedures for packing, handling, and shipping environmental samples are included in the ISGSP Work Plan.

7.5 Laboratory Custody Procedures

7.5.1 General

Upon sample receipt, laboratory personnel will be responsible for sample custody. The original field COC form will accompany all samples requiring laboratory analysis. The laboratory will use COC guidelines described in the USEPA guidance documents. Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for documenting and maintaining sample integrity.

7.5.2 Sample Receipt and Storage

Immediately upon sample receipt, the laboratory sample custodian will verify the package seal, open the package, and compare the contents against the field COC. If a sample container is received broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, Dover/Universal will be notified. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

7.5.3 Sample Analysis

Analysis of an acceptable sample will be initiated by worksheets that contain all pertinent information for analysis. The analyst will sign and date the laboratory COC form when removing the samples from storage.

Samples will be organized into sample delivery groups (SDGs) by the laboratory. A SDG may contain up to 20 field samples (field duplicates, trip blanks, and rinse blanks are considered field samples for the purposes of SDG assignment). All field samples assigned to a single SDG shall be received by the laboratory over a maximum of 7 calendar days and must be processed through the laboratory (preparation, analysis, and reporting) as a group.

Each SDG will be self-contained for all of the required quality control samples. All parameters within an SDG will be extracted and analyzed together in the laboratory. These rules for analysis will ensure that the QC samples for an SDG are applicable to the field samples of the same SDG and that the best possible comparisons may be made.

7.5.4 Sample Storage Following Analysis

Samples will be maintained by the laboratory for one month after the final report is delivered to Universal. After this period, the laboratory is responsible for the disposal of the samples. Unused portions of the samples, sample extracts, and associated wastes will be disposed of by the laboratory in accordance with applicable rules and regulations, as specified in their Standard Operating Procedure for waste disposal.

8. Quality Control Requirements

8.1 Quality Assurance Indicators

The overall quality assurance objective for this QA/SAPP is to develop and implement procedures for sampling, COC, laboratory analysis, instrument calibration, data reduction and reporting, internal quality control, audits, preventive maintenance, and corrective action so that valid data will be generated. These procedures are presented or referenced in the following sections of the QA/SAPP. Specific QC checks are discussed in Section 8.2.

Quality assurance indicators are generally defined in terms of five parameters:

1. Representativeness
2. Comparability
3. Completeness
4. Precision
5. Accuracy

Each parameter is defined below. Specific objectives for the site actions are set forth in other sections of this QAPP, as referenced below.

8.1.1 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions and is dependent on sampling and analytical variability and the variability of environmental media at the site. The actions have been designed to assess the presence of the chemical constituents at the time of sampling. This QA/SAPP presents field sampling methodologies and laboratory analytical methodologies. The use of the prescribed field and laboratory analytical methods, with associated holding times and preservation requirements, are intended to provide representative data.

8.1.2 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between phases of the actions (if additional phases are required) will be maintained through consistent use of the sampling and analytical methodologies set forth in this QA/SAPP and through the use of established QA/QC procedures and the utilization of appropriately trained personnel.

8.1.3 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results, as discussed in Section 8.6.

8.1.4 Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize precision, sampling and analytical procedures will be followed. All work for the site actions will adhere to established protocols presented in the QA/SAPP. Checks for analytical precision will include the analysis of matrix spike, matrix spike duplicates, laboratory duplicates, and field duplicates. Checks for field measurement precision will include obtaining duplicate field measurements. Further discussion of precision QC checks is provided in Section 8.4.

8.1.5 Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, matrix spikes, blank spikes, and surrogate standards will be used to assess the accuracy of the analytical data.

8.2 Field Quality Control Checks

8.2.1 Field Measurements

To verify the quality of data using field instrumentation, duplicate measurements will be obtained and reported for all field measurements. A duplicate measurement will involve obtaining measurements a second time at the same sampling location.

8.2.2 Sample Containers

Certified-clean sample containers (I-Chem 300 Series or equivalent) will be supplied by the laboratory. Certificates of analysis will be filed in the project file.

8.2.3 Field Duplicates

Field duplicates will be collected from the different site materials to verify the reproducibility of the sampling methods. Field duplicates will be prepared by placing well homogenized aliquots from the same sample location into individual sample containers, which are submitted blind to the laboratory. In general, field duplicates will be analyzed at a 5% frequency (every 20 samples) for the chemical constituents. Table 1 provides an estimated number of field duplicates to be prepared for each applicable parameter and matrix.

8.2.4 Rinse Blanks

Rinse blanks are used to monitor the cleanliness of the sampling equipment and the effectiveness of the cleaning procedures. Rinse blanks will be prepared and submitted for analysis once per day per matrix. Rinse blanks will be prepared by filling sample containers with analyte-free water (supplied by the laboratory) that has been routed through a cleaned sampling device. When dedicated sampling devices are used or sample containers are

used to collect the samples, rinse blanks will not be necessary. Table 1 provides an estimated number of rinse blanks for environmental media samples to be collected during the removal action.

8.2.5 Trip Blanks

Trip blanks will be used to assess whether site samples have been exposed to non-site-related volatile constituents during sample storage and transport. Trip blanks will be submitted at a frequency of once per cooler of aqueous samples to be analyzed for VOCs. A trip blank will consist of a container filled with analyte-free water (supplied by the laboratory) that remains unopened with field samples throughout the sampling event. Trip blanks will only be analyzed for VOCs. Table 1 provides an estimated number of trip blanks to be collected for each matrix and parameter during the soil and groundwater sampling activities.

8.3 Analytical Laboratory Quality Control Checks

8.3.1 General

Internal laboratory QC checks will be used to monitor data integrity. These checks will include method blanks, matrix spikes (and matrix spike duplicates), spike blanks, internal standards, surrogate samples, calibration standards, and reference standards. Project QC limits for duplicates and matrix spikes are identified in Table 2. Laboratory control charts will be used to determine long-term instrument trends.

8.3.2 Method Blanks

Sources of contamination in the analytical process, whether specific analyses or interferences, need to be identified, isolated, and corrected. The method blank is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank is initiated at the beginning of the analytical process and encompasses all aspects of the analytical work. As such, the method blank would assist in accounting for any potential contamination attributable to glassware, reagents, instrumentation, or other sources that could affect sample analysis. One method blank will be analyzed with each analytical series associated with no more than 20 samples.

8.3.3 Surrogate Spikes

Surrogates are compounds that are unlikely to occur under natural conditions that have properties similar to the analytes of interest. This type of control is primarily used for organic samples analyzed by gas chromatography/mass spectrometry (GC/MS) and gas chromatography (GC) methods and is added to the samples prior to purging or extraction. The surrogate spike is utilized to provide broader insight into the proficiency and efficiency of an analytical method on a sample-specific basis. This control reflects analytical conditions that may not be attributable to sample matrix.

If surrogate spike recoveries exceed specified QC limits, then the analytical results need to be evaluated thoroughly in conjunction with other control measures. In the absence of other control measures, the integrity of the data may not be verifiable and reanalysis of the samples with additional control measures may be necessary.

Surrogate spike compounds will be selected utilizing the guidance provided in the analytical methods.

8.3.4 Laboratory Duplicates

For inorganics, laboratory duplicates will be analyzed to assess laboratory precision. Laboratory duplicates are defined as a separate aliquot of an individual sample that is analyzed as a separate sample. Table 1 presents an estimated number of laboratory duplicates for each applicable parameter.

8.3.5 Calibration Standards

Calibration check standards analyzed within a particular analytical series provide insight regarding instrument stability. A calibration check standard will be analyzed at the beginning and end of an analytical series, or periodically throughout a series containing a large number of samples.

In general, calibration check standards will be analyzed after every 12 hours, or more frequently, as specified in the applicable analytical method. If results of the calibration check standard exceed specified tolerances, then samples analyzed since the last acceptable calibration check standard will be reanalyzed.

Laboratory instrument calibration standards will be selected utilizing the guidance provided in the analytical methods summarized in Section 13.

8.3.6 Reference Standards/Control Samples

Reference standards are standards of known concentration and independent in origin from the calibration standards. The intent of reference standard analysis is to provide insight into the analytical proficiency within an analytical series. This includes the preparation of calibration standards, the validity of calibration, sample preparation, instrument set-up, and the premises inherent in quantitation. Reference standards will be analyzed at the frequencies specified within the analytical methods.

8.4 Data Precision Assessment Procedures

Field precision is difficult to measure because of temporal variations in field parameters. However, precision will be controlled through the use of experienced field personnel, properly calibrated meters, and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system, including sampling, handling, shipping, storage, preparation, and analysis.

Laboratory data precision will be monitored through the use of matrix spike/matrix spike duplicate and laboratory duplicate sample analyses.

The precision of data will be measured by calculation of the relative percent difference (RPD) by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = Analytical result from one of two duplicate measurements; and
B = Analytical result from the second measurement.

Precision objectives for duplicate analyses are identified in Table 2.

8.5 Data Accuracy Assessment Procedures

The accuracy of field measurements will be controlled by experienced field personnel, properly calibrated field meters, and adherence to established protocols. The accuracy of field meters will be assessed by review of calibration and maintenance logs.

Laboratory accuracy will be assessed via the use of matrix spikes, surrogate spikes, and reference standards. Where available and appropriate, QA performance standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

$$\% \text{ Recovery} = \frac{A-X}{B} \times 100$$

Where:

A = Value measured in spiked sample or standard;
X = Value measured in original sample; and
B = True value of amount added to sample or true value of standard.

This formula is derived under the assumption of constant accuracy between the original and spiked measurements. Accuracy objectives for matrix spike recoveries are identified in Table 2.

8.6 Data Completeness Assessment Procedures

Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90%. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

9. Instrument/Equipment Testing, Inspection, and Maintenance Requirements

9.1 General

Testing and maintenance schedules have been developed for both field and laboratory instruments. A summary of the testing and maintenance activities to be performed is presented below.

9.2 Field Instruments and Equipment

Prior to any field sampling, each piece of field equipment will be inspected to assure it is operational. If the equipment is not operational, it must be serviced prior to use. All meters that require charging or batteries will be fully charged or have fresh batteries. If instrument servicing is required, it is the responsibility of the appropriate Task Manager or field personnel to follow the maintenance schedule and arrange for prompt service.

Field instrumentation to be used in this study include a PID to measure organic vapors and meters to measure pH, conductivity, turbidity, and temperature. A logbook will be kept for each field instrument. Each logbook will contain records of operation, maintenance, calibration, problems, and repairs. The BBL Task Managers will review calibration and maintenance logs.

Field equipment returned from a site will be inspected to confirm it is in working order. This inspection will be recorded in the logbook or field notebooks as appropriate. It will also be the obligation of the last user to record any equipment problems in the logbook.

Non-operational field equipment will be either repaired or replaced. Appropriate spare parts will be made available for field meters.

9.3 Laboratory Instruments and Equipment

9.3.1 General

All laboratory instruments and equipment repair and maintenance shall be documented. Documentation will include details of any observed problems, corrective measure(s), routine maintenance, and instrument repair (which will include information regarding the repair and the individual who performed the repair).

Preventive maintenance of laboratory equipment generally will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house staff or through a service call from the manufacturer.

9.3.2 Instrument Maintenance

Maintenance schedules for laboratory equipment will adhere to the manufacturer's recommendations. Records will reflect the complete history of each instrument and specify the time frame for future maintenance. Major repairs or maintenance procedures will be performed through service contracts with the manufacturer or qualified contractors. Paperwork associated with service calls and preventative maintenance calls will be kept on file by the laboratory.

Laboratory Systems Managers are responsible for the routine maintenance of instruments used in the particular laboratory. Any routine preventative maintenance carried out will be logged into the appropriate logbooks. The frequency of routine maintenance will be dictated by the nature of samples being analyzed, the requirements of the method used, and/or the judgment of the Laboratory Systems Manager.

All major instruments will be backed up by comparable (if not equivalent) instrument systems in the event of unscheduled downtime. An inventory of spare parts will also be available to minimize equipment/instrument downtime.

10. Instrument Calibration and Frequency

10.1 Field Instruments and Equipment

Field personnel are responsible for ensuring that a master calibration/maintenance log is maintained following the procedures specified for each measuring device. Each log will include, at a minimum where applicable, the following:

- name of device and/or instrument calibrated;
- device/instrument serial/identification number;
- frequency of calibration;
- date(s) of calibration(s);
- results of calibration(s); and
- name of person(s) performing calibration(s).

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

Equipment to be used during the field sampling will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manual to ensure that all maintenance requirements are being observed. Field notes from previous sampling events will be reviewed to ensure that any prior equipment problems are not overlooked and that any necessary repairs to equipment have been carried out.

Calibration of field instruments will be performed at the intervals specified by the manufacturer, or more frequently as conditions dictate. Field instruments will include a PID, pH meter, thermometer, nephelometer, and specific conductivity meter. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service.

Calibration of field instruments is governed by the specific Standard Operating Procedures (SOPs) presented in the OM&M Plan. All readings and calibrations will be recorded in the field notebook.

10.2 Laboratory Instrument and Equipment

When analyses are conducted according to the USEPA SW-846 methods, the calibration procedures and frequencies specified in the applicable method will be followed. For analyses governed by SOPs, see the appropriate SOP for the required calibration procedures and frequencies. Records of calibrations will be filed and maintained by the laboratory. These records will be subject to a QA audit. For all instruments, the laboratory will maintain trained repair staff with in-house spare parts or will maintain service contracts with vendors.

All standards used in the calibration of equipment are traceable, directly or indirectly, to National Institute of Standards and Technology (NIST). All standards received shall be logged into standard receipt logs maintained by the individual analytical groups. Each group shall maintain a standards log that tracks the preparation of standards used for calibration and QC purposes.

11. Data Management

The purpose of data management is to ensure that all of the necessary data are accurate and readily accessible to meet the analytical and reporting objectives of the project. The field investigation will encompass a large number of samples and analytes from a large geographic area. From the large amount of resulting data, the need arises for a structured, comprehensive, and efficient program for management of data.

The data management program established for the project includes field documentation and sample QA/QC procedures, methods for tracking and managing the data, and a system for filing all site-related information. More specifically, data management procedures will be employed to efficiently process the information collected so that the data are readily accessible and accurate. These procedures are described in detail in the following sections.

The data management plan has three elements: 1) sample designation system, 2) field activities, and 3) sample tracking and management.

11.1 Sample Designation System

A concise and easily understandable sample designation system is an important part of the project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy resampling of select locations to evaluate data gaps, if necessary. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sample collected, as outlined in Section 6.2.1.

11.2 Field Activities

Field activities designed to gather the information necessary to make decisions regarding the offsite areas require consistent documentation and accurate record keeping. During site activities, standardized procedures will be used for documentation of field activities, data security, and QA. These procedures are described in further detail in the following subsections.

11.2.1 Field Documentation

Complete and accurate record keeping is a critical component of the field investigation activities. When interpreting analytical results and identifying data trends, investigators realize that field notes are an important part of the review and validation process. To ensure that the field investigation is thoroughly documented, several different information records, each with its own specific reporting requirements, will be maintained, including the following:

- field logs; and
- chain-of-custody forms.

A description of each of these types of field documentation is provided below.

Field Logs

The personnel performing the field activities will keep field logs that detail all observations and measurements made during the remedial investigation. Data will be recorded directly into site-dedicated, bound notebooks, with each entry dated and signed. To ensure at any future date that notebook pages are not missing, each page will be sequentially numbered. Erroneous entries will be corrected by crossing out the original entry, initialing it, and then documenting the proper information. In addition, certain media sampling locations will be surveyed to accurately record their locations. The survey crew will use their own field logs and will supply the sampling location coordinates to the Database Administrator.

Chain-of-Custody Forms

COC forms are used as a means of documenting and tracking sample possession from time of collection to the time of disposal. A COC form will accompany each field sample collected, and one copy of the form will be filed in the field office. All field personnel will be briefed on the proper use of the COC procedure. A more thorough description of the COC forms is located in the SOPs (ISGSP Work Plan).

11.2.2 Data Security

Measures will be taken during the field investigation to ensure that samples and records are not lost, damaged, or altered. When not in use, all field notebooks will be stored at the field office or locked in the field vehicle. Access to these files will be limited to the field personnel who utilize them.

11.3 Sample Management and Tracking

A record of all field documentation, as well as analytical and QA/QC results, will be maintained to ensure the validity of data used in the site analysis. To effectively execute such documentation, carefully constructed sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of COC forms. The completed COC forms associated with samples collected accompany the samples. Copies of all completed COC forms will be maintained in the field office. The laboratory shall verify receipt of the samples via fax or e-mail within two days of receipt.

When analytical data are received from the laboratory, the incoming analytical data packages should be reviewed against the information on the COCs to confirm that the correct analyses were performed for each sample and that results for all samples submitted for analysis were received. Any discrepancies noted must be promptly followed-up with the laboratory.

12. Data Review, Validation, and Verification

12.1 General

After field and laboratory data are obtained, the data will be subject to the following:

- reduction, or manipulation mathematically, or otherwise into meaningful and useful forms;
- review;
- organization, interpretation, and reporting; and
- data validation, if warranted.

12.2 Field Data Reduction and Review

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks or data sheets and/or on forms. Such data will be reviewed by the appropriate Task Manager for adherence to the OM&M Plan and this QA/SAPP and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

Field data calculations, transfers, and interpretations will be conducted by the field personnel and reviewed for accuracy by the appropriate supervisor. Logs and documents will be checked for the following:

- general completeness;
- readability;
- usage of appropriate procedures;
- appropriate instrument calibration and maintenance;
- reasonableness in comparison to present and past data collected;
- correct sample locations; and
- correct calculations and interpretations.

12.3 Laboratory Data Reduction and Review

12.3.1 Laboratory Data Reduction

The calculations used for data reduction will be specified in each of the analytical methods referenced previously. Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be entered into permanently bound laboratory notebooks. The data entered will be sufficient to document all factors used to arrive at the reported value.

Concentration calculations for chromatographic analyses will be based on response factors. Quantitation will be performed using either internal or external standards.

Inorganic analyses will be based on regression analysis. Regression analysis is used to fit a curve through the calibration standard data. The sample concentrations will be calculated using the resulting regression equations. Non-aqueous values will be reported on a dry-weight basis. Unless otherwise specified, all values will be reported uncorrected for blank contamination.

12.3.2 Laboratory Data Review

Data will be subject to multi-level review by the laboratory. The group leader will review all data reports prior to release for final data report generation. The quality assurance manager will review the final data reports, and the laboratory director will review a cross section of the final data reports prior to shipment.

If discrepancies or deficiencies exist in the analytical results, then corrective action will be taken in accordance with laboratory policy. Deficiencies discovered as a result of internal data review, as well as the corrective actions to be used to rectify the situation, will be documented in the case narrative.

12.4 Data Validation and Verification

All data generated for health and safety and engineering design/control purposes will be subjected to the data validation and verification procedures outlined in Section 13, if warranted. Data generated for disposal purposes will not be reviewed. Initially a data usability review will be performed on the data.

13. Validation and Verification Methods

13.1 Data Validation and Verification

Data validation entails a review of the QC data and the raw data to verify that the laboratory was operating within required limits, the analytical results were correctly transcribed from the instrument read outs, and which, if any, environmental samples were related to any out-of-control QC samples. The objective of data validation is to identify any questionable or invalid laboratory measurements.

No data validation is proposed at this time. However, data will be reviewed for usability. If validation should become warranted, the data will be validated using the most recent versions of the USEPA's and NYSDEC's data validation guidance documents. These procedures and criteria may be modified, as necessary, to address project-specific and method-specific criteria, control limits, and procedures.

Data validation will consist of data screening, checking, reviewing, editing, and interpretation to document analytical data quality and to determine whether the quality is sufficient to meet the data quality objectives. Data validation will include a review of completeness and compliance, including, but not limited to, the elements provided in Table 4.

The data validator will verify that reduction of laboratory measurements and laboratory reporting of analytical parameters is in accordance with the procedures specified for each analytical method and/or as specified in this QA/SAPP. Any deviations from the analytical method or any special reporting requirements apart from that specified in this QA/SAPP will be detailed on COC forms.

Upon receipt of laboratory data, the following procedures will be executed by the data validator:

- evaluate completeness of the data package;
- verify that field COC forms were completed and that samples were handled properly;
- verify that holding times were met for each parameter. Holding time exceedences, should they occur, will be documented. Data for all samples exceeding holding time requirements will be flagged as either estimated or rejected. The decision as to which qualifier is more appropriate will be made on a case-by-case basis;
- verify that parameters were analyzed according to the methods specified;
- review QA/QC data (i.e., make sure duplicates, blanks, and spikes were analyzed on the required number of samples, as specified in the method; verify that duplicate and matrix spike recoveries are acceptable);
- investigate anomalies identified during review. When anomalies are identified, they will be discussed with the Project Manager and/or Laboratory Manager, as appropriate; and
- if data appears suspect, investigate the specific data of concern. Calculations will be traced back to raw data; if calculations do not agree, the cause will be determined and corrected.

Deficiencies discovered as a result of the data review, as well as the corrective actions implemented in response, will be documented and submitted in the form of a written report addressing the following topics as applicable to each method:

- assessment of the data package;
- description of any protocol deviations;
- failures to reconcile reported and/or raw data;
- assessment of any compromised data;
- overall appraisal of the analytical data; and
- table of site name, sample quantities, matrix, and fractions analyzed.

It should be noted that qualified results do not necessarily invalidate data. The goal to produce the best possible data does not necessarily mean producing data without QC qualifiers. Qualified data can provide useful information.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the data validator. Suggestions for reanalysis may be made by the QAM at this point.

Tables

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engineers, scientists, economists

Table 1

Universal Instruments Corporation
Former Dover Electronics Site
Kirkwood, NY

OM Soil and Decontamination Water Sampling Program

Environmental and Quality Control Analyses

Parameter	Estimated Environmental Sample Quantity	Field QC Analyses						Laboratory QC Sample						Total
		Trip Blank		Rinse Blank		Field Duplicate		Matrix Spike		Matrix Spike Duplicate		Lab Duplicate		
		Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	
Decon Water Samples														
PCBs		NA	--	1/day		NA	--	NA	--	NA	--	NA	--	
TCL Volatile Organics		1/cooler		1/day		NA	--	NA	--	NA	--	NA	--	
TCL Semivolatile Organics		NA	--	1/day		NA	--	NA	--	NA	--	NA	--	
TAL Inorganics		NA	--	1/day		NA	--	NA	--	NA	--	NA	--	
Ignitability		NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	
Reactive Cyanide/Sulfide		NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	
Corrosivity		NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	
Soil Samples														
PCBs		NA	--	1/day		1/20		1/20		NA	--	NA	--	
TCL Volatile Organics		NA	--	1/day		1/20		1/20		NA	--	NA	--	
TCL Semivolatile Organics		NA	--	1/day		1/20		1/20		NA	--	NA	--	
Total Inorganics		NA	--	1/day		1/20		1/20		NA	--	NA	--	
TCLP VOCs		NA	--	NA	--	1/20		1/20		NA	--	NA	--	
TCLP SVOCs		NA	--	NA	--	1/20		1/20		NA	--	NA	--	
TCLP Inorganics		NA	--	NA	--	1/20		1/20		NA	--	NA	--	
Ignitability		NA	--	NA	--	1/20		1/20		NA	--	NA	--	
Reactive Cyanide/Sulfide		NA	--	NA	--	1/20		1/20		NA	--	NA	--	
Corrosivity		NA	--	NA	--	1/20		1/20		NA	--	NA	--	

Notes:

1/day = One rinse blank per day or one per 20 samples, whichever is more frequent. Rinse blanks not required when dedicated sampling equipment is used.
1/cooler = One trip blank per cooler of volatile organic sampling of aqueous media.
1/20 = One per 20 samples if over 10 samples collected.
Freq = Frequency
NA = Not Applicable
No. = Number
QC = Quality Control

Table 2

New York City Department of Sanitation
Conversion of Eight Marine Transfer Stations

Initial Soil and Groundwater Sampling Program

Analytical Quality Control Limits[1]

Parameter	Accuracy - % Recovery		Precision - RPD	
	MS/MSD	Surrogate	MS/MSD	Duplicate[2]
Soil				
Volatile Organics	70-140	75-125	30	--
Semivolatile Organics	40-120	30-140	30	--
PCBs	50-140	30-150	30	--
Metals	80-120	--	--	20
Groundwater				
Volatile Organics	70-140	75-125	30	--
Semivolatile Organics	40-120	30-140	30	--
PCBs	50-140	30-150	30	--
Metals	80-120	--	--	20

Notes:

1 The listed QC limits are based on USEPA guidance and are advisory. However, frequent failures to meet the QC limits warrant investigation of the laboratory

2 Duplicate control limits apply to laboratory duplicates. Field duplicate limits are 100% RPD for all parameters.

MS = Matrix Spike
MSD = Matrix Spike Duplicate
RPD = Relative Percent Difference

Table 3

New York City Department of Sanitation
Conversion of Eight Marine Transfer Stations

Initial Soil and Groundwater Sampling Program

Sample Containers, Preservation, and Holding Times

Parameter	Method[1]	Bottle Type	Preservation	Holding Time[2]
Soil				
Volatile Organic Compounds	8260	2-EnCore™ samplers 1-40ml glass vial	Cool to 4°C	48 hours to preservation 14 days to analysis
Semivolatile Organic Compounds	8270	1-8oz glass jar with Teflon®-lined lid	Cool to 4°C	14 days to extraction 40 days to analysis
PCBs	8082			14 days to extraction 40 days to analysis
Inorganics (except mercury)	6010	1-4oz widemouth glass jar	Cool to 4°C	180 days to analysis
Mercury	7471			28 days to analysis
TCLP-Volatiles	1311/8260	1-4oz glass jar with Teflon®-lined lid	Cool to 4°C	14 days to TCLP extraction 14 days to analysis
TCLP-Semivolatiles	1311/8270	1-8oz glass jar with Teflon®-lined lid	Cool to 4°C	14 days to TCLP extraction 7 days to extract prep 40 days to analysis
TCLP-Metals (except mercury)	1311/6010	1-4oz widemouth glass jar	Cool to 4°C	180 days to TCLP extraction 180 days to analysis
TCLP-Mercury	1311/7470			28 days to TCLP extraction 28 days to analysis
Reactive Cyanide	SW-846 Chapter 7.3	1-8oz widemouth glass jar	Cool to 4°C	7 days to analysis
Reactive Sulfide	SW-846 Chapter 7.3			14 days to analysis
Ignitability	1010			7 days to analysis
Corrosivity	9045			48 hours to analysis
Water				
Volatile Organic Compounds	8260	2-40ml glass vials with Teflon®-lined lid	HCl to pH<2 Cool to 4°C	14 days to analysis
Semivolatile Organic Compounds	8270	2-1 liter amber glass bottle with Teflon®-lined lid	Cool to 4°C	7 days to extraction 40 days to analysis
PCBs	8082	2-1 liter amber glass bottle with Teflon®-lined lid	Cool to 4°C	7 days to extraction 40 days to analysis
Inorganics (except mercury)	6010	500ml plastic bottle	HNO3 to pH<2 Cool to 4°C	180 days to analysis
Mercury	7470			28 days to analysis

Notes:
1 = USEPA. Office of Solid Waste and Emergency Response. *Test Methods for Evaluating Solid Waste.* SW-946 3rd ed. Washington, D.C. 1996.
2 = All holding times are measured from date of collection.

TCLP = Toxicity Characteristic Leaching Procedure
ml = milliliter
oz = ounce

Table 4

New York City Department of Sanitation
Conversion of Eight Marine Transfer Stations

Initial Soil and Groundwater Sampling Program

Data Validation Checklist

Review for Completeness	
1.	All chain-of-custody forms included.
2.	Case narratives.
3.	QA/QC summaries of analytical data, including supporting documentation.
4.	All relevant calibration data, including supporting documentation.
5.	Instrument and method performance data.
6.	Documentation showing laboratory's ability to attain specified method detection limits.
7.	Data report forms of examples for calculations of concentrations.
8.	Raw data used in identification and quantification of the analysis required.
Review of Compliance	
1.	Data package completed as described above.
2.	QAPP requirements for data production and reporting have been met.
3.	QA/QC criteria have been met.
4.	Instrument type and calibration procedures have been met.
5.	Initial and continuing calibration have been met.
6.	Data reporting forms are completed.
7.	Problems and corrective actions documents.